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# Parent-Child Musical Co-Creation with Tangible and Embodied Interfaces

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**Abstract**

Co-creative activities can lower barriers for engaging in artistic practice, encourage social interaction, and create opportunities for learning. Encouraging parent-child engagement can enhance the socio-cognitive benefits of co-creation. However, facilitating this type of engagement necessitates considering design principles that incorporate the different needs of adults and children in co-creative practice. This paper discusses the design and preliminary evaluation of two tangible/embodied installations (*TuneTable* and *Sound Happening*) that aim to facilitate collaborative music-making experiences with adults and children.

**Author Keywords**

Co-creation; tangible interfaces; embodied interfaces; music; parent-child interaction

**ACM Classification Keywords**

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous; See <http://acm.org/about/class/1998> for the full list of ACM classifiers. This section is required.

**Introduction**

Co-creative activities, or activities that facilitate egalitarian collaborative interactions in which participants collaboratively create a shared artifact

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(e.g. musical composition, visual art piece) as equal partners, can lower barriers for engaging in artistic practice [1] and create opportunities for learning [6]. Encouraging parents and their children to collaborate together on these types of activities can additionally enhance the socio-cognitive benefits of co-creative play and help to strengthen family bonds [3].

Our work focuses on developing principles for the design and evaluation of co-creative systems in domains ranging from dance to music to visual art, with an emphasis on experiences that facilitate adult-child co-creative interaction. This paper will focus on describing the design of two systems for embodied and tangible musical co-creation: *Sound Happening* and *TuneTable*.

## Sound Happening

### Installation

*Sound Happening* (Fig. 1) is an installation for musical play in which participants can generate music by moving colorful balls around a defined interaction space. Different colored balls control different instrument sounds (percussion, piano, and bass). The interaction space is divided into a 2x8 virtual grid where each grid square is mapped to a different musical note. This allows participants to explore the musical space together as well as layer musical instruments by playing with different balls.

### Design Principles

*Sound Happening* incorporates three key design principles centered on encouraging parent-child play. First, the installation has a *low barrier of entry* facilitated by an embodied user interface that evokes the existing *cultural form* [4] of ball play. The embodied

user interface makes the system amenable to use by children of even very young ages (all a participant needs to do to interact is pick up or kick a ball). At the same time, the cultural form of ball play evokes a clearly defined set of interaction dynamics that allows adults to join in the interaction without fear of social embarrassment. This is important, as prior studies have found that adults tend to shy away from publically engaging in play that involves potentially embarrassing physical interaction dynamics (e.g. donning a costume as part of pretend play in a museum) [2] [7].



**Figure 1:** A father and his daughter interacting with *Sound Happening* at the Children’s Museum of Pittsburgh.

Second, the installation is designed to allow for *multiple levels of interaction*. Very young children can engage with concepts relevant to early childhood education (e.g. color identification, cause-and-effect, motor skills), while older children and adults can explore more complex activities like musical patterns and rhythm making.

Finally, iterative observation-design cycles at the Children’s Museum of Pittsburgh led us to incorporate *toughness* as a design principle for facilitating adult-

child interaction. The staff at the Children’s Museum of Pittsburgh use the term *tough art* to describe installations that can stand up to long-term heavy use by adults and children alike. One example of how we incorporated “toughness” as a design principle involves the types of balls used in the installation. We found that the bouncy balls we originally brought to the museum led to chaotic interactions with even a small number of participants, where balls bounced off the ceiling and were pelted at passerby, and parental engagement consisted mostly of scolding and ball retrieval. Replacing the balls with balloons reduced the chaotic nature of the interactions, but balloons (perceived as being free) were taken from the exhibit by adults and children alike. We finally replaced the balloons with beach balls, which were rarely removed from the exhibit and minimized chaotic interactions, allowing adults to transition from a social regulatory role to a play partner as well as facilitating deeper child engagement that extended beyond throwing balls at other participants.

## **TuneTable**

### *Installation*

*TuneTable* (Fig. 2) is a tangible tabletop installation designed to engage participants with computing concepts via the co-creation of sample-based music compositions. Tangible pucks representing music samples are combined with “computing” pucks (e.g. loops, conditionals) on the tabletop in order to co-create unique musical compositions [8]. The installation targets middle-school age parents and students.



**Figure 2:** A father and his two sons interacting with the first version of *TuneTable* at the Museum of Science and Industry in Chicago.

### *Designing for Active Prolonged Engagement*

The design of *TuneTable* has been heavily informed by research in museum studies on designing for family-style social engagement. Active Prolonged Engagement, or *APE*, is a framework developed by exhibit developers at San Francisco’s Exploratorium as a way of guiding the design and evaluation of museum exhibits that aim to foster active physical engagement, relatively prolonged interaction times (e.g. 5 minutes rather than 30 seconds), and social interaction between group members [5]. The *APE* framework focuses on four key aspects of interaction: 1) social engagement; 2) intellectual engagement; 3) physical engagement; and 4) emotional engagement [5]. All four features are intended to be considered at the group level rather than the individual level, further emphasizing *APE*’s focus on facilitating family group engagement.

We are currently in the process of designing and evaluating two very different versions of *TuneTable*

(both guided by the design principles outlined in APE) and aim to conduct a comparison-based APE evaluation in order to better understand which modalities better facilitate family-based co-creative interactions.

The first version of *TuneTable* (Fig. 2) uses tangible pucks modeled after a blocks-based programming language. Orange *sample pucks* (each of which plays a particular beat or sample) can be combined and modified with *function blocks* that correspond to computing concepts (e.g. functions, conditionals, loops). Participants stand around the four sides of the square table and can choose to either work together to build a shared composition in the center of the table or work on individual compositions in the space directly in front of them. The table facilitates the parallel construction of multiple musical compositions.

In contrast, the second version of *TuneTable* is focused on communicating computational concepts independent of code. Instead of linking actions to highly-abstracted block-based code, this version of *TuneTable* uses embodied interaction to create a physical language that expresses computational logic. Musically, *TuneTable* has evolved into a step sequencer. This cultivates collaboration as all players work on the same piece of music (while owning and operating a small, well-defined part of it), and encourages not only listening to one's own creation, but constantly considering it in the context of the whole: as the step sequencer makes its way around the table, players listen to the work of others as they anticipate hearing their own.

## Conclusion

*TuneTable* and *Sound Happening* are both embodied social experiences that we have developed in order to

better understand how to design for adult-child co-creative interaction. Our work highlights design principles that can be used to encourage adult-child co-creativity, including designing for low barriers of entry and multiple levels of engagement, designing *tough art* installations, and utilizing APE to inform the design of physically engaging, socially interactive experiences.

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