Cooperative Inquiry Revisited: Reflections of the Past and Guidelines for the Future of Intergenerational Co-design

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Since its creation, the Cooperative Inquiry method of designing technology with and for children has been refined, expanded, and sometimes questioned. Cooperative Inquiry has been adopted and used widely throughout the world and continues to evolve and grow to meet current needs. This paper examines the origins of Cooperative Inquiry, discusses how it has changed since its original inception, and clarifies the intent of its techniques. This paper concludes by presenting how Cooperative Inquiry can support designing with and for today's international, independent, interactive, and information active children in the context of the developing world, mobile computing, social computing, and the ubiquity of search.

Keywords: Children, Cooperative Inquiry, Co-design, Participatory Design Methods

1. Introduction

Children can have a voice in the design of new technologies. We have spent the past fifteen years designing technology for children with children, and we continue to do so today. In this paper, we discuss our experiences designing with children, clarify seven assumptions about design partnering with children, and set forth new ideas for designing with and for today's international, independent, interactive, and information active children [12] in the context of the developing world, mobility, social computing, and the ubiquity of search.

1.1 Design Partnering Through the Years

In 1999, we published an introductory article on our methods of designing with children [9]. Cooperative Inquiry, which suggests on-going inclusion of children in the design process, is grounded in the HCI research and theories of cooperative design [27], participatory design [61], contextual inquiry [3], activity theory [49], and situated action [63]. Cooperative Inquiry is unique from these previous design methods in that it is specifically intended to inform the design process of teams that include adults and children. Although many of the techniques may have similarities to those in other design theories, they have been specially modified to meet the needs of an intergenerational design team [10]. Additionally, Cooperative Inquiry is a method of design partnering in which adults and children work together. The intense involvement of adults and children together in Cooperative Inquiry sets this method apart from informant design with children [59, 60]. The involvement of adults with children differentiates Cooperative Inquiry from Children as Software Designers [36] in which children work either alone or with their peers.

Since our initial publication, not only has our own team gone on to expand and situate the discussion of these methods [10, 11, 21, 28, 29], but other researchers have discussed their adoption and use of Cooperative Inquiry with a wide range of participants in a variety of contexts including schools [53, 55, 64] and homes for children with disabilities [30]. Researchers utilizing Cooperative Inquiry also develop a wide variety of technology, from educational software [55] to alternative and augmented communication systems for children with special needs [30].

Figure 1: Children and adults working together using Bags of Stuff

1.1.1 Cooperative Inquiry

Cooperative Inquiry offers a set of techniques that can be used by teams of adults and children together throughout the design process. In Cooperative Inquiry, "design" includes all of the steps necessary to conceive, develop, and produce a technology – essentially all of the work from start to finish in the creation of technology, including brainstorming, coding, building, iterating, and testing. This is intentionally a broad use of the term "design" as Cooperative Inquiry is a process which encompasses a long timeline in design. Cooperative Inquiry design techniques include using *bags of stuff* and large sheets of paper to prototype; *sticky notes* to critique; journals, videos, and white-board discussions to reflect; and role playing to problem solve.

Bags of Stuff is a prototyping technique in which children and adults use big bags filled with art supplies such as glue, clay, string, markers, socks, and scissors to create low-tech prototypes of technology [10] (see Figure 1). This is based on one of the oldest cooperative design methods used in Scandinavian countries [6]. In Cooperative Inquiry, the team sits on the floor to engage in low tech prototyping, which is different from the original Scandinavian low tech prototyping technique. We also

always break into small groups when creating low tech prototypes. Due to the small group prototyping, the process of sharing ideas is more structured.

After the low-tech prototypes are created by groups of two to three children and one to three adults working together, each group presents their ideas to the whole team. We designate one adult team member to take notes on the *Big Ideas* on a white board during these presentations. As each team presents, the note-taker writes down the ideas that are surprising, most repeated among groups, or ideas that receive the most reaction from the whole team (see Figure 8). After the presentations, the team discusses these ideas and decides which to pursue. We have found that using a bag of art supplies can strongly supports bringing children into the design process.

We have found value in tailoring the materials with which to prototype to specific projects. For example, we now often brainstorm on large sheets of paper, which allows numerous design partners to gather around a table or floor space to collaboratively work on one idea (see Figure 2). This two-dimensional brainstorming technique has been especially useful when working on screen-based interfaces. The advantage of the large paper versus a small sheet of paper is the collaboration and elaboration that can occur by gathering around one large workspace. We have also learned that it is sometimes necessary to tailor the contents of the Bags of Stuff to a specific project. For example, when exploring technology involving music, it is necessary to include auditory supplies – such as bells and noisemakers.

Figure 2: Children and adults brainstorming together using large sheets of paper

Sticky noting is a Cooperative Inquiry technique for critiquing an existing technology or prototype of a new one. The technique begins with all adults and children using a technology. As they are working, all partners write down on sticky notes what they like or dislike about the current technology, and any suggested changes to the technology. Each like, dislike or design idea is written on a separate sticky note. As the notes are written, they are gathered and given to an adult researcher who places them on a large wall space (see Figure 3). One or more researchers groups the notes in categories (e.g. likes, dislikes, design ideas) as well as subcategories which emerge from the sticky note comments. For example, many partners might like where the buttons are placed, or possibly lots of partners dislike the audio used. The outcome is a kind of informal frequency analysis [13] which shows possible trends that can inform directions for the next iteration of a technology.

Figure 3: Sticky notes clustered into big ideas within likes, dislikes, and design ideas

One of our most recent techniques is *Layered Elaboration* [70]. In Layered Elaboration, design partners either create or are provided with a base design on which to elaborate and iterate. As each small group elaborates on the original design, a sheet of clear acetate is laid over the original design. Sheets of acetate can be added upon each other so that each group can add their ideas without

"destroying" the original, or the work of other groups. Between iterations, we hold *stand up meetings* in which design partners quickly explain their ideas before the design is passed on to another group for further elaboration.

At various times during the design process, we ask all partners to reflect on their experiences by writing or drawing in journals, videotaping activities, and having large group discussions [11]. We find that reflecting in this way can help all members, adults and children alike, to clarify ideas and continue the elaborative creative process. These reflective experiences can be adapted for use with all ages as children who cannot yet write can draw or speak about their ideas. If a child chooses to draw, an adult team member will sit with that child, and with her permission, annotate the drawn reflections in writing to provide clarification for later analysis. Likewise, if a child prefers, she can tell her ideas to an adult design partner who will enter them into the child's journal (see Figure 4).

Figure 4: Adults and children reflecting and recording in journals.

1.1.2 Changes to Cooperative Inquiry over the Years

Through the years, Cooperative Inquiry has continued to change and grow. As we created a set of methods that worked well for children, we discovered that "children" was too broad an age range. The children on our longstanding design team are 7 – 11 years old; however, we have worked with both children older and younger than this range, and found that each has their own unique needs.

When working with older children (ages 10-13), for example, children needed more specific guidance when low-tech prototyping [39]. When working with younger children (ages 4-6), we discovered that they needed more support to effectively collaborate [21]. This ultimately led to the creation of a new Cooperative Inquiry technique called *Mixing Ideas*. In Mixing Ideas, individual team members each begin with an idea and then follow a step-by-step method of combining the ideas into one big plan [28]. The support given in the combining process through Mixing Ideas is often enough to support the fragile egos of young children and help them see their influence on the final product. Helping the team to explicitly see the combining of ideas by using the Mixing Ideas technique also can help to build cohesion on the team.

Over the years, we have also found it necessary on occasion to modify how we work with children in the design process to meet our evolving needs. For example, in the early days of our intergenerational design partnerships, we did a lot of *technology immersion* with children in order to better understand how they used technology [18]. While observing children in the long-term use of a technology can be valuable, we have found this particular activity to be time-consuming, and the results we were getting seemed to be less helpful than we had hoped in that the information gathered from these techniques did not contribute significantly enough to the design of new technology to support the amount of time needed to complete them.

In designing with and for children, we recognize three underlying dimensions of the roles of children in the design process; they are: *the relationship to developers, the relationship to technology,* and *the goals for inquiry* [10]. Each of these dimensions encompasses a continuum of possibilities based on the role the child plays in the design process [10] (see Figure 5). In keeping with our philosophy of continually revisiting our method to ensure that it is the best that it can be, later in this

paper, we will explore how these dimensions can be expanded upon to meet the needs of today's children.

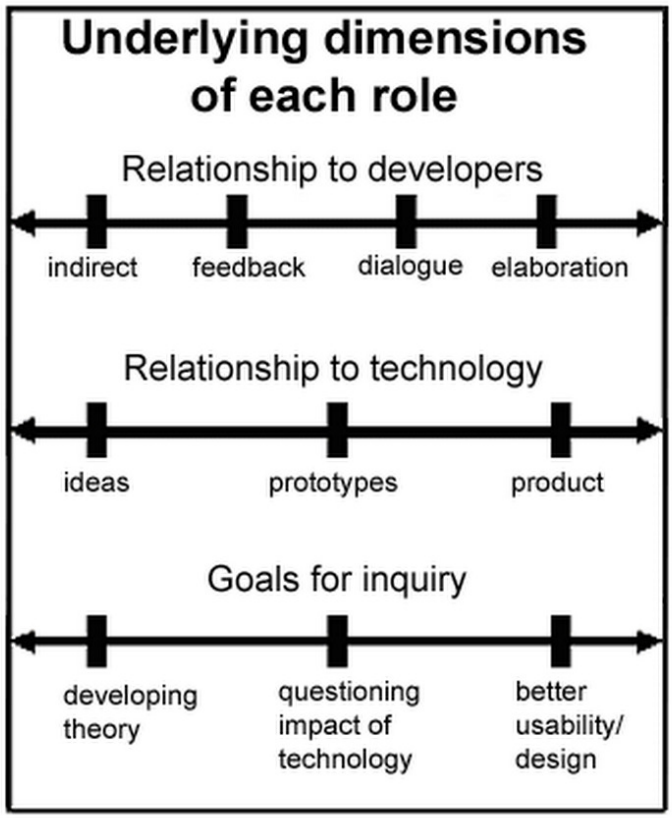

Figure 5: Dimensions of roles in the design process

1.1.3 Cooperative Inquiry and Idea Elaboration

We have found that the most important goal of any design partnership between adults and children is idea elaboration [10]. Idea elaboration begins when one team member (adult or child) shares an idea with the team. From this idea, a new thought or direction may be inspired by another adult or child. When these ideas build upon each other to create new ideas, ultimately it may be difficult to remember whose ideas they were originally. Many of our techniques directly support idea elaboration. Both adults and children share in the process together so that all views are incorporated.

It can be said that the elaboration process is the hallmark of a good design team with or without children. However, idea elaboration is often quite difficult for young people – and can become more so when they are expected to elaborate with adults. More commonly, adults conceive of ideas and either teach them to children or ask for feedback. The notion of elaborating on each other's ideas in a team that consists of adults and children is more difficult and therefore these teams should use design techniques created to encourage and enhance elaboration. Since elaboration is so central to the design approach of Cooperative Inquiry, this goal of elaboration influences all that we do in our design partnerships.

1.1.4 Cooperative Inquiry in Practice

We are often asked to explain how Cooperative Inquiry looks in practice. While each team may conduct their activities differently depending on the context and resources, what follows offers a snapshot of our experience.

Our sessions run twice a week, after school, in our lab at the university. While this lab space is shared by all researchers in our lab, the space is kid-friendly – it includes a floor level table, comfortable chairs, couches, and inviting places to sit (figures 1, 2, 3, 4, 6, and 8 show work in our lab). Before these twice weekly sessions, which run through the academic year, we have a two week design team boot camp each summer in which our researchers and child design partners participate in two intensive weeks of daily, day-long design partner activities.

When the children arrive for a design session, they eat a snack together with the adults participating in that day's design session. This helps to ease children and adults from their everyday lives into their role as design partner. While all child design partners join every session (barring sickness or vacation), adult design partners attend sessions relevant to their research. We generally have 6 to 8 children and 3 to 4 adults at a session.

After snack, we begin the work of a session. We could be using bags of stuff to design the iPod of the future. We might be using sticky notes to critique a newer version of a partner's website. We

might go outside to test a new mobile technology built by one of our graduate students. No matter what the activity, we end by coming together to have a large group discussion, share our ideas, and think about future directions. At the end of the session, the children leave, and the adults remain to debrief and discuss the day's activities, outcomes, and what's next.

2. Assumptions about Cooperative Inquiry

Although Cooperative Inquiry has been adopted and widely used, some researchers have questions concerning the specific techniques and the value of working with children during the design process. By discussing and addressing the following seven assumptions about Cooperative Inquiry, we hope to support the growth and evolution of co-design with children. It should be noted that although some of these assumptions reference published papers, others have been brought to our attention through informal means such as conversations with our colleagues. Our intent in this section is to address these issues in a manner intended to clarify the intent and implementation of Cooperative Inquiry. These clarifications are based on our experience working with children using the Cooperative Inquiry method on a continual and regular basis twice every week of the school year, and for two full-time weeks over the summer, for nearly fifteen years.

2.1 Assumption One: Adults are acceptable proxies for children in the design process

Some colleagues have asked us why we work with children, and why we do not just work with adults as proxies for children in the design process. Despite the fact that we were all 7-year-olds once, no adult member of our team is a 7-year-old today. The technological complexity and richness of a child's environment today is different than the childhood environment in which today's adults grew up [42, 47]. Today's children are experts at what it means to be a child today.

Beyond this, it is often argued that adults with training in child development, such as teachers or psychologists, should be able to represent the needs of the children they work with. This approach has been used, especially in cases where the target population is considered "difficult" – such as children with autism [8]. While there are additional challenges to working with difficult children as design partners, there are those, ourselves included, who advocate partnering with children with special needs [25, 29]. We have often found that adults who work with children are influenced by the way in which they work with children, and that many times, even given the best intentions, they are thinking of their own needs (e.g., classroom organization, discipline) as opposed to the needs of the child.

An example of the way in which children are able to voice their technological requirements in a way that adults cannot came many years ago. We were given a technology which was a shared surface on which adults could collaborate, intended for office use. In order for the technology to work, users had to sit on a magnetic foam pad for their finger to be recognized on the computing surface. In our effort to redesign the technology so that children could "finger paint" on the screen [21], we quickly discovered that not a single child would sit still when they went to draw on the surface.

These children had been talking for months about Magic Keys for use with computers of the future – keys that could open up treasure boxes and let you play special games. Our team realized that the magnetic pads did not need to be for sitting – they could become magic keys. We mounted the surface vertically and cut the pads into the shape of keys for the children to hold in order to make the Magic Wall work. If users did not hold the magic key, then there would be no magic, and thus, no drawing. Working with these children streamlined our process to quickly come up with a kid-friendly solution to a potentially development-halting issue.

2.2 Assumption Two: Existing power structures between adults and children cannot be overcome

We once asked one of our young design partners to help us figure out how to help adults become better listeners. He was 8 years old and had been a design partner for over a year. After some brainstorming of ideas such as "microphones that help make children's voices louder" and "checking adult's ears" to be sure they could hear, our young design partner grew quiet, wondering if anything on this list could "really work." Finally he simply said, "You just have to be patient with them, since they only know what adults know. But when we're patient you can learn from adults and they will learn, too. We all need to talk together and listen together. Sometimes people have to remember to hear first and then talk" [17, p.8]. This young design partner has taken an issue that concerns many researchers and turned it on its head – instead of adults having to patiently listen to children, he saw it as his job to allow the adults their shortcomings, and to work with the adults despite the challenges. Still, many researchers question whether the pre-existing power differentials inherent between children and adults can be adequately modified to produce a true partnership [42, 58, 59], or if they are simply too socially engrained to be overcome. While we agree that these power issues exist, we would argue that they can be resolved, especially in the context of design partnering. Others have pointed out how important it is to do this, especially in cultures where the power differentials between adults and children are especially pronounced [37]. Overcoming power differentials in any context takes time and specific techniques.

The issue of time is unique to each team. Given the long-term commitment of our child design partners at the University of Maryland, time is a luxury that we have. We find that most children at first are not entirely comfortable with allowing us to change their idea of power structures, but over time, they become comfortable with the idea of the adults on the team as their design peers.

There are numerous techniques that we use to change these perceptions of power differentials, including wearing informal clothing, using informal language, not raising hands to speak, everyone being on a first-name basis, eating together, and sitting on the floor together (see Figure 6) [1, 9, 11, 47,

70]. We also find that during our summer two weeks which kick off our research year, informal fun time together is important for building relationships. We do this through adults and children participating together in activities like playing outside, visiting the campus farm, and participating in scavenger hunts (see Figure 6). These activities, which seem simple, have great influence when undertaken by adults and children together.

Additionally, we "pay" our child design partners with a small technology gift, such as an iPod shuffle or robot dog, at the end of each year [1]. Offering our children the kind of pay that we can, given child labor laws, shows them that they are valued contributors to the group. Other teams have gone so far as to involve children in the grant writing process and to involve them even in decisions on how they will partner with adults [52].

Figure 6 – Changing the power structures between adults and children; left, informal play (scavenger hunt) activities; right, adults and children sit together on the floor

However, the power pendulum can swing too far, and if adult partners are not mindful, the children can end up dictating the sessions. It is quite typical that a new adult who joins our team will be so concerned that the children have a voice in design sessions that they essentially offer no input. This is not the way an intergenerational design team using Cooperative Inquiry should function. As mentioned earlier, one of the most important goals of Cooperative Inquiry is idea elaboration, in which adults and children build on each other's ideas.

There are some roles in Cooperative Inquiry in which adults do maintain typical adult responsibilities. For example, adults on a design team must provide structure to the design sessions and keep sessions on pace to accomplish the design tasks. This means adult design partners must plan the basic flow of design sessions before the children arrive. Occasionally, an adult will need to step a caregiver role, for example if a child needs to use the rest room we will walk into the hallway to ensure they safely make it there and back, or that if two child design partners are clearly not getting along we might need to intervene to help mitigate an argument between a seven and nine year old before feelings are hurt. It is important at any time that an adult is fulfilling these typically adult roles that we maintain our roles as partners – and that we treat children at all times with the same respect we would afford adults.

We do not try to change all pre-existing adult/child relationships, merely the ones that exist in the context of the design process. We have never had a report from a child, parent or teacher where overcoming power structures within our lab has caused a child to behave inappropriately in school or at home. We find that children are able to differentiate between contexts and how to behave differently in different contexts.

2.3 Assumption Three: There are specific characteristics that a child must have in order to be a design partner

One concern often brought up is that child design partners must be academically and/or technologically advanced. Researchers may worry that to be effective design partners, children need to be extremely expressive [48]. We have found that being smart or tech-savvy does not necessarily equate to being able to collaborate well. In fact, it may be more difficult for an academically smart child to collaborate since he or she may have less of a need to do so on a regular basis. As we are situated in a university setting, people often wonder if we work with particularly smart children. We have no such criteria. If we are

looking for any specific characteristic in our design partners, it is to create a more diverse team. Thus, we strive for a rough balance of gender, age, and ethnicity.

For design teams working in schools, museums, or other settings beyond the direct control of the researchers, the idea that certain criteria need to be met in order to be a design partner can be hard to overcome. Often, a school will want to "impress" the researchers by offering only their "best" students as design partners [37]. In our own research, the ability to choose design partners has sometimes been usurped by the school or setting [19], however we do not define a set of preconditions for children other than being able to commit to participating on the team.

2.4 Assumption Four: There is no distinction between informant and design partner

A common question we have been asked is to clarify the difference between the levels of involvement children can have in the design process, most notably the distinction between informant and design partner [10] (see Figure 7).

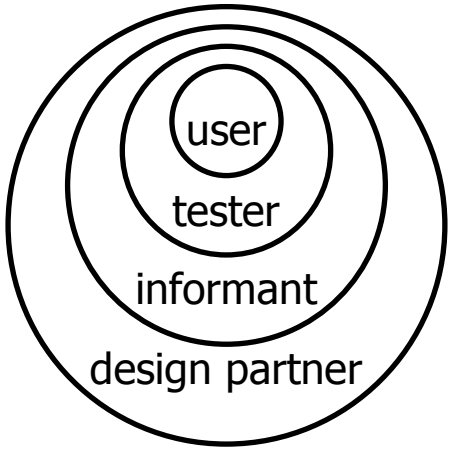

Figure 7 – Design roles assumed by children [10]. This figure shows the increasing involvement that children can have in the design process.

Informant design came to prominence in the late 1990's [59, 60]. Informant design advocates working with children in the design process at specific points during the design process when their input

is considered to be the most valuable [57]. On the other hand, with design partnering, children are involved in the design process at all stages [9]. The continuity of child involvement is the essential difference in the two methods. Informants are called in when their thoughts and advice are needed. Design partners are equal stakeholders throughout the design process. The relationship to adult designers for a child informant is one of having a dialogue, whereas the relationship to adult designers for a child design partner is one of elaboration (Figure 5).

As children who are involved as design partners enter into a long-term agreement, there is time at the beginning of their tenure as a design partner to train them. At any given time, our team includes both new and veteran child design partners. We have found that it often takes months for a child to become true design partner – who understands and can use our methods and techniques, and who is not afraid of offering opinions and communicating ideas.

Some of the confusion in the distinction between informant and design partner likely stems from the fact that though the involvement of the children is different, some of the techniques, such as low-tech prototyping, are the same. Although the technique may be the same, what the child is able to contribute to in the design process may be fundamentally different. With informant design, the goal is for children to have a dialogue with and provide feedback to adults; whereas for design partnering, the primary goal is elaboration, which is a fundamental difference in the underlying dimension of how children relate to adults (see Figure 5) [10]. The role of an informant can be likened to that of a consultant [31], brought in at the time when her input is the most needed. The goal of building the idea together (design partner), as opposed to having a dialogue and then adults going back to work to create the ideas (informant) is quite different. This is not to say one is better than the other, only that these roles of informant and design partner are different.

2.5 Assumption Five: Children come up with ideas that are fantastical – and unusable

We need to value the imaginations of children, because young people can remind us of the obvious and teach us to consider the impossible. We need to empower children to share their ideas in ways that enable adults to truly hear and appreciate what they are saying [10]. Much of what is exciting about design partnering with children are the fantastical ideas that are proposed. Without these cutting-edge, often visionary ideas, our technology process would stagnate. More often than once the adults on our team have been puzzled by an issue, taken it to the design team, and been overwhelmed by the onslaught of obvious solutions the children help us to imagine.

During brainstorming, our teams will often design ideas that we clearly cannot build – for example, a rocket ship with a teleportation device. Part of the process of working with children as design partners is to have creative, thoughtful adults who are able to hear what children are saying and pull out the big ideas that are workable for the technology – all as a part of the elaboration process (see Figure 8) [16]. The key is to realize that it is not the rocket ship or the teleportation that the children thought we could build tomorrow – rather a mobile technology (rocket ship) that could socially network with their friends (teleportation). These underlying truths are often discovered in large group discussions at the end of sessions in which adults and children ask critical questions to each other about designs, such as "Why does it need to be a rocket ship?" and "We can't build a teleportation device by next week. What would be the next best thing?"

Figure 8 – Top, Artifacts from a Bags of Stuff activity; bottom, the big ideas gleaned from group discussion of the low-tech prototypes

Some have voiced concerns, as a premise rather than a conclusion, that technology created through the intergenerational design process is not carried to fruition nor is the resultant technology better than it would have been without the input of child design partners [38, 45]. While we cannot prove empirically that the resultant technology is "better", over the years of working with child design partners, our design team has produced numerous and varying types of technology. Together, we have explored making new storytelling worlds [2, 46]; travelled to new outdoor places with mobile technologies [7]; taken new digital library journeys [11, 33]; and built bridges between children from different cultures [40].

2.6 Assumption Six: The children involved in design teams are limited representatives

We are often asked how so few children can represent the needs of all children. People worry that the input given by children will be skewed to the specific children involved in the process [48]. We believe this to be no truer of a team using Cooperative Inquiry than with any design team, made up of adults or

children. We strive to recruit children who are diverse in socioeconomic status, gender, ethnicity, and age, in order to gain the most diverse views possible when designing, as we also do with adults.

Additionally, we feel that the issue of generalizability is misplaced in reference to child design partners. The children we partner with are design partners – not testers of technology. Though we strive for diversity in both adult and child design partners, a statistically representative sample is not necessary for the design process. Ensuring a representative sample is necessary for instances when we are empirically testing a product [13], not for when we are designing. We do, however, sometimes find the need to consult with a larger group of children than our design partners. At that point, we ask other children to participate as users, testers, or informants [10] to supplement the work of our design team.

Another issue that has been raised is that once children are trained as design partners, they may no longer represent the views and needs of children as a user group [65]. Over the years of working with children to become design partners, we have found that design partnering does not fundamentally change who children are or their world views. They still care about the same things that they cared about before – but now they have the skills and tools necessary to communicate their wants and needs as designers and as a part of a team with the power to create technology.

2.7 Assumption Seven: Design teams need to follow the Cooperative Inquiry method exactly to be successful

Cooperative Inquiry is a method that can be applied in many different design situations. While teams have different resources (e.g. time, funding, access to children), we believe that most teams can use and benefit from using some part of Cooperative Inquiry. Certainly many factors need to be taken into account when choosing how best to work with children in the design process, including time and funding available [29], however, others have found the costs of participatory design in certain situations to be modest [66]. It is important to remember that at its core, Cooperative Inquiry is a method made up

of a collection of techniques used in conjunction with a philosophy of partnership and elaboration. Not all techniques must be used by all teams, and all techniques can be adapted and modified to best fit for a team's specific needs. As explained in the initial Cooperative Inquiry paper, "These techniques do not necessarily offer a magic formula for working with children, but rather a philosophy and approach to research…" [9, p. 594]. Numerous researchers around the world have design partnered with children in varying ways to best meet their needs. Some use an overall "scaled-down" model of Cooperative Inquiry [67]. Others adapt it to a context other than a university lab – such as a museum [58], school [42, 50], or field trips [38]. Other modifications include changing the adult to child ratio [43, 50], and time of day [42]. Cooperative Inquiry is a widely applicable method that allows children and adults to work together to design technology.

2.8 Challenges of design partnering

While we believe in the value of partnering with children, at times these techniques can be difficult, time-consuming, and even frustrating. More than one of our sessions has included yelling children and frustrated adults. However, more often than not, we walk away with a surprising idea that could have never come from just adults or children.

There are incontrovertibly challenges inherent in design partnering. Schedules must be accommodated – not only those of school age children with other extracurricular activities, but also of graduate students, staff, and faculty members trying to balance research, classes, and other responsibilities. As mentioned earlier, the time it takes for a child to become truly comfortable as a design partner can often be a matter of months. During this time, children may be less likely to offer insightful ideas in the design process. Time and longevity are vital – we have rarely found a child who walks through the door on day one and is ready to participate as a full-fledged design partner. They need time to learn the method and its techniques and to get used to the process.

Likewise, there is a learning curve for adults in becoming design partners. Over the years, our team has included adults from a wide range of fields. We find that there tend to be field-specific challenges for adults in learning to design with children. Educators need time to get used to the idea of working with children as opposed to teaching to them. Computer scientists and engineers often need time to learn how to talk with children. Given time, most adults who are invested in producing quality technology for children and who believe in the process can develop into effective design partners.

3.0 Design Partnering Today and in the Future

Through the years, we have continually modified, extended, and expanded the Cooperative Inquiry method as contexts and times change. Together with our child design partners, we have created technologies we believe were developmentally appropriate for the children of their time. These technologies range from storytelling robots [47] to online digital libraries [14]. Fifteen years into designing with children, we see that the children of today are no longer the children we began design partnering with before the turn of the 21st century. While today's world poses new trends in designing with and for children, it is important to note that the underlying roles that children can play in the design process have not changed, rather, the underlying dimensions of roles are expanding due to new technologies and contexts.

We find that there are four salient characteristics of children today: they are internationally aware, independent, interactive, [12] and information active. As technology and progress continue to shrink the world by making it more accessible, and as children are becoming more internationally aware, there is a need to partner with children across the country and globe including what is considered as the developing world. Today's children's independence can be supported by designing for mobility. Social computing addresses the interactive nature of today's children. Finally, the information activity of today's children begs us to address the ubiquity of search. In this section, we look at each of these in

turn, including considerations and guidelines for how to design with and for children given each characteristic.

3.1 The Shrinking and Developing World

As children grow up and ultimately enter the workforce, they will find it necessary to collaborate and communicate with their peers not only in their immediate physical workplace, but also in the global workplace. Children are becoming aware that not all people are equally advantaged – not only in their own country, but around the globe. Therefore, partnering with children who are far away and in part of the developing world is important to encourage our children's empathy, community, and future well-being. Our efforts to engage in distributed design in our own research include partnering children across the country and the globe in our digital libraries research, as well as with the United Nations Children's Fund, which works to advance children's rights internationally (http://www.unicef.org/). We have worked in the area of the developing world in working with the People in Need Website which connected children in American with children in Haiti [20].

3.1.1. Considerations for Design Partnering with Children in the Shrinking and Developing World

The immediate issue in design partnering with children in the shrinking and developing world is how to do it. The initial Cooperative Inquiry techniques were developed with the assumption that all researchers, child and adult alike, would be physically co-located. Working with partners halfway around the world adds to the dimension of a child's relationship to developers – we no longer need only to think about the kinds of interaction that children will have with adults, but we also must consider partner location which can range on the continuum from co-located to entirely distributed. Furthermore, we should consider whether our partners are in developing or industrialized countries, and what this means for their access to technology, both socially and physically.

In designing with and for children in the developing world, there are practical considerations to manage. We need to be more hardware agnostic and consider accessibility and per device cost. Additionally, deployment matters [14]. The ability to get technology into the hands of children cannot be overlooked. It is our belief that the HCI community should consider the immediate impact of what we develop on users today. We must also consider technology, latency, and maintenance problems as the developing world has different issues in technology than the industrialized world. Finally, designers must consider more than just the technology. The politics or social impact of getting people to use what we are creating can often be challenging. We must make changes in what we are creating based on these considerations.

3.1.2 Guidelines for Design Partnering with Children in the Shrinking and Developing World

In partnering with children in distributed locations, we have found that updating some of our techniques made it possible to engage in distributed co-design. The technology available to researchers today enables us to overcome the geographical distance that may exist between partners. We have found that even in emerging countries, we may be able to locate the technology we need to support this kind of collaboration.

A technique that we have found useful when working with groups that are geographically disparate is to design online. Our team has created a tool to support distributed co-design, DisCo [69]. Using an easy-to-understand interface that runs on computers with access to the internet, DisCo supports asynchronous co-design in which child and adult design partners may be geographically non-co-located. The eventual goal of DisCo is to connect children across the globe, including those in the developing world.

3.2 Mobile Technology

Mobile devices – including cell phones, personal digital assistants, and now tablets – are inundating the world [24, 34]. According to one estimate [34], on average, more than four of every five people worldwide have access to mobile phones. In the United States, approximately 87% of adults have a cell phone, and of those 46% have a smartphone [51]. With this proliferation of mobile devices, children are using them more often [26, 68]. Almost three quarters of the top selling apps in the iTunes store are for pre-school or elementary-aged children [62]. Parents are upgrading their mobile devices and giving their old technology to their children to play with [71]. Beyond the wide accessibility of mobile devices, these smaller devices are more natural for young children as they can more readily be used while in motion – and most children are active. Physical movement and play involve mobility, which are inherent characteristics important for the social and cognitive development of young children [32]. Indeed, mobile devices are becoming an even more integral part of the lives of adults and children.

3.2.1 Considerations for Designing Mobile Technology

While designing mobile technologies for children, there are a few considerations that need be made. First, mobile device usage is generally spontaneous for short bursts of time [57]. Rarely are mobile devices used for hours on end, instead, they are used for short periods of time to look up an address or phone number, send text a message, check email, or play a game. Mobile technologies can interrupt users as these several of these provide alerts which can distract the user from other tasks and compete for attention. We call the interplay between the virtual and physical worlds *Digital/ Physical Switching*. We do not see this trend in technology use as inherently good or bad because we are still learning about its impact on a child's world. What we can say is that it is something we only minimally saw in the early days of computing because children were stationary at desktop computers, tethered to mice and keyboards. We expect as mobile technologies become even more common than traditional computers,

more Digital/Physical Switching may lead children to more multi-tasking in learning and social situations.

3.2.2 Guidelines for Designing Mobile Technology

Mobile devices can be used in many contexts. Because of the importance of context, mobile technologies should be designed in the context for which they are intended. For example, in designing technologies for field trips, we found it necessary to have children not only use these systems outside of a laboratory setting, but also do design activities within that outdoor setting [7]. Since technologies will be used in a real-world environment, evaluation of technologies should be in their native context. Traditional lab usability tests miss the richness and chaos of a real-world setting [56]. Lastly, mobility should be viewed as a purpose and not just a feature of a particular device. Most mobile technologies have the added benefit of being easily carried by a child from place to place. By instilling a reason for the child to use the device in real-world context, these devices can encourage active learning. For example, a mobile collaborative story application [22] can spur children to explore their environment and encourage exploration, elaboration, and learning. Such an application has the purpose of mobility – where children must be moving to make the best use of the application, instead of simply being able to carrying their device wherever they go.

3.3 Social Computing

Many technologies today, for children and for adults, focus on what we think of as social computing – that is, technology that brings people together. There are many forms of social computing. Online, people are brought together through online social sites like Facebook. Physically, people can be brought together using mobile devices designed to encourage collaboration. We must consider all types of social computing – virtual and physical, collocated and disparate, when designing for today's children.

3.3.1 Considerations for Social Computing

When designing for social computing, we should keep in mind whether the resultant technology is intended for co-located or distributed use. Even though we believe that social computing can be fun, motivating, and possibly even educational, when designing online environments for children, we must be mindful of their safety. Children are inherently social beings and enjoy interaction, sometimes leading to divulging of inappropriate information. At the same time, we need to be respectful that children are important and self-aware, and often want to be in control. Walking the line of keeping children safe and allowing them the necessary freedom and challenge to grow in online social situations is an important consideration.

Additionally, we need to remember that not all of children's collaborations involving technology are with other children. Intergenerational collaboration occurs often around technology – with a father showing his daughter a new app for finding sports scores on the iPhone, to a grandfather reading a story online with a grandson. These intergenerational interactions offer opportunities for growth for both partners. Finally, as mentioned earlier, we must not always think of the virtual and physical worlds as entirely separate. They have already begun to overlap, in technology such as Webkinz, where a technologically-enhanced stuffed animal has another life online. The popularity of social computing applications that encourage an interaction between the virtual and physical world will continue to grow.

3.3.2 Guidelines for Designing Social Computing

In designing social computing applications for children, there are some guidelines we should remember. Finding an appropriate setting in which to observe a child interacting in social computing is difficult. If we bring children into a lab setting, we more than likely change the manner in which they interact with the technology. A child on his bed at home with a laptop is likely to have a different comfort level and different behaviors than one asked to sit in an adult chair in front of a desktop at a lab. As much as

possible, when gathering design requirements for social computing, we should be venturing out into the child's world, rather than forcing them into ours.

Additionally, the design process should reflect the eventual product. For example, when designing products to encourage non-co-located interaction, researchers should consider online co-design such as DisCo. Likewise, if a product is intended to support intergenerational interaction, then participants of each age group should be involved in the design process. Finally, and most practically, we should be mindful that co-design for multiple devices is hard to deploy. It is ideal to have the same number of devices as designers – which is not always possible, especially in the early prototyping stages. This can be ameliorated by using low-tech design techniques as much as possible at the beginning of the design process.

3.4 Ubiquity of Search

Today, children are often online. Rideout et al. [54] report that 84% of children between the ages of 8 and 18 go online at home. Extending beyond the home, Lenhart et al. [44] report that 95% of children between the ages of 12 – 17 go online in some setting. Children today search the internet, and expect to find a wealth of information. The kinds of searching that children do varies greatly [23], from simple searches at home (i.e. searching for game sites) to complex searches at school (i.e. composing a paper over the course of a few months). Given this ubiquity of search and the variety of search tasks, it is important that we think of children as we design search engines for them – not only remembering the developmental and cognitive levels of children, but also thinking of the whole child including the social and affective implications of search design [4, 23].

3.4.1 Considerations for Ubiquity of Search

Children enter queries into search tools such as Google in natural language, as questions, and less frequently, as keywords. While search engines have gotten better at handling the varied queries from

children over time, they cannot handle complex searches that require breaking a search apart into smaller pieces [23]. Once past the keyword search, children often find results pages challenging [23. 35] having difficulty discerning that results are clickable [35], knowing which sources are reliable, or having the required reading proficiency to understand the website snippet provided [23]. Therefore, when designing search engines for children, researchers must pay special attention to the results pages and ensure that they are navigable, understandable, and usable by children.

Finally, we should consider that most searches no longer occur within a self-contained information space. In the past, children's searches involved mainly finite data sets, such as those included on a CD encyclopaedia or DVD-Rom [41], or on preselected category search sites, such as Yahooligans! [5]. Today, children routinely search the internet with its boundless available information.

3.4.2 Guidelines for Designing for Ubiquity of Search

Due to the pervasive nature of the internet and search engines for children, using finite data sets is no longer an optimal way to design and research. In the past, creating small data sets simply for the purposes of research was valid. However, as children today search tremendous amounts of information on the internet, in order to understand how children search and filter results, it is imperative that they are working with authentic available data.

When designing for the ubiquity of search in our own foray into studying children's search practices on the internet [15, 23], we discovered that in-context design and testing is crucial. Children search in their home or school environments, not in contrived lab settings. Rideout [54] reports that youth are more likely to go online at home (57%) than at school (20%) or other places such as the library or friends' homes (14%). Their performance at home is necessarily affected by all of the distractions inherent in daily life – just as it would outside of the study context. Therefore, working with children in their natural environment(s) is imperative to guiding real-world design. Finally, industry is

listening. Our partner for our search engine study is Google. They are invested in providing children with optimal search engines, and it is our job as designers to investigate how to do this.

4.0 Conclusion

Over the years, through our research we have both created new technologies for children [7, 11, 46] and developed new ways to work with children in the design process [21, 28, 69]. Today, we continue our efforts in collaborating with young people, pushing the boundaries of designing technologies with and for children. Today we need to consider design partnering with all children, including those in the developing world. Today we need to consider design methods that can support the design of mobile and social technology, that support the endless curiosity of children as they search for what matters. We feel that Cooperative Inquiry fulfils these needs as it meets its original goals and intents and as it continues to expand and evolve.

Acknowledgements

This paper, and in fact all of our work, would not be possible without the help of our child design partners, to whom we are forever grateful. We thank our numerous adult design partners who work tirelessly with those child design partners. Thank you to our colleagues Juan Pablo Hourcade, Franca Garzotto, and Beth Foss for insightful comments and feedback on early drafts and ideas for this paper. In addition, there have been countless organizations that have funded our work over the years and to each and every group we are thankful. In particular, we would like to acknowledge the National Science Foundation, the Institute of Museum and Library Services, the World Bank, Microsoft Corp., the National Park Service, Discovery Communications, and Google.

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