EPESonic: Understanding Fictional Framing of Metaphorical Actions in Young Children's Digital Interaction

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Abstract
In this Demo, we present *EPESonic* [1], a movement-based installation prototype for researching design aspects relating to young children's meaning making through metaphorical action in a multimodal, digital setting. This prototype is the outcome of an embodied design approach that has been developed through co-design workshops with young children aged 2-7, their caretakers and museum professionals. With this prototype and its iterations, we have studied the relationship between pre-determined metaphorical action and fictional framing, digital feedback and playfulness. The goal of our prototype design is to provide methodological insights about embodied learning design for young children that integrate fictional narrative, play and digital feedback to support meaning making with metaphorical actions.

Author Keywords
Gesture-based design; contextual factors; young children; science learning; embodied learning.

CSS Concepts
• **Human-centered computing~Interaction design**; *Interaction design process and methods*; Contextual design.

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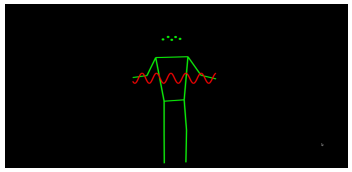

Figure 1. *EPEsonic* is the prototypical design outcome of a research process on metaphorical action and audiovisual movement-based design in a fictional setting.

In *EPESonic,* the user sees a third person avatar drawn as a green stick man character against a black background in front of them on a screen. In between their hands, they hold a red "wriggly line", which changes height and width in the manner of a sine wave.

These two parameters may be dynamically affected and altered by the users changing the width between their hands and their height. In addition to the visualization, the frequency and volume are also depicted as an audible sine tone.

Introduction

This Demo showcases a prototype installation that is the design outcome of an iterative research process with young children aged 2-7, that specifically draws on embodied design and the idea of metaphorical action: a body-based movement that metaphorically reflects a phenomenon. In *EPESonic* prototype installation, two parameters of sound – frequency and volume - have been mapped onto specific movements as embodied actions, which enable users to change both audible sound as well as a visualization of the sound visible on the screen in front of the users. Whilst gesture-based interaction interfaces have been developed over several past decades for a variety of purposes [2], a number of questions remain when designing for young children's learning. The learning sciences have shown evidence on the role of gestures as a supportive modality in young children's meaning making [3, 4], especially with regards to embodied metaphors. However, little work has explored the application of metaphorical actions in conjunction with fictional, digital feedback and play as contextual factors for young children's installations.

Related work

Several recently published design frameworks and guidelines have highlighted opportunities for embodied learning in applying metaphorical gestures and actions in movement-based digital environments [5, 6], and empirical evidence suggests movement-based interaction applying metaphorical actions may support children's meaning making about subjects including geometric shapes [7], alphabetic shapes of letters [8, 9], concept of magnitude [10] Newtonian physics [3, 4], mathematical ratios [11], and sound [12].

Our work with *EPESonic* draws from these existing studies, and through an iterative prototype design process with young children is interested in understanding how movement during interaction may support meaning making in this age group, and how contextual factors including fictional framing, feedback design and play support meaning making and affective engagement. In particular, we draw from previous work on designing for metaphorical gestures to dynamically change sound [12], and, in particular, on the idea of re-enactment of abstract concepts such as reported in recent studies [3, 11].

EPESonic

The *EPESonic* prototype [see Fig. 1] is the design outcome of a study to understand methodological approaches and contextual factors of movement-based design that may support children's embodied meaning making about abstract science concepts. This prototype is themed around changing sound through pre-determined metaphorical actions that are fictionally framed in a playful setting. The actions - stretching arms wide apart horizontally, or bringing hands together, and lifting them up and down - affect the frequency and volume of an audible tone and a wave-like visualization respectively. Interacting with *EPESonic* enables children and adults to dynamically change sound based on their body-movements: pitch and volume outputs from the system correspond to pre-determined arm movements. The prototype uses PoseNet environment platform that has been developed to support dynamic sound creation and changed based on movement, as well as additional visualizations.

Figure 2: A child with their parent exploring the audible sound and its visualization in the *EPESonic* installation prototype during a co-design workshop.

Practical Considerations

The *EPESonic* Demo is an open-ended experience for up to 10 minutes that can be accessed from anywhere in the world via a browser and URL address. The technical requirements are simply access to the internet with a computer with a webcam and audio output. We recommend interacting with the prototype in a well-luminated space with enough room to move about, preferably against a light-coloured wall. Up to three persons can interact with the prototype simultaneously, given that all have sufficient free space to extend their arms outwards and upwards. Interacting with *EPESonic,* can also be done seated.

Ethics

The *EPESonic* Demo is developed using PoseNet (aka *PersonLab* [13]), an openware motion detection software by Google Creative Lab that runs entirely in the browser. PoseNet can detect human figures from images and videos using a single-pose or multi-pose algorithm. No person identifiable information associated with the pose detection is collected: the algorithm merely estimates the position of the key body joints. Because it runs entirely in the browser, it does not send or record data, complying with privacy legislation.

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