Octoract: An Eight-Dimensional Framework for Intergenerational Participatory Design Techniques

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ABSTRACT

In this paper, we present a framework that describes commonly used design techniques for Participatory Design with children. Although there are many currently used techniques for designing with children, researchers working in differing contexts and in a changing technological landscape find themselves facing difficult design situations. The Octoract framework presented in this paper can aid in choosing existing design techniques or in developing new techniques regardless of the stage in the design cycle, the technology being developed, or philosophical approach to design method. The framework consists of eight dimensions, concerning the design partners, the design goal, and the design technique. The partner dimensions are *design experience of the participant* and *partner ability*. The design goal dimensions are *design space* and *maturity of design.* The technique dimensions include: *cost, mobility of technique,* and *technology level*. Two cases will be presented which describe new techniques and two case of an existing technique.

Author Keywords

Children; design; design techniques; design methods

ACM Classification Keywords

D2.2. Design Tools and Techniques: Evolutionary prototyping

General Terms

Design.

INTRODUCTION

While many existing techniques are available for design researchers to use to design with children, technology continuously evolves. New techniques need to be developed in order to adapt to changing technologies and design spaces. For example, video games were screen-based and controlled with a joystick or keyboard a generation ago, but today, video games are available on phones where the input is unlike a joystick or a keyboard. Similarly, home video game systems are now able to sense players' movements and require no physical device interaction. As children's technologies shift, the techniques used to work with children must keep up with this evolution.

In our research we have utilized Participatory Design (PD) as means to design technology for and with children. At its core, PD is an overarching methodology that involves end-users in the technology design process. In the mid-1970's, computer-based technologies were introduced into the workplace in Europe, and workers began to feel that they were losing control of their work environment. In Germany and the Scandinavian countries, this feeling of loss was an important theme concerning democracy in the workplace [7] and led to the seminal work of the UTOPIA project [1]. The UTOPIA project sought to give a voice to newspaper workers in Sweden in the design of new computer-based tools for their work in the early 1980's. This project continued in the spirit of other democratizing projects in 1970s Scandinavia where researchers observed and helped trade unions influence the technologies used in the work place [1]. It was not until the late 1990s that PD design was adapted and more widely used with children [1, 7].

Collaborative Design, or co-design, is the subset of Participatory Design where expert designers work with the target audience to solve a problem. Participatory Design is often used to include any activity with an end-user; however, co-design implies that the end-user is part of the design process. This subtle distinction is necessary because we use the term co-design to imply that the user becomes involved in the design process instead of merely testing a system or providing feedback at the end of the design process. Our Octoract framework is centered around co-design activities with children as the end-user group. Design researchers work with *techniques* to "enable children and adults to work together to create innovative technology for children" [6]. We define a technique as a creative endeavor that is meant to communicate design ideas and system requirements to a larger group. Researchers have also developed different *methods* for working with children in the design of new technologies. We define methods as collection of techniques used in conjunction with a larger design philosophy. Cooperative Design, Bonded Design, and Informant Design [3, 8, 11] are examples of popular methods used in the intergenerational co-design process.

Previously, researchers have categorized Participatory Design methods and techniques in various ways. Muller and Kuhn [14] described methods and techniques through the level of involvement with end-users, the time in the design process, where the technique or method was used (Scandinavian countries or not), if the technique or method was being used for commercial purposes, and group size. Sanders and colleagues [18] describe Participatory Design tools and techniques through the dimensions of form, purpose (i.e., probing, priming, understanding, and generating), and context (i.e., group size, face-to-face vs. online, venue, and stakeholder relationship).

This previous work is extremely important, however, these classifications systems were either designed for adult-centered Participatory Design, or as a checklist that evaluates what a technique can output and where it can be used. We feel that working with children requires a different lens to examine techniques and a framework needs to consider the different motivators in designing new techniques. The goal of this paper is to provide a framework for how to describe existing design techniques, as well as create effective new design techniques for working with children in the design process. It attempts to be agnostic to the design method employed by researchers. Instead, we focus on the practical use of the framework to understand existing techniques and to support design researchers when new or modified techniques are needed. The paper begins by reviewing examples of existing methods and techniques, then goes on to identify a multidimensional framework developed from evaluating existing techniques. In the concluding section, the use of this framework is described in the development of two new techniques by the authors for conducting design work with children.

PREVIOUS WORK

Methods and techniques exist independently, and many techniques are not exclusively used in one specific method. For this review, we chose to examine the methods and techniques from the most cited papers in the ACM Digital Library based on the keywords of "children", and "Participatory Design" or were chosen from other sources, for example the journal Library and information science, because of the similarities or differences to highlighted methods. Our goal is to present examples that provide an overview of design philosophies differing along a spectrum of when and how children are involved in the design process. Below we describe four methods made up of multiple techniques.

Druin [6] outlined the roles that children can play in the Participatory Design of technology from a spectrum of minimally involved to full partner: user, tester, informant, and design partner. The most involved method of bringing children into the design of technology is *design partnering*, where children are integral parts of creating a technology. This philosophy is called *Cooperative Inquiry*. Cooperative Inquiry has been used in the design of children's technologies for over a decade. This method prescribes that adults and children work together as design partners, using idea elaboration to create low-tech prototypes [4]. The prototypes are redesigned iteratively and usually increase in technological sophistication or focus at each iteration. Prototypes then receive feedback from the design team and the iterative cycle continues. In this methodology, the intergenerational design team participates in the design of the technology throughout its life cycle.

Another role researchers ask children to be is *informants*. This role involves children to offer input and feedback at different stages of the design process, but not continuously to guide the design process [16]. Informant design utilizes both hi-tech and low-tech prototyping techniques depending on the design problem and results desired. Philosophically, this method differs from Druin [6] in that researchers can choose the best stages of the design process for the involvement of children and only seek input during those critical stages. Informant design is intended to be a compromise between working with children as full partners, such as in Cooperative Inquiry, and adults designing technology with children in mind [16].

Bonded Design [11] is similar to Cooperative Inquiry, except that design partners work with researchers for shorter periods of time and the design projects are done in schools instead of a lab environment. This is done because the amount of time and resources required for a full-year of design partnering are often outside the means of design researchers. One philosophical difference of Bonded Design from Cooperative Inquiry is that all participants are also thought of as learners in addition to being designers.

The *Mad Evaluation Session with Schoolchildren* (MESS) day method used by the Child Computer Interaction (ChiCI) group is mix of several techniques unified by the goal "to help children have technologies that are worthy of them; that support playfulness, that are fun to use, and are engaging and exciting" [15]. This example fits the definition of method because of the unification of multiple techniques with a larger design philosophy. This method relies heavily on evaluation and low-tech prototyping during MESS days. In this method, the research team works with a group of children to evaluate new technologies, participate in design sessions, and take part in research experiments [14]. This method is similar to Bonded Design, but has more of an emphasis on evaluation and fun.

The MESS days method is closely related to an older method called Bluebells [11] that was developed by the same group. In Bluebells, adults plan activities to focus on requirements, children play several games that create outputs for designers, and then adults incorporate ideas into the design requirements. The game techniques used during the play sessions generate new ideas and output for the adult designers to use in future designs.

Techniques

Human-Computer Interaction researchers have used a number of techniques to work with end-users. In order to develop a framework of developing new techniques to support intergenerational PD, we examined the literature for prior techniques design researchers used in working with children and adults. Many of the techniques used in Participatory Design with children have been used with adults or were inspired by those used with adults. In this section, we discuss techniques identified in the Human-Computer Interaction literature as having been used in Participatory Design with children, ordered by publication date (earliest to latest).

Bags of Stuff is a low-tech prototyping technique [4] long considered to be one of the earliest and most common PD prototyping techniques that utilize art supplies as the medium for the creation of low-fidelity prototypes. Large plastic bags are filled with arts and craft supplies such as yarn, Styrofoam shapes, glue, paper, markers, scissors, and cardboard rolls. Design teams comprised of two to four children and one to three adults are each given a bag to use in the development of a low-fidelity prototype. Ideally, each team develops one prototype, although depending on the ideas generated a team may have more than one prototype. At the end of the design session, each team takes turns standing in front of the larger group and describing their ideas.

Another commonly used technique is *Storyboarding* [21]. In Storyboarding, the story of a system design is drawn onto large sheets of paper to establish a timeline as well as the aesthetics of the system. This technique is generally used later in the design process, as most of the design parameters should be established so the design team can provide feedback.

Another example of common materials used in a design technique is often referred to as *Stickies* [6]. Stickies, or sticky notes, are small pieces of paper with a mild adhesive that stick to surfaces. The Stickies technique is especially useful towards the end of the design process as a way to identify likes, dislikes, and design ideas around a nearly complete prototype. In this technique, the larger group is split up into smaller teams made up of one or two children and at least one adult. The teams evaluate the technology by writing one like, dislike, or design idea on each sticky. The stickies go onto a whiteboard where an adult design partner organizes them into groupings of similar themes. This technique involves more than simple evaluation, as the likes, dislikes, and design ideas are used to inform the design requirements in the following iteration.

In designing with children, there are several traditional uses of *Paper Prototyping* [19]. Letter or A4 sized paper is used to sketch designs [11]. In this way, designers are able to express their ideas in a way that seems intuitive for both children and adults. *Big Paper* uses large pieces of paper, like those found on easel pads, as the medium for design. These large pieces of paper offer an unconstrained view of the design problem, as there is room for every design partner to draw their own ideas. In this way, Big Paper can generate a wide array of design ideas and approaches for design problems that are loosely defined or need an influx of ideas.

KidReporter is a technique where the child designers can be responsible for the documentation of a design session [1]. Adult researchers give children video cameras and notepads, which children can use to take photo and video during the evaluation of a system. This technique is useful for children who may have difficulty writing or reading, and allows for a high level of interaction with the system under examination, as well as results in a large amount of different types of data.

Mixing Ideas [8] is a technique originally created as the result of working with children aged 5 and 6 as design partners. Younger children often have a harder time working as partners in the design process and instead want to work individually in the creation of their designs rather than collaboratively with others. In this technique, design partners create their own individual designs and talk about them with the large group. At a later point in time, an adult member of the team cuts up or disassembles the designs so the group can utilize the existing parts in one new design.

ComicBoarding [12] is a newer technique that helps children who may be hesitant about designing to communicate their ideas to researchers. In ComicBoarding, researchers ask children to come up with a story about a technology they are designing. An artist is on hand to draw the story as the children describe the technology.

Layered Elaboration [22] is a more recent paper-based prototyping technique in which designers add layers of transparent material to enable iterative design without destroying the original idea. In this technique, the larger group is split into several smaller teams. Each smaller team is given a clipboard with a piece of drawing paper on it. Each team creates a design to address the stated problem. At the end of a specified amount of time, the teams meet to describe their designs to the larger group. When all of the teams have presented, an overhead transparency is layered on the drawing paper and the clipboard is exchanged with another team. The next team adds to the design by drawing on the overhead transparency. This process is repeated as needed and elaborations are stacked on top of each other to enable understanding of the whole design.

Obstructed Theater is one of the newer design techniques used by the Usability of Music for Social Inclusion of Children project [14]. In this technique, design researchers filmed a video of two children performing a sketch in which they describe a mobile device while never showing the device on screen. The video is shown to the design group at the beginning of the session. Because the described device is never shown, Obstructed Theater [13] allows children to be prompted at the beginning of a design session without influencing their designs.

Modifying existing techniques

We do not define what constitutes a simple modification of a technique or the development of a completely new technique. Such a definition heavily relies on the context of the design work. Modifications can be the result of simple material substitution or subtle alterations.

Existing techniques can be modified depending on the design problem or context of the research. Design researchers only need to change the materials or approach to match the kinds of problems they are trying to solve. For example, the authors have modified Bags of Stuff to be more suited to a specific environment. *Mobile Bags of Stuff* is a technique in which Bags of Stuff are used, but the designers must get up and move to another location, such as a stairwell or outdoors, to build their prototypes so the materials used are fewer and portable.

Idea Synthesis

The output of any technique should be a list of ideas, themes, or requirements that can be used in the next iteration of the design or to improve the technology. The idea synthesis, through which information is extracted from the design session, may look very different depending on the method used. For example, in Cooperative Inquiry, there is a group discussion involving the child design partners as well as adults as the ideas from small teams are written on a whiteboard. The authors refer to this as *Big Ideas*. Big Ideas is not a technique, per se, but it is an important part of the co-design process. Other methods may exclude the children from the idea synthesis altogether [9, 15].

MULTIDIMENSIONAL TECHNIQUES FRAMEWORK

From our review of the literature, we find that common dimensions exist between different techniques. To develop our framework, we employed a constant comparative analysis [20] to identify emergent patterns in the techniques. To do this, we reviewed the techniques to answer two questions: 1) how are the techniques similar and different with respect to the implementation of the technique and 2) how are the techniques similar and different with respect to the design team (i.e., children, researchers)? During the first round of review, we annotated noticeable similarities differences between the techniques. We observed differences in materials used, interaction in the design space, what technologies were being designed, how the design partners would interact in the techniques, etc. From this process, three researchers collapsed our observations into eight codes that we believe were present in all the techniques via group discussions and comparisons of different aspects of techniques. Using these eight codes, we went back and re-analyzed the techniques to determine if the codes were able to capture the most salient aspects of the techniques. No codes were added during the reanalysis.

Therefore eight dimensions resulted from this analysis that can be considered when thinking of how to use techniques to achieve design goals. These eight dimensions led us to call this framework Octoract, which in geometry is an 8-dimensional cube. In the Octoract framework, two of the dimensions concern the intergenerational participants, two of the dimensions concern the problem space being addressed, and four of the dimensions concern the technique. There is no particular order to the presentation of the dimensions because the needs of the researcher determine the priority of the dimensions.

The two dimensions of the intergenerational participants are:

1. *Previous design experience*
2. *Ability*

The two dimensions of the design goal are:

3. *Design space*
4. *Maturity of the design goal*

The four dimensions of the technique are:

5. *Cost*
6. *Portability*
7. *Technology level*
8. *Physical interaction*

In the sections that follow each of these dimensions will be further defined and described. We also explain the role and understanding of context in these dimensions.

Dimensions of the Child Participants

1. The *partner experience* dimension (Figure 1) examines how much design experience is necessary to participate in the design sessions.

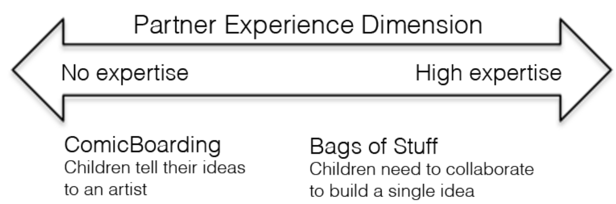

Figure 1. The spectrum of the partner experience dimension.

The dimension goes from no experience, allowing a child or adult who has never been a design partner to participate in design sessions, to high experience, where design teams need to posses more expertise to successfully work on a design task. Most of the time, design techniques with children should be easy, natural, and accessible. High-experience techniques have common pitfalls, such as the tendency to reproduce idea prompts, which can be avoided with child and adult designers with more experience. A technique requiring no experience might be ComicBoarding, as most participants can express ideas to another for illustration. An example of a technique requiring higher experience is Bags of Stuff, which is difficult for some partners due to the need to produce a collaborative, single design artifact arising from idea elaboration.

2. The *partner ability* dimension (Figure 2) refers to the age and cognitive ability of the design partners involved. This dimension ranges from no accommodations to accommodations needed. Younger and older design partners occasionally need techniques that are modified [7, 8]. Partners with special needs may need additional supports as well, such as ensuring that there is a complete supportive team in place around the child design partner prior to engaging any techniques [9, 10] or providing visual schedules to aid children on the autistic spectrum with progressing through the technique activity [2]. If a design partner is of differing age or cognitive age, accommodations can be included in the existing techniques. For example, Storyboarding requires design partners to draw out the scenarios of a system on large pieces of paper. In contrast KidReporter needs children to act as interviewers and use video recording equipment. However, because of the context and the diversity of design partners, different accommodations may need to be made, therefore we have not placed the two techniques on the ability dimension as examples (Figure 2).

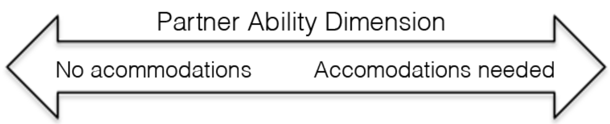

Figure 2. The spectrum of the partner ability dimension.

Dimensions of the Design Goal

3. The *design space* dimension (Figure 3) looks at how specifically the design problem is defined. The dimension runs from unspecific to highly specific. If a problem is unspecific, the technique may need to be generalizable to a wide range of design problems. Researchers might use Bags of Stuff to have children build low-fidelity prototypes and collaborate their ideas together on an unspecific problem. If the problem is highly specific, the technique will need to accommodate that particular design space. For example, if researchers and designers have a specific user interface they would want children to critique, using Stickies can help child partners quickly give feedback.

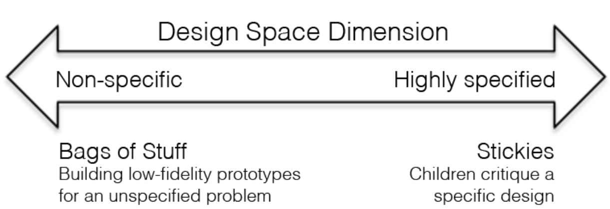

Figure 3. The spectrum of the design space dimension.

4. The *maturity of design* dimension (Figure 4) examines how far along the current design is in the overall design process. The dimension ranges from early in the design process to late. If the design session occurs early in the process, then the main goal of the technique is to foster generation of design idea and directions. For example, Bags of Stuff allows children to design low-fidelity prototypes early in the process to generate design themes. If the technique is employed in the middle of the design process, it may be utilized for the elaboration and iteration of the existing design. For instance, Stickies could be used to evaluate an already existing prototype. If the technique is to be used at the end of the design process, it will need to facilitate evaluation of the existing design.

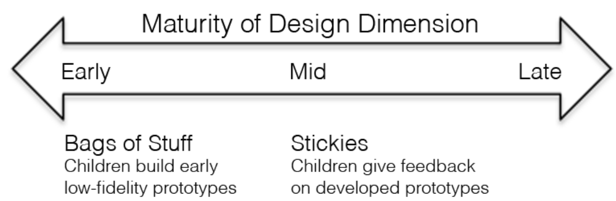

Figure 4. The spectrum of the maturity of design dimension.

Dimensions of the Technique

5. *Cost* (Figure 5) refers to the financial price of design materials. This dimension spans no-cost materials to high-cost materials. An example of a no-cost technique would be theatrical plays in which designers explain new technologies through acting. An example of a low-cost technique, such as Stickies and Paper Prototyping, would be drawing ideas on paper with pencil, as paper and pencils are not expensive materials. A high-cost technique may include specialized equipment like video camera recorders, such as KidReporter. In addition to actual cost of materials, time and labor costs are a consideration. Some techniques, such as KidReporter, result in more of an investment of researcher time to analyze the design team's output (video recordings).

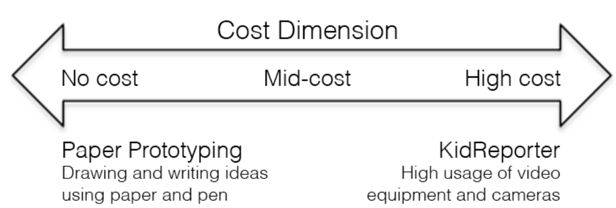

Figure 5. The spectrum of the cost dimension.

6. The *portability* (Figure 6) of the technique describes the physical mobility of the technique or of the mobility of the artifacts generated by the technique. This dimension ranges from not portable to being highly portable. A non-portable technique would need to be in one location, for example tethered by the need to use a computer lab or design in a particular space that has a specific recording setup.

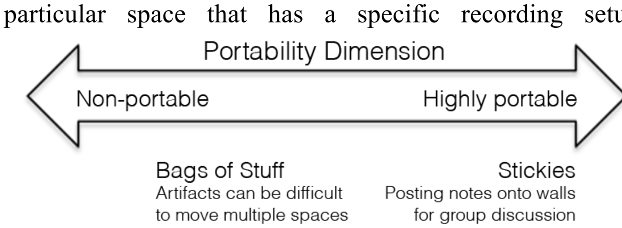

Figure 6. The spectrum of the portability dimension.

If designers need to consider working with children outside of a controlled lab setting, we recommend they consider whether or not the new or modified technique can be implemented in different environments. For instance, the artifacts generated by the Bags of Stuff technique can be difficult to move from one location to another. We classify Bags of Stuff as lower in portability than Stickies, which can be done in most rooms with walls that allow the posting the notes up for group discussion.

7. The *technology dimension* (Figure 7) looks at the sophistication level of the technology utilized in the technique. The dimension ranges between low-tech and high-tech. An example of a low-tech technique is the utilization of paper as a medium to express ideas such as in the (e.g., Bags of Stuff, Paper Prototyping techniques,), while a high-tech technique may use tablet computers on which designers express their ideas. Mission from Mars [5] requires the use of cameras, televisions, microphones, and other video equipment. There is a positive correlation between cost and technology level; more high-tech techniques tend to be more expensive. However, high cost does not necessarily mean high technology usage.

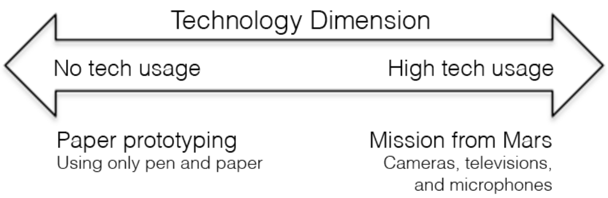

Figure 7. The spectrum of the technology dimension.

8. The *physical interaction* dimension (Figure 8) examines the degree to which designers will physically move around during the design process because of the technique.

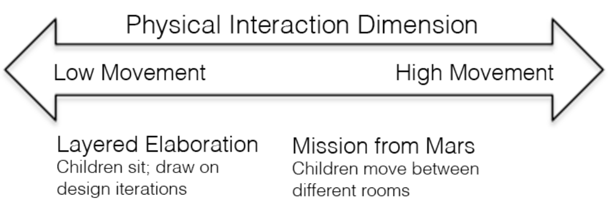

Figure 8. The spectrum of the physical interaction dimension.

The dimension goes from low physical interaction to high physical interaction. Some techniques may require the designers to sit in place in order to complete their designs and these techniques would be low physical interaction. For instance, Layered Elaboration tends to only need children to sit and draw on design iterations. Techniques that require participants to move around would be considered high physical interaction. This differs from the portability dimension as physicality refers to the bodily movement required for the technique, and the portability dimension refers to the mobility of the technique itself. For instance, in Mission from Mars, children move between different rooms for the technique.

UTILITY 1: A FRAMEWORK FOR DESCRIBING TECHNIQUES

In this section, we briefly describe the design challenges of two techniques (ComicBoarding [12] and Mission from Mars [5]) and we breakdown the technique through the lens of the above framework. In this section and others, we will refer specifically to the eight dimensions by numbers *(1, 2, 3, 4, 5, 6, 7, 8)*. Figure 9 shows the two techniques as analyzed from the framework.

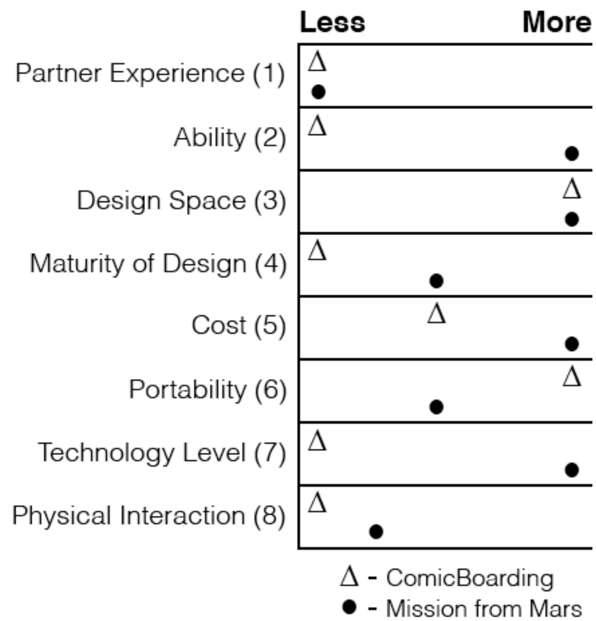

Figure 9. Using the eight dimension of the framework to classify two prior techniques in co-design with children.

Existing Technique #1: ComicBoarding

Design challenge: Creative expression

It is occasionally difficult for child designers to express their ideas via drawing, as they may be accustomed to rote learning practices where brainstorming is not encouraged [11]. In such cases, it is possible to bring in an outside artist who can aid child designers in ordering and expressing their ideas by communicating ideas verbally with the child via storytelling and then drawing the ideas while the child designer offers input.

Eight dimensions and creative expression

The *partner experience (1)* dimension for ComicBoarding is low for child designers as we believe children are proficient at explaining idea via storytelling. ComicBoarding is designed to allow children of any background to participate in design activities, but a more experienced artist would be needed to be able to accurately represent and contribute ideas to the design problem. Since children need to only narrate a story to an artist little accommodation needed on the *partner ability (2)* dimension. However, determination of the ability spectrum also depends on the context of a research project.

In ComicBoarding, it is established that the child designer will design either within a partially completed comic, somewhat grounding the *design space* (3) to a more specific area, or within a free-form comic, which is a more unconstrained *design space* [11]. The *maturity of design (4)* dimension is generally early stage, as the ideas are being generated on the spot by the designers As ComicBoarding requires hiring an artist, the *cost* (5) of the technique is moderate. However, as the output of the technique is drawings on paper, the technique is highly *portable* (6). As for the technology *dimension (7)*, nothing more than paper and drawing supplies are needed in ComicBoarding. For the user dimensions, *physical interaction (8)* is low as the technique calls for designers and an artist to sit and work together.

Existing Technique #2: Mission from Mars (MfM)

Design challenge: Communicating with children

One of the principles of Contextual Design [3] states that people are experts at what they do, but have a difficult time articulating their own practice to designers. This same principle applies with children. The MfM technique [5] provides a way for children to express their ideas on everyday life. In MfM, children communicate to a "Martian" (an adult researcher in another room) who represents someone that does not understand life on Earth. Designers present the narrative, setup the children into groups for the Martian broadcast, and help the children communicate to the Martian.

Eight dimensions and communication

MfM requires a numerous amount of electronic equipment. The children are brought into a broadcast room in which they speak to the Martian though a video feed that includes monitor, video camera, speakers, and the equipment that locally connects the devices. The *cost (5)* is high and the *technology* dimension (7) requires high usage. MfM was implemented in a school between two classrooms. The *portability (6)* dimension is mid-level. As long as two rooms are present and have enough electrical outlets and space between for the devices to connect, MfM can be implemented. For the *design space (3)* dimension, MfM is highly specific. The researchers were directly focused on how to improve upon *eBag*, a digital repository in which children can store photos, documents, and other electronic artifacts. The *maturity of design (4)* is mid-level; the researchers were still in the process of developing eBag and making iterative changes.

In considering the user dimensions, the *partner experience (1)* is low; children were only recruited for this one session and did not need prior design experience. In considering the *partner ability (2)* dimension, high accommodation may need to be present due to the numerous tasks. Children were presented with the narrative and had to decode alien symbols. They also had to work in groups, develop a presentation for the alien broadcast, and had come back for discussion. This constant switching between different tasks and rooms also meant that the *physical interaction (8)* of the children is low to mid level.

UTILITY 2: A FRAMEWORK FOR SUPPORTING NEW TECHNIQUES

In this section, we outline two techniques we have developed with thank to the inspiration of the Octoract framework and its eight dimensions. We describe the design challenge that prompted the creation of a new technique, explain how we came up with the technique, and explain the details of the technique.

We implemented and designed the two new techniques for use with an intergenerational design team – named *Kidsteam* - using the Cooperative Inquiry design method. Kidsteam is composed of adult researchers and children ages 7 – 11 that meets twice a week during the school year to co-design new technologies. However, we believe that these techniques can be used with different design methods.

New Technique #1 – Big Props

Design challenge: Motion and gestures

Kinect™ is a motion sensor camera that detects physical player movement for the Xbox™ video game system. We wanted to see what non-specific design ideas the design team would come up with for the Kinect™ camera. However, it became clear to us that none of the prior techniques generally used during Kidsteam design sessions would capture the dynamic nature of the Kinect™ technologies. For example, typically when the design team creates a non-specific technology, we utilize the Bags of Stuff technique to develop low-fidelity prototypes. However, for the design challenge of using the Kinect™ to create new technologies, the Bags of Stuff prototypes were too stiff and motionless. We needed to design a technique that allowed for the same non-specific design space as Bags of Stuff, but could show us gestures and dynamic motions of children by allowing more physicality.

Developing the new motion technique based on aspects of the framework

In our consideration of the design challenge of motion and gestures, the *physical interaction (8)* dimension needed to be a high priority. The children needed to demonstrate gestures and that interaction would be very high. Since the Kinect™ design session focused on an unspecific *design space (3)* and early *maturity of design (4)*, we also wanted the same low *cost (5)*, low *tech (7),* and low *partner experience (1)* dimensions as Bags of Stuff [4]. As we started to consider the issues of high physical activity with the low-fidelity prototyping properties of Bags of Stuff, our research group considered other prior techniques, but could not find one suitable for the task at hand. We decided to develop a new technique based on the high physical interaction needs combined with the development of low-fidelity prototypes.

Big Props as a technique

We developed *Big Props* as a technique to design children's technologies that depended on motions, gestures, and dynamic movement (Figure 10). In Big Props, children are divided into groups with the adults and given a random assortment of large stage props (e.g., balls, umbrellas, blankets). Using the props, each small group comes up with a scenario for the motion-based technology and shares the gestures and interactions with the larger design team. After each group presents their idea, the props are rotated around and the teams come up with another new idea. When we first implemented Big Props, the other dimensions started to become clearer. After implementation, we observed that children's high physical motions meant that *portability (6)* of Big Props would be limited to large rooms that could accommodate a lot of activity. We also realized that the high physical activity meant that Big Props required design partners on the *partner ability (2)* dimension to have high ability physically and cognitively. Children need to be careful demonstrating the gestures and motions and adults must constantly monitor and supervise for safety issues. Big Props can be used with a variety of methods. For example, Informant and Bonded Design sessions could utilize this technique. This technique is not limited to one design philosophy.

Figure 10. Big Props is a technique that design partners use props to act out gestures and motions for technology that requires such interactions.

New Technique #2 – Line Judging

Design challenge: Rapid idea evaluation

Graduate students in our lab asked Kidsteam for opinions on a series of technologies that could help children learn foreign languages. The graduate students came to Kidsteam with numerous ideas about technologies, such as a website that would teach children alphabet songs in different cultures, a mobile app that would help children learn groceries in different languages, a game that would allow users to match pictures with words from different languages, and many other ideas.

Developing a rapid-fire evaluation based on the framework

We knew from past experiences that simple voting is difficult for engagement. Voting means that children have to sit for a long time and raise their hand up for either a "yes", "no", or "neutral" answer. We wanted the children to vote on a spectrum (highly negative to highly positive) and we wanted them to quickly see their opinions in a spatial manner. Since we wanted the children to vote quickly on the new ideas, we knew that the *cost* (5) and *technology (7)* dimensions for our new technique should be extremely low. Voting also needed to be a technique that is highly *portable (6)*. Since multiple design ideas have to already be in place, the technique the *design space (3)* needed to be highly specific and the *maturity of design (4)* could range from early to mid-level designs. Since voting had to be simple, our child partners needed a technique that had low *design experience (1)* and low accommodations for *ability (2)*

As we examined prior techniques, we found that none of them were sufficient for this design task due to the need for rapid evaluation of design ideas. Our typical technique for this type of design problem is Stickies, where the design team evaluates a late-stage prototype in depth. Because of the numerous early-stage ideas the graduate students had, we needed the Kidsteam to both quickly vote on the ideas they liked as well as express their thoughts on expanding or modifying a numerous and diverse amount of ideas.

Line Judging as a technique

Based on the priorities identified, we developed *Line Judging* as a technique that is similar to Stickies [8] in that it allows the design team to indicate liking or dislike of ideas (Figure 11). We drew a 3-meter line on the lab floor in masking tape. The design team began by standing together at the middle of the line. One of the graduate students briefly described each technology idea. Once the Kidsteam heard the idea, they moved themselves in one direction for positive feelings, in the opposite direction for negative feelings, or remained in the middle for neither like or dislike. Once the team decided on their individual positions, they began to share their opinions about the idea. Participants had the option of standing anywhere on the line to state their opinion and if their opinions changed, they can change their position on the line. After the opinions and ideas were shared and debated, the design partners returned back to the middle position and started the process over again with a new idea. Based on the initial implementation of Line Judging, we found that *physical interaction (6)* was on the mid-range because children were constantly moving around the line. Line Judging is applicable to multiple methods as well. For example, a MESS Day session could easily utilize this technique as a way to evaluate new technologies.

DISCUSSION

The Octoract framework provides a means to describe existing techniques and to differentiate techniques and methods. The ability to describe design techniques in existence using the eight dimensions can aid in providing new directions for design and for the creation of new techniques.

While we do not advocate eliminating older and proven techniques, we suggest that developers and researchers need to consider a framework for future development and modifications of design techniques for children. Each of the two new techniques presented in this paper show instances for the need to develop new techniques based on new situations. The same process used in this paper can be replicated in many situations, resulting in a multitude of new techniques, suited to specific contexts or to wider use. Beginning with a design challenge, or goal, for an end-user design session, researchers and developers can then proceed to develop a new technique by considering how each dimension should be altered to best suit their particular context.

Use of the above framework can also provide a common ground around which researchers in differing fields and from many methodological philosophies can communicate their ideas. As researchers expand end-user design work into multiple fields, and technology continues to change with time, the ability of design techniques to keep pace as well as span disciplines will become crucial.

Figure 11. Line Judging is a technique that participants use to evaluate multiple early ideas. Children and adults initially stand in the middle of the line and move towards stage left (negative), stage right (positive), or the middle (neutral) as a way to express their opinions.

Although idea synthesis is a critical part of the process of using a design technique and of the method philosophy used by the researchers, it is possible to create a technique without regard to either how this idea synthesis will occur or the method used. Idea synthesis is not included as part of the framework, as, like methods, it exists independently of the technique chosen or created for the design work. There are commonalities between the techniques described here, although we have mainly focused on what distinguishes techniques from each other. Techniques should be fun, interactive, enable interaction, applicable to a wide audience, and provide an alternative way for children to communicate. Techniques should also enable adults the opportunity to listen and learn from children.

This framework is not designed to replace other Participatory Design frameworks or to be mutually exclusive to those that seek to describe Participatory Design techniques and methods. For example, the Octoract framework compliments Sanders et al.'s [18] framework for classifying PD tools and techniques' Purpose dimension specifically, the generating ideas sub-dimension.

We believe that the Octoract framework more explicitly addresses the needs of those researchers and practitioners that would like to work with children in projects involving intergenerational Participatory Design. Researchers often have limitations on where projects can take place and how much technology is available for use by participants, Similarly, practitioners may be concerned about costs or where in the design process the current project is when choosing techniques to work with children.

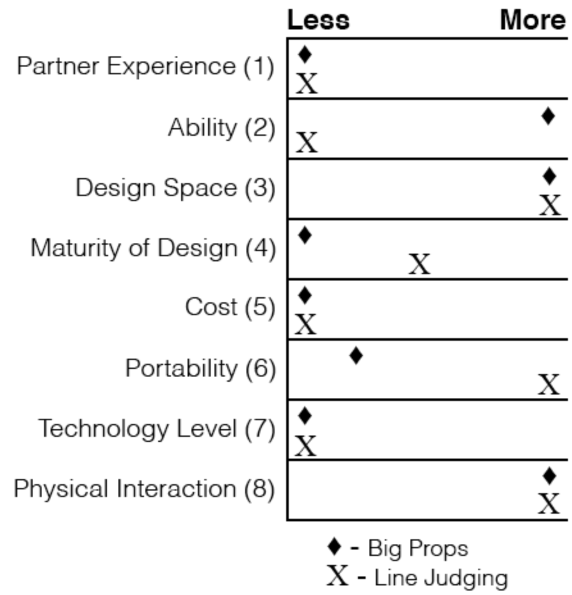

Figure 12. The figure shows a comparison of the techniques Big Props and Line Judging on the eight dimensions of our framework.

LIMITATIONS

We acknowledge that some techniques may differ from other techniques on only one or two dimensions. However, we do not define what constitutes a new technique versus a modified technique based on dimensional differences, as we believe that the *context of the design problem* is of greater importance than dimensional differences. We acknowledge that users of this framework will likely find that it is necessary to alter techniques to fit their design needs.

Additionally, we understand that some may find that this framework needs slight modification to align with the parameters of differing design methods. Researchers from varying philosophies working with children are encouraged to use the eight dimensions as a guide when considering how to approach their design problems. We advocate for a cohesive understanding of the intersection of culture and these eight dimensions.

FUTURE WORK

We believe future work lies in developing techniques for underserved populations of children. Researchers and designers should consider how to develop techniques that are adaptable for children with developmental, cognitive, physical, or emotional impairments. For instance, the Bags of Stuff technique presumes that children can grasp, hold, and manipulate objects with dexterity and precision. Consideration as to how techniques can be altered to enable participation for all end-users is important, especially given the potential for technology to provide assistance to underserved populations.

Additionally, this paper has considered design techniques from the perspective of children as users. It is of future interest to compare a similar taxonomy of techniques used with adults, and to examine via the same coding method whether the eight dimensions of this work hold true for work with adults.

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