Physical Creativity and Performative Interaction

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ABSTRACT

In this paper, we discuss a new form/class of interaction: physical creativity. We explore how exertion interfaces can promote physical creativity and the role that this might play in performative interaction, using children's playgrounds and clapping games a context for our pilot system and studies.

Author Keywords

Performative interaction, physical creativity, exertion games, exertion interfaces, kinesthetic literacy, Physics of clapping, playground games and songs, folklore, Opie archives, British Library.

ACM Classification Keywords

H.5 [**Information Interfaces and Presentation**]; K.3.0 [**Computers and Education**]: General; J.2 [**Computer Applications**]: Physical Sciences and Engineering – *Physics*; J.5 [**Computer Applications**]: Arts and Humanities; K.8 [**Personal Computing**]: Games.

General Terms

Design, Documentation, Experimentation, Human Factors, Theory.

INTRODUCTION

Interaction with digital technology is becoming increasingly physical. This growing trend is evident in the recent commercial success of interactive games and devices such as Konami Dance Dance Revolution, Nintendo Wii Remote, and Activision Guitar Hero. These interfaces require participants to move their bodies around in physical space to interact with the system and each other. An advantage of these devices is that they have a 'low entry fee' [30], meaning that anyone can immediately engage with the system through simple physical movements and can disengage with minimal effort. However, despite these systems encouraging participants to move, the range of possible movements is generally quite limited. For example, with Guitar Hero, users can only strum or press buttons on the guitar to trigger digital effects. As such, the possibility of these interfaces for promoting "**physical creativity"** [22] has largely been underexplored.

Physical creativity focuses on the "creative process" [7, 8] and specifically on the ability to innovate through exertion. It goes beyond memorizing a procedure and differs significantly from mimicking movement in that physical creativity focuses on exertive movements of the body as self-expression, improvisation and imaginative play. People who engage in physical creativity exhibit their physical skill and agility through breaking from simple routine by elaborating on, extending, or reconfiguring patterns of movement. For example, a karate master will develop a new way of blocking a blow, or figure skater will design a new spin. In other words, physical creativity focuses on remaking over reproduction.

In analyzing young people's media production, Burn and Durran [5] use Vygotsky's notion of creativity, which suggests that creativity is a combination of reproduction *and* innovation and is closely related to play [29]. Burn and Durran describe how children learn the meaning of symbolic substitution through the manipulation of physical objects in playful activity and how such activity has implications for intellectual development. Our interest is in exploring how playground games, which are highly exertive, structured repertories of play that are learned and apparently rehearsed and reproduced, relate to innovation, transformation, invention and improvisation [5, 9]. To do so, we are developing an exertion interface system for updating, analysing and re-presenting a small selection of playground games found in the Opie Collection of Children's Games and Songs [16-18], as well as those emerging from ethnographic studies of playgrounds in Sheffield and London [9] which we are archiving in the British Library [4, 9].

In this paper, we describe the outcomes of the development and testing of a prototype exertion interface for capturing playground "clapping" games (Figure 1) and songs using the Nintendo Wii and an open source environment for developing applications. While a multitude of 3D motion tracking and gesture systems exist, many of these systems are costly and require extensive set up and/or training. Our intention is to develop a prototype low-cost and low-fi

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system that could be used for both teaching and research – for allowing children to record and playback playground games as well as for capturing, analyzing, visualizing and playing back 3D movement data.

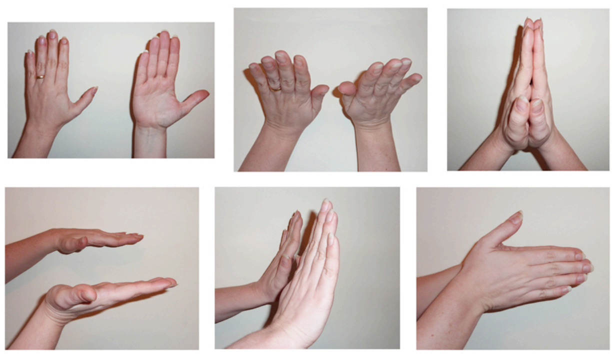

Figure 1. Top and side view of a 'three way clap'.

BACKGROUND

In 1944, Iona and Peter Mason Opie began collecting, archiving and classifying hundreds of nursery rhymes and songs from written sources and their seminal publications, such as *The Oxford Dictionary of Nursery Rhymes* [16], have influenced throngs of folklorists. In the 1950s they corresponded with teachers to explore school-aged children's lore and produced *The Lore and Language of Schoolchildren* [17]. In later field work and publications, such as [18], the Opies refuted the idea that mass media negatively affected or extinguished traditional games and their vibrant testimony and audio archives stands as lasting proof that children's traditional games thrive in streets and playgrounds (Figure 2). Our intention is to carry forward this seminal work and this paper focuses on preliminary results emerging from a pilot study with our prototype system which focuses on *clapping* games (Figure 2).

Figure 2. Playing *Coca-Cola* (left) and *Black Shoe* (right).

Clapping is an exertion activity. Exertion interfaces [14] are defined as interaction with technologies which focus on intense physical effort from the participant, such as jogging [15], swinging an object around the body [21, 23] or jumping up and down. Preliminary studies with exertion interfaces suggest action itself is central to meaning mapping [23, 27] and that exertion interfaces can have positive effects on personal health, moral character and the human spirit even when participants are not in the same space or are participating at different times [26]. However, physical creativity in exertion interfaces has largely been underexplored.

Exertion interfaces are often rule-bound, focus on competitive play, and introduce the concepts of winning, combat or conflict [15]. Salen and Zimmerman [20] describe the variability of formal rules in games. Our research focuses on developing exertion interfaces which combine highly rule-governed Ludic play (such as clapping games) and promote 'Paidia' [6] or open play - the often shared, anarchic and spontaneous play found in improvisation and live performance. Giddings describes these conceptual oppositions as rule-bound play and emergent play [11]. The playground is a particularly good "setting" for exploring these conceptual oppositions in play, as described in Richards' [9] ethnographic observations of children performing improvised martial arts movements, and in Bishop's [9] description of the clapping game *Eeny-Meeny Dessameeny*.

Developing an exertion interface for the performative activities found on a playground is not an easy task. Playground games are a complex combination of music, physical movement, gestural repertoires, the imaginative use of found physical objects and environments as well as language (see [2, 5, 9, 13, 17, 18, 31]).

DESIGNING FOR PHYSICAL CREATIVITY

Kinesthetic literacy

Applying **kinesthetic literacy** [22, 26] as a guideline for design for physical creativity allows children to know the limitations of both self and other, giving them an opportunity to adapt play according to these limitations. We see kinesthetic literacy as having two major learning objectives: *learning to move*, and *moving to learn* [26]. *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 [21, 23, 27] 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. For example, in previous work [27], we explored how a tangible, exertion interface can be used to learn about basic science concepts such as the concept of acceleration. Doing so can reveal information about social skills, competition and cooperation, and knowing when and why different movement actions are appropriate and effective as well as contribute to an understanding how aspects such as "witting" transitions in performative behavior [21] can be applied in learning contexts.

Performative interaction

Our interest is in exploring how to design and develop an exertion interface for promoting physical creativity through "witting transitions in performative behavior" [10, 21, 24]. Sheridan defines performative interaction [21, 24] as the transitions from observing to participating to performing through: wittingness (awareness of the performance frame); technical ability (acquiring and execute simple routines); and, interpretive ability (the ability to develop a method of making the performative activity uniquely their own – an embodiment of their own skill). We look to analyze physical creativity using these previously developed performative interaction measures and models ("tripartite interaction" and the Performance Triad Model [21, 24]) as well as emerging through performative investigations [1, 12, 19] and our pilot studies.

Performing interaction in **a clapping game focuses attention inward rather than outward**. With our clapping game, transitions in performative interaction happen through points of impact. Transitions from observing to participating happen through memorizing songs and acquiring competency of clapping patterns or gestures. Transitions from participating to performing happen when participants deviate from or add to the known patterns and rhythms. Physical creativity happens when participants transition to performers – when the participants *choose* to deviate from the known patterns. Since this deviation happens through the physical exertion, we might consider this a form of **showmanship**. Showmanship is usually considered a dramatic 'mental game' that competitive people use in an exertion activity order to 'get into the head of their opponent' usually with the intention to win over an audience or crowd. However, **playground clapping games are not designed for an audience** – they are a form of "participatory performance" [28] rather than "presentation performance". The activity happens between two people, or multiple people facing inward, playing with each other rather than against each other. As such, there isn't any emphasis on mentally 'wearing down the opponent'. In fact, doing so would ruin the game as participants rely on each other to play the game. These kinds of bodily and social performances and actions also connect with forms of cultural capital [3] – the transmitted repertories of gesture, word and music that allow such activities to be invested with cultural meaning and the construction of identity.

DESIGNING THE SYSTEM

To design our interface, we used design guidelines from our previous studies in designing performative tangible interaction [23], namely that the interfaces must be: intuitive; unobtrusive; enticing; portable; robust; and, flexible. The most significant technical challenge for Wii Clapping is in mapping various levels of granularity [23, 27]; how do different levels of Wii Clapping movement relate to the cultural reality of clapping movement? In our first experiments, we investigated how to understand and then program the basic units of each clapping movement. Each non-verbal dynamic (up/down; clap against/clap together, etc.) are basic units or clapping 'memes' (see Marsh's Movement Key [13, p. 342]) and these clapping memes are programmable entities. What kinds of implications does this have for the level of specificity, or for the balance between real time recording of clapping and triggering simulated animations of clapping? Can the variables be made more salient? When developing our interface, we must consider that these 'natural' or 'intuitive' interactions might be rooted *either* in children's experience of traditional clapping *and/or* in their experience of mediated play with these kinds of interface/devices (Figure 3 & 4).

Figure 3. Prototypes for capturing 3D motion.

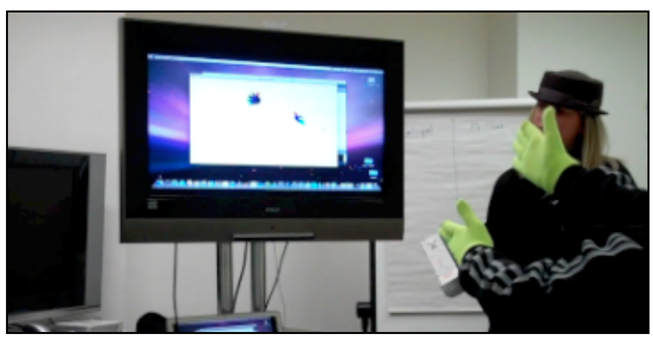

Figure 4. Children playing with the clapping interface.

PROTOTYPE SYSTEM RESULTS

Clapping on the playground is usually the preserve of girls [4 ,16] and each girl has a different level of competency and knowledge about clapping games. Older girls often teach the younger girls how to play the games. We conducted our pilot study with both boys and girls (2 boys and 4 girls), aged 8-11, from a school in London. Two girls in our study had very high levels of knowledge about clapping games and knew different variations of the games. All of the girls had more knowledge/competency about clapping games and played clapping games more often than the boys. For our study, the participants worked in groups of two on three different activities (drawing (Figure 5), interviews and playing with the system) with at least one investigator for approximately 45 minutes for each activity (see [22]).

Figure 5. Children's drawings from the pilot study.

Rhythm, pace and punctuation

In a clapping game, physical movement is intertwined with physical (and aural) rhythm [13]. Points of impact in a clapping game are the equivalent of a drumbeat or continuous pulse overlaid with pitch (the tune) and rhythm (associated with the words and their vocalization in the accompanying chant or song). However, the point of impact in our prototype game is digital rather than physical – children punched at the air rather than hit another child's hands. This fact did not seem to affect the movement of children's clapping – children were still able to keep an even pace. However, since punctuation is the **point of impact after a short, spontaneous burst of energy** the current design was unable to detect and respond accordingly. Our system could detect and respond to changes in speed but not the point of impact. With our current design we were unable to tell if the changes in speed were due to a change in direction, or hitting something. If we consider that **all clapping games rely on understanding the point of impact and very quick changes in direction** then we need to consider how to design our interface to take in to account the virtual point of impact and **speed, directionality** and **magnitude of movement**.

Loci of attention

In a traditional clapping game, children face each other and look at each other's eyes, not always at each other's hands, particularly when they become 'experts'. The current prototype forces children to look at the digital hands on the screen to make the link between their own movements and movements on the screen. Children suggested that 'digital guides' or markers might be useful for visual, audio or haptic feedback and related this to the arrows and digital markers in games like in Konami Dance Dance Revolution and Guitar Hero. Some children were able to produce the clapping sound very quickly and then they repeated the clapping action that they needed to do to produce the sound continuously but without looking at the screen. Appropriate audio or haptic feedback (see [23]) could provide an alternative feedback modality so that children would not need to face the screen to interact with other players.

Fluid frame of reference

Interaction with the Wiimote in our study required action in 3D space and as such orientation and positioning in real space must be a consideration as well as orientation in the digital space. However, unlike traditional Wiimote games which combine grip and grasp with pressing buttons to get the desired digital effect, in our game the controller moves with and around the body [e.g. [23]] and gestures are fluid rather than pre-defined. Like the continuous nature of the data flow, participants continuously moved their bodies and the Wiimote around the space and in many cases became increasingly physical as they became more familiar with the interface (e.g. jumping up and down). However, because participants were able to move the controller in 3D space without any physical boundaries, the screen was the only point of reference from which they could **orient and position** themselves or the controller.

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