Sketching through the body:

Child-generated gestures in Full-Body Interaction Design

Marie-Monique Schaper, Laura Malinverni, Narcis Pares
{mariemonique.schaper, laura.malinverni, narcis.pares}@upf.edu
Universitat Pompeu Fabra
C/ Roc Boronat 138
08018 Barcelona, Spain

ABSTRACT

The aim of this paper is to explore techniques to design specific gestures with children to improve the interaction design of a Full-Body Interaction Learning Environment. This exploratory case study is part of the EcoSystem Project, a learning environment aimed at supporting children's understanding of environmental issues related to air-pollution. In order to involve children in the design of the physical interaction with the system, we used two different techniques to facilitate the design of gestures: “*sketching through the body*” and “*sketching with puppets*”. The results indicate that children adopted different strategies to design gestures for each technique. Within them, the most effective approach was related to the switch between performing gestures with their own bodies and simulating those gestures with puppets. This finding indicates the potential of those Participatory Design methods which combine multi-modal resources as instruments to allow children to reflect upon their own knowledge and express it more precisely.

Categories and Subject Descriptors

D.5.2 [User Interfaces]: Evaluation/methodology – Prototyping
– User-centered design

General Terms

Performance, Design, Human Factors

Keywords

Full-Body Interaction; Learning; User-generated gestures; Game design; Movement; Bodystorming

1. INTRODUCTION

The design of Full-Body Interaction games has become an emerging field over the last decade. Studies building on the embodied cognition framework point out the benefits of physical activity and specific gestures to enhance learning of abstract concepts through concrete experiences [6, 7]. The IDC community has shown an increasing interest and focus on embodiment as an alternative perspective in human computer interaction. This is reflected in the growing body of studies investigating novel tools and methods to design kinesthetic

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interaction [3]. In this context, researchers have been using *bodystorming* techniques in Participatory Design (PD) and user-centered design to provide users and designers with a shared understanding of the Full-Body Interaction experience [11, 14]. Nevertheless, in earlier studies movement and gestures have been directly designed by interaction designers. As consequence they either did not necessarily reflect user behavior, needed extensive user-training [18] or biased learning outcomes during the playing experience [12]. New approaches draw their attention towards user-generated gestures to improve the interaction design of interactive experiences [18]. However, so far only a few studies have incorporated children in the design process of user-generated gestures for Full-Body Interaction [5, 10]. Hence, we present in this paper a PD study to advance in Full-Body Interaction design by comparing two different techniques. The goal is to facilitate the design of gestures and evaluate their suitability in order to involve children as design partners.

2. RELATED WORK

The term *bodystorming* was set out by Burns [4] as a performance technique for bodily brainstorming. He described bodystorming as “reenactivating” the studied environment or scenario through performance techniques where designers themselves become “actors”. A substantial amount of researchers have followed this example and have developed bodystorming techniques by deriving them from theatre practices or dance performance. However, since this approach did not allow designers to draw explicit conclusions on user behavior, bodystorming techniques were incorporated in PD, involving end-users and other stakeholders of the project. Based on this, a number of researchers have demonstrated the benefits of role-play as an effective design and evaluation method in PD workshops [11, 14]. By providing a first-hand experience, these techniques help participants to reflect upon their own behavior and to facilitate effective design solutions to researchers.

So far few studies have been devoted to exploring bodily-based techniques when children are incorporated in the design process [9, 17]. Research in Full-Body Interaction aimed at the investigation of child-generated gestures commonly relies on traditional usability testing and observations while children interact with the prototype [5, 10]. However, these methods do not give children the opportunity to provide their own solutions in the design process. Due to children's limited linguistic competence it is difficult for them to produce explanations for the gestures [15]. Hence, using bodily-based techniques may be beneficial in design processes that include children as design partners. By focusing on gestures as well as on speech in the evaluation methods we may offer “an additional window into the mind of the child” [8] and

inform the design process more accurately with respect to actual children's understanding of interaction.

3. THE ECOSYSTEM PROJECT

This study is part of the EcoSystem Project [17], a Full-Body Interactive Learning Environment (FUBILE) aimed at improving children's global understanding of environmental issues related to air-pollution. The game is based on a floor projection representing a virtual simulation of a semi-urban landscape. Children play in groups of 4 and have to collaborate with each other to reduce the amount of air-pollution in the environment. Children are invited to experiment with the existing relationships between carbon dioxide emission and strategies for its reduction and absorption. In the game children can play three different roles, namely:

1. Produce wind energy to replace the amount of energy produced by a steam power station and hence reduce air-pollution.
2. Grow plants and vegetables to facilitate CO² absorption and contribute to consuming local produce.
3. Recycling organic waste and produce compost to increase the growth of plants and reduce waste incineration.

The participants have been involved at different stages of the design process as co-designers, informants, and testers [13] to make their own design contributions or to inform about different aspects of the game design. Previous studies [17] have indicated that the FUBILE facilitated children's understanding of the elements and rules of the ecosystem. Nevertheless, children still had some difficulties to grasp the relationships between the different elements in the environment. Starting from this perspective, we hypothesized that using gestures or actions to enact these relationships would have been helpful to facilitate their understanding. In this paper we explore the methods that we applied to design specific gestures with children. The goal was to improve the interaction design of the system and, hence, address the better understanding of the Ecosystem environment by children. We conducted a study with children to identify how they can be encouraged to give their own design solutions. We used two different methods to facilitate the design of gestures: “*sketching through the body*” and “*sketching with puppets*”. The participants were asked to think of different gestures to demonstrate reciprocal relationships between specific game elements. To evaluate the results of the PD workshops, we recorded videos during the activity and two researchers analyzed and coded them.

3.1 Method and Procedure

The exploratory study was carried out on two consecutive days in our Full-Body Interaction Laboratory. A total of 17 children (11 girls and 6 boys) between 10-11 years old participated. Each of the two sessions had a duration of approximately 60 minutes. Children were randomly divided into 4 groups of 4-5 members. At the beginning of the session, they were introduced to the common goal and to the three different interaction roles available in the game (wind power, plants and compost) by using role cards (Figure 1). The cards were read aloud by one child at a time. Then, each group was invited to play for 6 minutes (Figure 2). For the study, we developed a mid-fidelity prototype using a Wizard

of Oz method. The game was projected on a 2x3 meters area on the floor and was controlled by a researcher.

Figure 1: Role cards with game instructions

After playing the game, we started the workshop with a short training activity. Then, children were instructed in the specific design goals. We showed them a diagram depicting the reciprocal relationships between the different elements. Children were asked to propose design ideas to make the relationship between wind energy and energy consumption of the city as well as the relationship between plants and compost more explicit. These design goals were verbally reported and written on a board. For this activity, the groups were alternately assigned to one of the two conditions: “*sketching through the body*” and “*sketching with puppets*”. Both conditions are methods aimed at facilitating children to come up with new solutions of specific gestures or movements to improve the interaction design of the proposed learning environment. In the “*sketching through the body*” condition children were asked to use their bodies to perform possible actions to address the proposed design challenges. In the “*sketching with puppets*” condition, children were provided with a graphical layout of the environment and with four flexible anthropomorphic puppets (Figure 3). They were then asked to use those puppets to design gestures or actions. Hence, children were encouraged to discuss their ideas on how reciprocal relationships may be demonstrated through specific gestures. After this, we provided them with cameras and asked to record videos of their ideas. Finally, each group presented the design solutions to their peers and the researchers of the session.

Figure 2: Children interacting on the floor projection

3.3.1 Sketching through the body: case studies

Group A

The group was composed of four girls and one boy. Children started to discuss and role-play the different elements of the environment. The first idea was proposed by an enthusiastic girl moving her arms up and down saying: “I’m the windmill”. Then,

she called upon the other children in her group and encouraged them to play the role of the steam power station. Two other girls followed her suggestion and one piggy-backed on another while saying “We are the steam power station”. The group was very excited, laughing and proposing ideas. Another active girl proposed to a boy: “You can be the plant and I will water you”. The researcher reminded them to think about how to design the relationship between the different elements. The group repeated their initial proposals. Hence, the researcher rephrased the question by asking about the relationship between the windmills and the city. One of the girls proposed: “Somebody should perform as the city and make a happy face when a windmill appears”. Then, the researcher asked about the relationship between the plants and the compost. Another girl told the boy: “You are now the compost”, and he obediently personified “being the compost”. During the explanation the group enacted the different scenarios. However, they did not propose any specific gesture for the relationships between the different elements.

Group B

This group was composed of one girl and three boys. In general, the children were very excited and proposed many ideas. Especially, the girl in this group was very vivacious and delighted to take part in the activity. She started off by standing up and performing a dance “to be the windmill”. Encouraged by her performance, a boy also stood up and proposed to raise the arms and move the fingers “to be a plant”. Then, another boy suggested being the steam power station. The last child personified the compost by throwing himself onto the floor. None of the researchers intervened during the brainstorming activity. During the explanation children enacted the scenarios using their bodies to personify the different elements (windmills, plants, steam power station, compost). One researcher asked: “Have you thought about how you can represent the relationships between the game elements?”. This question referred to children’s design goals during the session, which consisted of making explicit gestures to convey the relationships between the game elements. The children then realized that they had not.

Figure 3: Flexible anthropomorphic puppets

3.3.2 Sketching with puppets: case studies

Group C

The group was composed of three girls and one boy. The children started to discuss how to enact the wind energy. The boy was the first who proposed an idea. He moved his arms to perform the windmill. A researcher reminded them: “Think about how you could design the relationship between the energy produced by the windmill and the city”. Thus, one of the girls took initiative and proposed a verbal explanation which was accompanied by the bodily gestures of waving the arms. Then, another girl tried to

enact the proposed idea of her school mate with the puppet. She took a puppet and placed it on the paper layout of the environment in the same position that had been physically performed by the first girl. The researcher now asked: “And how could you represent the relationship between the compost and the plants more explicitly?”. The first girl took the initiative again. She took a puppet and bent its legs so as to place one foot on a plant and the other on the compost, hence connecting the two. Her school mate imitated the gesture with the puppets just as in the previous scenario. She enacted the open position of the legs. The children continued working without the aid of the researcher. A third child proposed another possible form of connecting the city and the windmill. She took two puppets and made them hold hands to create a chain. During their explanation the group proposed the following three gestures as possible forms of making explicit relationships: (a) connecting the two elements by opening the arms and waving them, (b) connecting the two elements by opening their legs, and (c) connecting the two elements by making a human chain.

Group D

This group was composed of three girls and one boy. The group was poorly engaged with the activity and presented some difficulties in starting with the brainstorming. The children seemed not used to work collaboratively between them and did not talk with each other or used the puppets. A researcher asked them about how to design the relationship between plants and compost. Two children took two puppets and made them hold hands to create a chain connecting the two game elements. Later they repeated the same action to connect the city with the windmill. During the presentations of the groups, this group explained their gesture proposal for creating a human chain.

4. DISCUSSION

From the analysis, we observe that the different groups adopted different strategies to design the gestures, which led to different outcomes. Groups A and B, assigned to the “*sketching through the body*” condition, showed a more homogenous tendency. Both groups proposed a wide range of ideas and were very excited and engaged during the activity. However, they did not manage to focus on the design goals and tended to personify mainly game elements rather than relations between these. This difficulty was not overcome with the intervention of the researcher. On the other hand, groups C and D employed the puppets for designing gestures, successfully addressed the design goals and managed to propose solutions related to the design challenges when asked by the researchers.

Relevant differences in their approaches suggest potential insights related to both PD methods for FUBILEs, as well as to the design of the FUBILEs itself. For example, group D mainly employed the puppets for designing gestures. In their brainstorming phase, nevertheless, they showed some difficulties related to coming up with novel proposals. In contrast, group C, which was constantly switching between “acting” and “using puppets”, showed a much higher capability of proposing novel design solutions for the specific challenge. Such findings could be related to the importance of generating a balance between “getting immersed in a situation” and “stepping back” from it in order to construct knowledge and learn [2]. As Ackermann points out, to reach a deep understanding, people “need to step back and look at things from afar”, by changing their perspective and adopting different points of view [1]. Thus, the act of continually switching between performing with their own bodies and simulating those gestures

with puppets may have helped children to reflect upon their own knowledge and express it more precisely. In particular by role-playing through their body, children may have become immersed in the challenges and then, by using the puppets they might have had the opportunity of “stepping back” and externalize to their ideas more concrete. These initial observations require further analysis in order to validate our findings. Nonetheless, some initial insights can be extrapolated.

On the one hand, combining role-play and puppets could represent an effective strategy to involve children in the design of FUBILEs. The use of multimodal resources (body and puppets) may facilitate children’s expressivity and attention focus by providing a diversification of entry paths to the proposed design challenge. Nonetheless, constant collaboration and guidance by researchers is necessary to properly orient and support children. As our study showed, all groups needed some additional external inputs to properly focus on the specific goals.

On the other hand, greater attention should be given to group formation, since using random distribution of children in working groups may be detrimental to collaborative relationships. In this context a better gender distribution could have been beneficial as well as using methods to evaluate children’s previous relationships in terms of reciprocal peer preferences and rejections. This awareness may help overcome difficulties in collaborative work, such as those that emerged within group D.

Finally, further considerations should address the very design of FUBILEs by evaluating the extent to which different environments could facilitate a balance between getting immersed in the experience and looking at it from distance.

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