Gains from Participatory Design Team Membership as Perceived by Child Alumni and their Parents

Brenna McNally[1], Matthew Louis Mauriello[2], Mona Leigh Guha[1], Allison Druin[1]
Human-Computer Interaction Lab
College of Information Studies[1]; Department of Computer Science[2]
University of Maryland, College Park
{bmcnally, mattm401, mguha, allisond}@umd.edu

Figure 1. Adults and children working together on a PD team to prototype children's technologies. **Far left:** Paper prototyping a web-based survival game. **Middle left:** Using mobile devices and paper mockups to iterate a history game. **Middle right:** Presenting paper mockup ideas for a mobile mental health application. **Far right:** Presenting 3D prototyped ideas for a virtual reality game.

ABSTRACT
The direct gains children perceive from their membership on Participatory Design (PD) teams are seldom the focus of research studies. Yet, how HCI practitioners choose to include children in PD methods may influence the value participants see in their participation, and thereafter the outcomes of PD processes. To understand what gains former child members of a PD team perceive from their participation we conducted a two-part study. In Study 1 we surveyed and interviewed child alumni of a PD team to determine gains that are perceived first-hand. In Study 2 we obtained a secondary perspective by surveying and interviewing parents of alumni. We report on the perceived gains to former participants that were identified and described in these two studies—including *collaboration*, *communication, design process knowledge,* and *confidence*. We reflect on our findings through discussions of the continued applicability of gains, new opportunities, and implications for PD practitioners and methods.

CHI 2017, May 06-11, 2017, Denver, CO, USA © 2017 ACM.
ISBN 978-1-4503-4655-9/17/05...$15.00
DOI: http://dx.doi.org/10.1145/3025453.3025622

Author Keywords
Children; Participatory Design; Co-Design; Gains; Participant Perspective

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous;

INTRODUCTION
Participatory Design (PD) is a design approach used in HCI research that provides practices and techniques to actively include users throughout the technology design process [21,36]. PD researchers have been motivated to involve diverse populations as active partners in the design process, expanding the possibilities of new ideas for innovation. This inclusive approach to developing new technologies also results in the development of new PD methods that specialize in facilitating feedback from specific populations— such as the elderly [17,30], persons with special needs [18,4,33], and children [14,24,28,42]. In the case of children, whom our research focuses on, not only have numerous new technologies been developed [9,37,39,40] but there has also been a need to design new PD techniques [12,23,35,44,45] that support the full inclusion of children in the design process. However, while the benefits HCI practitioners receive from working with children in PD can include developing more child-centric interfaces, spending less time on testing after a technology is developed, and finding surprising new innovations [36], research is less clear on the gains to child PD participants.

There has been some discussion within the research community on the indirect benefits to child PD participants: for instance, that they have contributed to a better technology, or that their voice has been heard in the design of a technology that they, as a member of the user group, are meant to use [7]. In addition to remaining aware of indirect benefits, there is a need to assess what direct gains may exist for the youth who are involved in PD. Specifically, if we uncover the benefits that youth on PD teams experience we can improve existing design techniques and devise new techniques that better support their paths to innovation. This could lead to better design recommendations from the PD process. In addition to potential improvements to the process, developing an understanding of participant gains would advance our community's ethical ambition to go beyond "preventing harm" to participants, as promoting direct gains builds upon themes that are central to PD: attention and care for users [8], mutual learning [2,7,25], and core PD values of democracy, emancipation, and quality of work [21,36].

In response to these potential benefits from PD processes, studies that aim to identify the direct gains to PD participants have emerged [7,8,19]. However, research has yet to determine what gains persist over time from the perspective of child PD participants. Understanding the gains resulting from children's participation in PD could be of mutual benefit to both researchers and child participants. Our work attends to the gains that child PD participants experience in an effort to 1) improve the PD process and PD techniques, 2) create better technologies from this improved process, and 3) enhance participant-researcher relationships. Perhaps most importantly, our efforts to shed light on the long-term effects of children's participation on PD team are grounded in the philosophy that PD activities should be *"meaningful within themselves"* [2, pg.167].

In this work we seek to understand what meaning former participants derived from their involvement on a PD team that has been active since 1998. We ask, "*What gains, if any, do former child participants and their parents perceive from children's involvement on a Participatory Design team?"* We address this question through an examination of the perspectives of child participant alumni and their parents, captured through surveys and interviews with both groups. In Study 1, we surveyed twelve former child participants of a PD team with 1-5 years experience on the team, and six were further interviewed. In Study 2, seventeen parents, who cumulatively had 21 children participate on the team, were surveyed and four participated in follow-up interviews. In this way we obtained two distinct viewpoints on gains to children from participation on a PD team: 1) the removed, and in some cases adult, views of the persons who personally experienced gains, and 2) the views of parents who could observe changes in the behaviors and attitudes of their children outside participation on the design team.

The results of this work uncover direct gains that child alumni and their parents perceive from participation on a PD team, including *collaboration*, *communication, design process knowledge,* and *confidence*. We also discuss the continued applicability of gains to child alumni, new opportunities, and the implications of this work for PD practitioners and methods.

BACKGROUND AND RELATED WORK

We first provide a background on how PD has been adapted for use with children and on the specific PD team discussed in this work. We then review previous works that have investigated participant gains from PD activities.

Participatory Design with Children

Participatory Design offers a set of practices and techniques to involve end-users of a technology a role in actively designing it [36]. Originally conceived in a democratic movement to give Scandinavian factory workers a role in designing technology they would use on the job [5,21,36], the success of PD has led to its extension beyond this sociopolitical context. PD is now used to design technologies with other user populations as active participants in the process, such the elderly [17,30,], persons with special needs [18,4,33], and children [8,15,28,42]. It has also inspired methods such as co-design; while the term co-design is sometimes used synonymously with PD, the co-design subset of PD differs in that it does not assume any one stakeholder's views or input are more important than another's [6]. Co-design methods involve children to surface the desires of these young people [15]. During co-design sessions, techniques are utilized that have been adapted to support design input from children (e.g., the *Bags of Stuff* 3D prototyping technique, the *Big Paper* paper-prototyping technique) [45].

Methods of PD with children differ in the degree of participation requested from children. Informant Design, for instance, allows for many children to participate in the design process for a relatively short period of time, giving other stakeholders feedback on the work being developed at critical points in the design process [41,42]. The method of Bonded Design goes a step further, and involves an intensive, intergenerational partnership between adults and children built on the belief that children should be included in the entire design process [28]. In Bonded Design, the team works on a single project over the course of several weeks. Similarly, within the Cooperative Inquiry (CI) method, children and adults work closely throughout the entire design process. However, CI requires a high degree of participation from children, that of a design partner (Figure 2) [15]. In the CI method, which most closely follows the co-design subset of PD, children participate on the design team for an academic year and work on numerous projects, and can choose to participate for multiple years [24]. This work is situated within the context of a CI team, further described below.

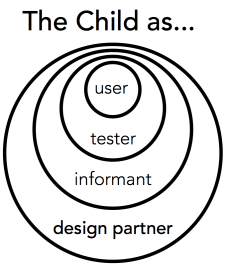

Figure 2. The relationships between the roles children can have in the design of technologies for children [15].

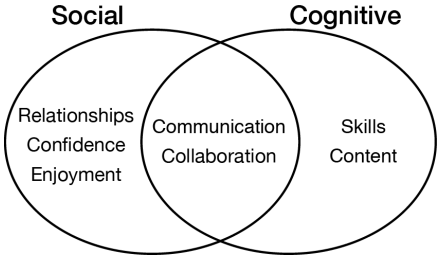

Figure 3. The social and cognitive experiences of child design partners [22].

Kidsteam History

This work discusses a CI team called Kidsteam, which has met at the University of Maryland's Human-Computer Interaction Lab since 1998. During Kidsteam design sessions, 6-8 children ages 7-11 work with adults from diverse disciplinary backgrounds as design partners to design technologies for children. These 90-minute design sessions are held twice weekly throughout the academic year, and are preceded by a two-week summer program where the team learns design techniques and how to work together. At the end of each year, child participants are given a $100 budget to spend on a technology gift of their choice (with parents' approval), and have in the past selected items such as e-readers, robot dogs, and mini-drones, which they receive at the team's annual party.

Throughout the program's 18-year history, Kidsteam has worked on a wide variety of projects for academic, industry, and nonprofit groups. Projects have ranged in content area from educational to entertaining— such as second language learning [32], STEM topics [1,29,37], and interactive theatre [40]— and across platforms— including mobile, tangible, wearable, and web applications. There are currently 60+ Kidsteam child design partner alumni, and many former child members are now adults (18+ years old).

Gains from Participation in PD Projects

While much of the literature concerning PD involves the technological or design process outcomes of PD work, recent years have seen an increased interest in the gains of different stakeholders on PD teams. Most notably, two studies by Bossen, Dindler, and Iversen and a third by Garde et al. specifically analyze the "gains" of participants on PD teams [7,8,19]. In each of these studies, differences in gains from participation are discussed across different stakeholder groups. Through retrospective interviews investigating the long-term gains that four distinct participant groups—students in their teens, teachers, administrators, and a politician—Bossen et al. reported that:

> *"In this case, interdisciplinary communicative skills, knowledge, and experience with new technology, linked to their professional practices, were amongst the gains" [7, p.149].*

Similarly, Garde et al discussed how most of their PD participants exhibited gains in the areas of technology learning, insights into work practices, feeling heard, and having a generally positive experience [19]. While gains of interdisciplinary, largely adult, PD teams have begun to receive attention, the gains of youth participants have received less attention, which our work begins to address.

Frustrations Impeding Gains. While participatory environments may foster gains from PD activities, conversely an environment that is rife with frustrations may obstruct gains. In looking at impediments to user gains, Bossen et al. identified three frustrations that seemed to impede gains: unresolved differences between aims, absence of a clear set-up for collaboration, and different conceptions of technology [8]. Despite the frustrations on the project, participant gains included technology access and cross-professional networking [8]. With regard to this work, while frustrations were discussed during participant interviews, and exist within PD with children [22,31], moving beyond identifying participant frustrations into a deeper understanding of how child frustrations impede gains is outside the scope of this work, which focuses on the identification and description of gains.

Gains of Children Who Participated on PD Teams

Despite seldom being the focus of research studies, gains to children can nonetheless be found throughout discussions and observations made by researchers in their descriptions of PD studies. Among the most commonly observed gains of child participants of PD teams are the related dimensions of collaboration and communication. Collaboration skills are a foreseeable benefit due to the nature of working on a design team, where the development of designs and prototypes requires collaborative efforts between team members [15,16]. Similarly, researchers describe how increases in communication skills, which generally emphasize children's ability to share their ideas during a collaborative design process, occur both between children [3] and between children and adults [26]. Another observed gain is content knowledge, as child designers are introduced to content knowledge that is relevant to design challenges. For instance, children designing a mobile application that incorporates thermography may gain content knowledge about heat transfer. Researchers acknowledge this fairly

often, both in regard to broad content learning [14,34] and learning curricular units in schools [3]. Additionally, as design is largely about solving problems, being part of a PD team may also help develop children's problem solving abilities [27]. Finally, a less specific gain to participants that researchers have noted is an increased understanding of technology through increased exposure to it [14,20,34]. While fewer researchers describe other participant gains from involvement in design processes, it is important to identify all areas that may be significant from the perspective of child participants. These less frequently cited benefits include designerly-ways-of-knowing (e.g., tackling ill-defined problems) [10], creativity [27], and fun [28].

In contrast to these works, whose primary concerns were outside the gains of their participants, two studies have discussed gains to child participants more directly. A study by Hansen & Iversen discussed the motivating factors of teenagers that participated in a PD project, and found motivations that included direct gains, such as encouragements (e.g., awards, lunch) and being endorsed as experts (e.g., respect, recognition) [25]. Work by Guha investigated the impacts that participating on a PD team had on children over the course of a year of participation [22]. Through observations of the children, artifact analysis, and interviews with the children and their parents, Guha uncovered impacts on child design partners in the areas of social and cognitive skill development (Figure 3) [22]. The next challenge—and the purpose of this study—is to return to former child PD team participants and their parents and discover what, if any, impacts of participation are perceived as gains after participation has ended.

STUDY 1: CHILD DESIGN PARTNER ALUMNI

To investigate the potential gains participation on a PD team can afford child participants, we conducted anonymous surveys with alumni of Kidsteam followed by interviews with a subset of survey participants. This work is part of a larger study, the first phase of which reported on the ethical implications of these surveys and interviews [31]. The method and analysis for the alumni data, while described in [31], are also described below.

Method

In Study 1, surveys and interviews were conducted with child participant alumni. The open-ended survey questions and interview transcripts were qualitatively analyzed.

Surveys

Participants. Child design partner alumni were recruited for an anonymous, online survey. Parents of the 56 eligible alumni were asked to forward a recruitment email to team alumni. Outdated contact information (e.g., defunct email addresses) prevented us from contacting approximately 23% of parents. A total of 12 alumni (3 male, 9 female) completed the survey. Their involvement on Kidsteam began between 1998 and 2013 and lasted for an average of 2.3 years (*SD*=1.3). Participants left the team an average of 6.4 years before the study (*SD*=4.1).

Procedure. The online surveys were distributed in spring of 2015 and were designed to take no more than 15 minutes. To begin the survey alumni had to indicate consent or, if under age 18, have a parent consent to participation and read an assent script to the alumni participant. The survey included open-ended, short answer questions as well as closed, 5pt likert-scale questions. Questions reviewed general experiences with the team, team relationships (e.g., respect), and topics related to participation (e.g. whether participants believed their ideas and opinions were important to the team). Participants were not compensated.

Interviews

Participants. Participants were recruited from those alumni who stated they were interested in being contacted for a follow-up interview at the end of the online survey. Of the seven volunteers, the six who best represented a range of years of participation, time since participation ended, and gender (one male, five female) were interviewed in fall of 2015 about their experiences and expectations. Participants were members of Kidsteam for an average of 2.0 years (*SD*=1.1), began participation on Kidsteam between 1998 and 2012, and three were currently adults (age 18+).

Procedure. The semi-structured interviews with child design partner alumni lasted 34 minutes (*SD*=16.8) on average and were held either on the University of Maryland's campus or via a videoconference (e.g., Skype). Interview questions began broadly (e.g., *"Tell me what it was like to be part of Kidsteam."*) and later included questions about areas of interest defined in the literature (e.g., positive/negative experiences, ability to participate). Participants did not receive compensation. Parents could be present during interviews with children under age 18 as long as they agreed not to engage in the interview. Participants consented and, as appropriate, assented to audio recording, which were transcribed for analysis.

Analysis

Our primary analysis consisted of qualitatively coding the open-ended survey question responses and the interview responses, which are supported by results of the likert responses where applicable. Following a method of coding prescribed by Straus and Corbin [35], a researcher began the analysis by open coding all responses to the open-ended survey questions. These data were then iteratively categorized through two coding checks with three members of the research team. An initial codebook was developed through combining the results of the coding checks with ideas drawn from research literature. The initial codebook contained 23 codes and their definitions, grouped under eight categories: *Relationships*, *Projects, Incorporation of Ideas*, *Security and Consent*, *Fun*, *Knowledge and Skills*, *Confidence*, and *Social Interactions*. The codebook went through an additional coding check with the research team to refine and clarify codes, resulting in 20 codes within the eight categories. The refined code set and definitions formed the final version of the codebook.

Inter-Rater Reliability was then computed between two researchers on a random selection of 20% of the short-response survey data and two randomly selected, transcribed interviews, coded at the sentence level. Researchers achieved a score of .92 using Cohen's Kappa, as calculated within NVivo software, considered *almost perfect agreement* (range: .81 to .99) [43]. Having reached agreement, one researcher independently coded the remaining open-ended survey response and interview data.

Findings

In this section we present findings on child design partner alumni's perceptions of the gains they received from their participation on a PD team and issues that may relate to gains. Quotes in this paper represent themes from the data, and are identified by participant group (i.e., A for alumni, and later P for parent), data source (i.e., S for survey and I for interview), and participant number (i.e., 3). For example, the third child alumnus to respond to the survey is identified as "AS3." This section begins with the results of an initial survey question about whether gains existed, and then goes on to detail the gains participants described in the entirety of their surveys and interviews.

Initial Responses on the Existence of Gains

Survey respondents were initially asked a binary question about whether they had learned anything from their participation on the team, with most (10) answering *yes*. One participant abstained from answering this question and another responded *no*. When the 10 survey participants who answered *yes* were subsequently asked a short-response question about what they learned, they described learning about design processes (9) (e.g., synthesizing ideas, brainstorming), conveying their ideas (4) (e.g., presenting), domain knowledge (3), and that their opinions mattered (3). These responses, in addition to other gains that participants described throughout the entirety of their surveys and interviews, are elaborated upon in the following sections.

Communication

Improvements to their ability to convey ideas to other people, including giving presentations, were observed by half of the interviewed alumni (3/6). These participants described how their ability to communicate with non-peers improved— both communicating with adults as a child or, in one case, communicating with children now that the participant is an adult. One of the interview participants described how presenting helped her overcome feelings of shyness, as being able to rely on her teammates to present with her created a safe space to learn how to communicate her ideas: *"One thing that helped was being in a group and presenting. I didn't always have to talk independently"* (AI1). Survey responses by some (2) alumni re-iterate the ideas that participation on the PD team helped them to, *"express my ideas to other people without feeling afraid"* (AS8), and to communicate with non-peer groups:

> *"I learned how to present and convey my ideas more effectively. I also think it helped me in my interactions with adults and expressing my ideas and concerns to them" (AS2).*

Collaboration

Collaboration skills, specifically the ability to work with teammates to produce and evaluate prototypes, were among gains noted by half of the alumni participants (5/12 survey, 4/6 interview). As participant AI6 described:

> *"I think the most important thing I gained from Kidsteam was working in a group. …You had to work and learn how to mix people's ideas and make new things from that, and not overpower the group."*

This participant also went on to describe how this applied to current schoolwork, stating: *"They make me work in groups in school, so it's helpful to know how to not [only] be a leader but to help move the group forward which is what I felt like I did in Kidsteam."* Similarly, another participant described working with the group as a safe space to produce and combine ideas, *"Being able to give equal amount of support in designing something as the next person, and having those ideas be listened to without the fear of discrimination"* (AS10). In addition to mixing and combining ideas to make a single design prototype, collaboration was discussed in terms of facilitating brainstorming: "*Even if my thoughts were not used directly, all of the ideas bounce off each other and spark new trains of thought"* (AS3).

Confidence

During discussions about their experiences on the team, most alumni interview participants (5/6) described an increase in their confidence (i.e., their ability to handle design tasks) as being interrelated with impacts on self-esteem (4/6) (i.e., how they felt about themselves as a person). More specifically, alumni realized the *value of their opinions and ideas* (5/6), especially when working with partners outside the university, such as the White House: *"When we went to the White House I realized [our ideas] are probably going to be affecting the whole country"* (AI2). These ideas were reflected in the survey responses, through comments such as, *"I learned that my opinion mattered"* (AS1), or another participant who noted that, *"My ideas do matter as a child"* (AS3).

Material Benefit

Alumni participants described the benefits of receiving the end-of-the-year gift. When asked what they believed the purpose of the end-of-the-year gift was, survey participants (12) described it as: a thank you (6), a reward for hard work (3), a way to attract new members (3), and a way to inspire kids with technology (2). Interview participants (2/6) described how choosing technology gifts they wouldn't normally receive was motivational:

> *"[There was] the prospect of getting this thing at the end of the year when I was at a point in my life when other people are deciding what I would get. Ram sticks so I could play Lord of the Rings, Battle for Middle Earth?*

There was no possible way I could have gotten that besides Kidsteam" (AI5).

Participant AI1 similarly described the end-of-the-year gift: "*It was a $75 parrot robot. This was the most extravagant thing I ever owned... I remember thinking that it was something that we could have created at Kidsteam."*

Design Process

Design process knowledge was one of the most common gains expressed by both survey participants (12/12) and interview participants (6/6). Alumni discussed the design process in three primary ways: 1) the design techniques that were used, 2) having new problem solving skills, and 3) insights into the complexity of the design process.

With regard to the design techniques used in the sessions, when referring to the Big Paper technique AS1 described how, *"I learned… it is also possible to draw something on a piece of paper and have it show up as a game on the computer."* Certain techniques were favored over others, as with AI1 who, *"hated journaling with a passion"* but, *"love[d] Bags of Stuff more than anything."*

Alumni also spoke about their understanding of design processes in terms of having new strategies to solve problems: *"I learned how to approach problems differently"* (AS6). Participant AI4 expanded on this idea, stating, *"It's not exactly like I could tackle problems I normally couldn't, it's about having a different strategy to solve the problem."* This ability to address problems in a different way applied to current creative interests and schoolwork of alumni. For example, participant AI4 described how creativity learned from Kidsteam helped with *"art and fiction writing"* that was done for fun, while Participant AI3 described how using design techniques learned on Kidsteam helped with schoolwork:

"When I'm doing a craft for a school project I kind of use the designing techniques that Kidsteam taught us. And also, I'm going to be taking Robotics Class. I'm pretty sure that's going to start helping. Even though we didn't really work with robots [on Kidsteam], the design factor is still there."

Finally, alumni described how they navigate the complexity of designing technologies. In the words of AS3, part of the responsibility of being a designer is considering how technology will, *"work with many people"* and how designers, *"have to consider many points of view."*

Career Direction

The three alumni interview participants who were currently adults (age 18+) each described how their history with adult members of the PD team influenced their career paths. These alumni described how they had re-contacted adult design partners who were currently working with the team, and how these adult design partners had directly influenced the alumni's job prospects through helping them obtain internships and job opportunities. Two alumni participants also described how Kidsteam influenced their undergraduate course selection, such as participant AI5:

"Now I'm studying CS, trying to figure out how to take as many design classes as I possibly can… I don't think I ever would have gotten close to that career path if I hadn't been in Kidsteam, but that's definitely the stuff that Kidsteam does, and it's what I'm hoping to do."

Factors Influencing Gains

Alumni participants discussed a number of factors that may influence the prevalence of gains or their ability to report gains from their participation on a PD team, including enjoyment, frustrations, and recall. As was also discussed in the first piece of this larger study, all survey participants (12/12) found the experience to be enjoyable [31], describing it as *"fun"* or *"very cool."* Participants also described their relationships with adults as being respectful and positive [31]. As participant AI4 summarized, *"I really liked the program."*

Alumni also cited frustrations, such as disliking a particular design technique, a recurring project, or not always *"getting along with"* the other child members of the team [31]. Finally, regarding recall, two interviewees (2/6) at one point responded that they did not remember the answer to a specific question very clearly.

STUDY 2: PARENTS OF ALUMNI

In study 2, we obtained an alternate perspective on the gains children on a PD team experience by surveying and interviewing their parents, who could observe changes in alumni attitudes and behaviors outside their participation on the team. The goal of this study was to corroborate and expand the results of Study 1.

Method

Study 2 presents an analysis of surveys and interviews that were conducted with parents of child design partner alumni.

Survey

Participants. As parents could have multiple children participate in Kidsteam, the 17 parents that were surveyed (4 male, 13 female) cumulatively had 21 children (10 male, 11 female) participate on the team. These alumni participated on Kidsteam between the years of 1998 and 2013, stayed on the team an average of 2.0 years (SD=1.3), and left the design team an average of 7.9 years prior to the start of the study (SD=4.9).

Procedure. Parents were recruited for the anonymous, online survey through email. The online surveys for parents of design partner alumni were designed to take no more than 10 minutes and included closed, likert-scale questions as well as open-ended, short answer questions. Questions began broadly (e.g., *"What were your expectations when your child joined Kidsteam?"*) before becoming more narrowly focused on topics identified from the literature across both the likert and open-ended questions. Parent participants did not receive compensation.

Interview

Participants. Parent interviewees were recruited in spring of 2016 from a pool of survey respondents who stated they were interested in participating in a follow-up interview. Four parents responded to the interview request (1 male, 3 female), and represented the experiences of 6 child alumni (5 male, 1 female) who participated on Kidsteam between the years of 1999 and 2013 for an average of 1.8 years (*SD*=.75). Participants left the design team an average of 9.0 years prior to the study (*SD*=5.4).

Procedure. All participants completed the follow-up interview at a location that was convenient to them, either at the University of Maryland's campus or via a videoconferencing service (e.g., Skype). Interview questions began with broad, open-ended questions— such as, "*In a few sentences, tell me about your overall experience with Kidsteam."*— and later included direct questions about areas of interest derived from the literature. The semi-structured interviews lasted an average of 23 minutes (*SD*=6.3). Participants agreed to be audio recorded during the interview; all recordings were transcribed for analysis. Interviewees did not receive compensation.

Analysis

To illuminate differences and similarities between the alumni and parent perspectives on gains from participation, analysis of the parent survey and interview data began with the codebook that was established in Study 1. The codebook was further refined after analyzing a randomly selected, transcribed interview with another member of the research team to refine, clarify, and discover any emergent codes. During this process a 9th category of *Fiscal Considerations* was added to the codebook.

Inter-Rater Reliability was then computed between two researchers on a random selection of 20% of the short response survey data and one randomly selected interview. A Cohen's Kappa score of .86 was achieved, as calculated within NVivo software, considered *almost perfect agreement* (range: .81 to .99) [43]. Having reached agreement, one researcher coded the remaining data.

Findings

In this section we present findings on the gains to child PD team alumni as perceived by their parents, as well as topics that relate to gains, (e.g., factors that may have influenced gains). The representative quotes presented in this section are identified by: participant group (i.e., P for parents), data source (i.e., S for survey, I for interview), and participant number (i.e., 3). For example, the second parent interview participant has the identifier "PI2."

Initial Responses on the Existence of Gains

When parent survey participants were initially asked a binary question about whether their child/children learned new skills from participating on the design team, 16/17 answered *yes.* While one participant answered *no,* he identified gains (e.g., confidence) in later questions. When respondents choosing *yes* were subsequently asked a short-response question about what their children learned, parent participants listed: design skill sets (9) (e.g., prototyping), group-work and collaboration (7), ability to convey their ideas (7), and comfort with technology (5). These and other gains discussed throughout the parents' surveys and interviews are discussed below.

Communication

When asked what impacts they noted from participating on a PD team, most (12/17) parent survey responses described how their children made improvements in communication, particularly with regard to giving presentations and communicating with adults. Parents described gains such as, *"presentation skills"* (PS8) and how participation on the team, *"has helped [my son] with advocating himself in school and with adults"* (PS16). Another parent survey participant (PS13) described how team events, such as speaking at a conference, contributed to improvements in her child's public speaking. In the follow-up interviews, a parent participant described how her children's team experiences might yet benefit them in the future:

> *"Also working remotely with people. The work [Kidsteam] did working with other teams far away will help [my son] because a lot of people work with others around the world" (PI2).*

Collaboration

Half of parent participants (11/17 survey, 3/6 interview) observed changes in their children's collaboration skills. Some parent participants discussed aspects of collaboration broadly in relation to working with teammates, such as the experience being, *"a good experience working with others"* (PS14) or, *"working within a group or team"* (PS1). Other parent participants were more specific regarding how their child had learned to work with others to design technologies, such as PS16:

> *"He is so good at working with a group of people. He understands preparation, he knows that when he makes a commitment to work with others that he needs to do his share, but he can step back and let others do what they need to do and not feel like he isn't doing his job."*

This ability to compromise was an aspect of collaboration that was also described by other parent participants, such as PS11, who stated, *"She learned more about working with groups and the necessary compromises"* (PS11).

Confidence

Parents of alumni (10/17 survey, 4/4 interview) described how their children gained in confidence during their participation on the PD team, partially attributing this to how participation illustrated to their children how important their ideas were. Parents described how, *"[Participating] made [my daughter] more confident*," (PS3) and, *"My child gained self-confidence in general"* (PS8).

Frequently, parent participants connected this confidence to children speaking about or sharing their ideas. Parent participants described how their children gained in *self-esteem* by having their opinions valued:

> *"It was very positive from the self-esteem point of view—the, your opinions are valuable point of view. …This is may be one of the few places where kids have their ideas seriously considered and discussed- and rejected or not, but in a real way" (PI3).*

Technology Exposure

Some parent participants (6/17 survey, 2/4 interview) described how their children gained *"computer skills"* (PS4) and became, *"more comfortable around new technology"* (PS3). Parent participants also noted that their children were *"exposed to interesting technologies"* (PS5) through participating on the design team, and that this exposure to new technologies fostered continued interest in working with computers.

Financial Benefits

While financial benefits were not covered in the surveys, all parent interview participants (4/4) discussed financial benefits of the PD team, some noting that these benefits could motivate facilitating children's participation on the team. These pragmatic gains included the facts that the program 1) was a free after-school activity, 2) included a free, 2-week summer program, and 3) offered a technology gift at the end of each year of participation.

Design Processes and Techniques

Design processes, such as *"brainstorming"* and *"applying specific prototyping techniques"* (PS8), were part of what parent participants (7/17 survey, 3/4 interview) discussed as an element their children had learned. Parent participants also described how their children still use specific design techniques in their schoolwork and professional lives, such as PI2 who described their child's use of Sticky Noting [28]: *"[My child] still loves his post-it notes."*

Respect in Relationships with Adults

Most (12/17) parent survey participants agreed that participating on the PD team changed perceptions of respect between their children and adults—both in terms of offering respect and expecting respect. As participant SP16 concisely explained, *"He affords [adults] respect and expects it in return."* Three of these participants specified that the PD team participation supported existing expectations of respect toward their children from adults, such as PS14 who stated, *"[It was] good to have adults model respect for him (but not saying it was a big change)."* Other participants discussed how the new expectations of their children contrasted with other adult relationships their children had:

> *"[My children] came to realize there were some adults who attended to what they were saying and to their ideas. They came to respect and like those adults[…] And when they went to school and had to deal with adults who had no interest in their ideas they could recognize OK this is an adult that doesn't do that. We could think it over and talk about it, and that became part of our conversation in dealing with their public schooling" (IP4).*

Attribution of Gains

While all participants were asked to focus on what gains they believed stemmed from membership on Kidsteam, parent participants often emphasized both why and to what extent they attributed the impacts they were discussing to participation on the PD team. As previously mentioned, some parents described how the PD team setting supported or enhanced existing expectations, such as SP11 who stated,

> *"[My child] was …accustomed to having [her] thoughts and ideas taken seriously by adults… I think the Kidsteam environment further supported this belief."*

Others, such as PI2 who homeschooled her child while he was participating on the design team, credits participation on the team with cultivating certain gains entirely:

> *"I was getting him educational opportunities wherever they were. I know there is where he picked up some reasoning skills, there is where he picked up typing skills. …I can ascribe [specific gains] to working with Kidsteam pretty firmly" (PI2).*

Factors Influencing Gains

Parent participants recounted two factors that may have influenced how they reported their children's gains: recall and enjoyment. Regarding recall, during interviews 2 of the 4 parent participants began descriptions of the experiences they and their children had by emphasizing that they were trying to recall events from many years ago, so it may be difficult to recall everything. The only parent interview participant who did not appear to have recall issues had a child who had left the team within two years of the interview. None of the survey responses (0/17) indicated issues of recall. Regarding enjoyment, parent participants observed that their children appeared to have fun on the PD team. *"He always complained to go to school every day but he was always very happy to come to Kidsteam"* (IP1). However, one parent recalled that their child said being on the team was, *"sometimes boring"* (PS15). Other parents explained how there was more excitement about attending on some days more than others, such as when the team was working on a particularly interesting project.

DISCUSSION

How participants are involved on PD teams matters. To continue to improve the PD process and techniques, and to create better technologies from this improved process, it is critical that HCI research goes beyond discussions of indirect benefits to participants by acknowledging that direct participant gains can be a part of PD outcomes (see Table 1). Here, we discuss the continued applicability of gains, new opportunities, and the implications of this work for PD practitioners and methods.

Continued Applicability of Gains

Within the findings of this study we learn that participants may actively benefit from their participation on PD teams. Participation on the design team influenced alumni's knowledge of the design process and how they engaged with technology, even after their participation on the team had ended and across the contexts of their schoolwork and their personal interests. What was further encouraging was that the parents of alumni largely agreed with the gains that the former participants described. We see these direct gains as enabling a way for HCI researchers to do more than "prevent harm" to child participants—to have an *attention and care* for participants such that they *actively benefit* from their participation in PD research programs.

However, it is important to note that the type of participation asked of alumni during their design team experience may have influenced the continued application of gains described in this study. In a number of ways, the CI method itself may create a "best case scenario" [7] for encouraging types of participation that could promote gains, such as its focus on relationship building and the long-term nature of participation. Alternatively, it may not be the case that such high degrees and durations of participation are required for children to experience direct gains. Future work should, therefore, consider what gains might emerge from other forms of PD with children.

Reflection on Obstacles to Gains

An essential step toward fostering participant gains is not only to identify and illustrate direct participant gains, but also to develop an understanding of obstacles to attaining gains. Prior work with adults in PD has identified how frustrations may be an impediment to participant gains [8]; while participants in this study described relatively few frustrations, this may have been influenced by an increased likelihood to respond to calls to participation if they had a positive experience on the team. Still, child PD alumni in this study as well as child PD participants in previous works have described frustrations that could impact gains [22,23]. To achieve a complete picture of gains from participation, and how to facilitate them, future work will need to examine what frustrations child participants encounter and how these frustrations may influence gains.

A Missing Gain: Content Knowledge

A noteworthy exception to the gains participants perceived in this work is *content* knowledge. The topics covered in design sessions (e.g., science inquiry, language learning) are a potential source of gains. Previous research suggested that content knowledge could be an expected outcome: *content* was a cognitive impact found in Guha's year-long case study evaluation of children on a PD team (Figure 3) [22], and *specific content* is one of three areas, along with *general* and *design* skills, where Barendregt posits PD could incorporate learning goals [2]. However, the gains described by participants in this research, while largely discussing the other topics within these two models, did not include content knowledge. This does not mean that content knowledge was not part of participants' immediate gains, nor do we believe these gains are non-existent after participation has ended. Rather, we believe this points toward an opportunity to encourage participants to perceive the value of the content presented in PD sessions, and that this gap points toward the need for work such as [2,3,7] that make content goals explicit.

Gains Described	Study 1: Alumni	Study 2: Parents	Differences and Similarities Between Study 1 and 2
Career Direction	✓		—
Collaboration	✓	✓	Both focused on teamwork and group compromise; alumni discussed its applicability to prototyping
Communication	✓	✓	Both focused on presentation skills. Parents focused on communication with adults and alumni on overcoming fears
Confidence	✓	✓	Both described knowing children's opinions matter; alumni also related this to self-esteem
Design Processes/ Techniques	✓	✓	Alumni focused on broader and process insights; parents on specific design techniques
Financial Benefits		✓	Both discussed end of the year gifts; parents also described the team as free after school and summer programs
Material Benefits	✓	✓	
Respect with Adults		✓	—
Technology Exposure		✓	—

Table 1. A summary of the gains children experienced through participating on a PD team that were described by child participant alumni and their parents.

Toward 21st Century Educational Goals

While the team in this study meets outside of school hours, many methods of PD with children take place within classrooms. In considering this broader context of PD with children, researchers have suggested that the benefits of participation on PD teams should reflect the expectations of the schoolroom context that children are in (i.e., there should be learning involved) [2]. Despite not seeing content knowledge in the results of this study, other gains described do relate to modern educational goals. The Partnership for 21st Century Learning (P21) is the most, *"detailed and more widely adopted"* [11, p.4] of existing frameworks for 21st century skills [38]. Many specific skills are focused on within the P21 framework, including *Life and Career Skills*—among them Flexibility and Adaptability, Initiative and Self Direction, Social Skills, and Leadership—and *Learning and Innovation Skills*—covering Creativity and

Innovation, Critical Thinking and Problem Solving, and Communication and Collaboration. A number of these 21st century competencies overlap with the gains to child participants highlighted by this work, including confidence, technology knowledge, and presentation skills. The overlap of gains from PD and 21st century learning goals suggests that the PD process itself may help meet the educational expectations of child PD participants and their parents.

Implications of Gains from PD for Practitioners

Here we present several implications for PD practitioners who wish to encourage participant gains through their work. While we are not able to draw causal relationships from this study, there were a number of influencing factors that participants described alongside the gains that were being explained. We present these factors as prospective ways to foster gains in PD activities.

Safe Design Environments. A common PD goal is to maintain respectful, safe environments for taking design risks. Participants' descriptions of how safe design environments encouraged gains may make it critical to encouraging gains in intergenerational PD.

Discuss Impact. Certain project types (e.g., public-facing projects, projects iterated over multiple sessions) were described alongside a number of gains (e.g., confidence) as evidence of participants' influence. Practitioners should be explicit with children regarding their project impacts.

Technique Choice. Participants described their continued use or adaption of techniques they learned on the PD team (e.g., sticky noting, Bags of Stuff). Practitioners hoping to encourage gains may choose to incorporate these techniques when able.

Reflections on Method: Multiple Perspectives on Gains

Obtaining multiple perspectives on a phenomenon is a common methodological approach, and is one this study suggests is particularly relevant to researching gains from PD team participation. This work begins to build an understanding of distinctions between how gains are perceived from the perspectives of child PD team alumni and their parents. Parents of child participants can observe their child's behavioral and attitudinal changes outside team participation, and therefore offer a new perspective on gains to children that may enhance or differ from those of participants or researchers.

In this study, gains were either noted by both child PD team alumni and their parents, but emphasized differently, or only noted by one group or another (Table 1). Regarding the former, while *Communication*, *Collaboration*, *Confidence, Design Process/Techniques,* and *Material/ Financial Benefits* gains were found across both participant groups, each group had a slightly different perception of these gains. For instance, while both participant groups discussed gains in lasting knowledge about design processes, parent perceptions of gains in this dimension were largely focused on specific design techniques, while alumni participants described an increased holistic understanding of the technology design process. Gains noted by only one participant group were less common, though important. For example, while alumni described their relationship with the adult design partners on the team as being respectful [31], it was only parent participants—having observed differences in how their children offered and expected respect from adults outside the design team—who described *respect in relationships with adults* as something gained through participation on the design team. Given the existence of these distinctions, we note that asking diverse populations about gains from PD activities may be necessary to obtaining a complete picture of gains from PD. These distinctions situate this work and may inform studies looking to inspire more meaningful forms of participation by supporting direct gains from PD activities.

Limitations of the Study

The ability of participants in this study to recall information from their participation is the primary limitation of this work. Imperfect memories of events, particularly as the team has been active for 18 years, may have caused facts to be obscured or exaggerated over time; moreover, attributing gains to a particular experience can be a difficult task [7]. However, what a participant may recall in this regard may also be connected to what gains were most ingrained—particularly in the case of the child alumni. Additionally, as previously discussed, the gains described in this work likely relate to the high degree and duration of participation asked of participants. Finally, two potential limitations arise from the pool of participants: the participants were mostly female, and it is possible that parents and alumni who chose to participate in the study were more likely to do so because they recalled their experiences positively.

CONCLUSION AND FUTURE WORK

This paper contributes a new understanding of what gains former child members of a PD team experience and attribute to their participation. Our findings identify and describe the direct gains of alumni and have implications for how the PD process of developing new technologies can positively impact the participants who partake that process.

This research is part of a larger study investigating PD practices while working with children, and there are a number of avenues for future study. A next step would be to investigate whether gains can be firmly ascribed to participation on PD teams. Gains from other forms of PD with children should be explored, as should the value of content presented to participants during design sessions. Future work should investigate what frustrations child PD team participants encounter and how these frustrations may impact gains. Lastly, gains of adults who work on intergenerational PD teams should be better understood.

ACKNOWLEDGEMENTS

We would like to thank the participants who volunteered for this research, the HCIL members who supported this research, and the design partners of Kidsteam.

REFERENCES

1. June Ahn, Michael Gubbels, Jinyoung Kim, and Johnny Wu. 2012. SINQ: Scientific INQuiry learning using social media. In *CHI'12 Extended Abstracts on Human Factors in Computing Systems* (CHI '12).
2. Wolmet Barendregt, Tilde M. Bekker, Peter Börjesson, Eva Eriksson, and Olof Torgersson. 2016. Legitimate Participation in the Classroom Context: Adding Learning Goals to Participatory Design. In *Proceedings of The 15th International Conference on Interaction Design and Children* (IDC '16), 167-174.
3. Ahmet Baytak and Susan M. Land. 2010. A case study of educational game design by kids and for kids. In *Procedia-Social and Behavioral Sciences.* 2,2: 5242-5246.
4. Laura Benton, Hilary Johnson, Emma Ashwin, Mark Brosnan, and Beate Grawemeyer. 2012. Developing IDEAS: Supporting children with autism within a participatory design team. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '12), 2599-2608.
5. Gro Bjerknes, Pelle Ehn, Morten Kyng, and Kristen Nygaard. 1987. *Computers and democracy: A Scandinavian challenge*. Gower Publishing Ltd.
6. Elizabeth Bonsignore, June Ahn, Tamara Clegg, Mona Leigh Guha, J. Yip, Allison Druin, and J. P. Hourcade. 2013. Embedding Participatory Design into Designs for Learning: An Untapped Interdisciplinary Resource? In *CSCL 2013 Conference Proceedings Volume 1 — Full Papers & Symposia* (CSCL 2013), 549–556.
7. Claus Bossen, Claus, Christian Dindler, and Ole Sejer Iversen. 2010. User gains and PD aims: assessment from a participatory design project. In *Proceedings of the 11th Biennial Participatory Design Conference* (PDC '10), 141-150.
8. Claus Bossen, Christian Dindler, and Ole Sejer Iversen. 2012. Impediments to user gains: experiences from a critical participatory design project. In *Proceedings of the 12th Biennial Participatory Design Conference* (PDC '12), 31-40.
9. Luca Colombo, Monica Landoni, and Elisa Rubegni. 2014. Design guidelines for more engaging electronic books: insights from a cooperative inquiry study. In *Proceedings of the 15th International Conference on Interaction Design and Children* (IDC '14), 281-284.
10. Nigel Cross. 2006. *Designerly ways of knowing*. Springer London.
11. Chris Dede. 2010. Comparing frameworks for 21st century skills: *21st century skills: Rethinking how students learn.* 20: 51-76.
12. Christian Dindler, Eva Eriksson, Ole Sejer Iversen, Andreas Lykke-Olesen, and Martin Ludvigsen. 2005. Mission from Mars: a method for exploring user requirements for children in a narrative space. In *Proceedings of The 2005 International Conference on Interaction Design and Children* (IDC '05), 40-47.
13. Betsy DiSalvo and Carl DiSalvo. 2014. Designing for Democracy in Education: Participatory Design and the Learning Sciences. In *Proceedings of the Eleventh International Conference of the Learning Sciences* (ICLS '14).
14. Allison Druin. 1999. Cooperative inquiry: developing new technologies for children with children. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI'99), 592-599.
15. Allison Druin. 2002. The role of children in the design of new technology. *Behaviour and Information Technology.* 21,1: 1-25.
16. Allison Druin and Carina Fast. 2002. The child as learner, critic, inventor, and technology design partner: An analysis of three years of Swedish student journals. *International Journal of Technology and Design Education.* 12,3: 189-213.
17. R. Darin Ellis and Sri H. Kurniawan. 2000. Increasing the usability of online information for older users: A case study in participatory design. *International Journal of Human-Computer Interaction* (IJ HCI). 12,2: 263-276.
18. Elizabeth Foss, Mona Leigh Guha, Panagis Papadatos, Tamara Clegg, Jason Yip, and Greg Walsh. 2013. Cooperative Inquiry extended: Creating technology with middle school students with learning differences. *Journal of Special Education Technology.* 28,3: 33-46.
19. Julia A. Garde and Mascha C. van der Voort. 2014. Participants' view on personal gains and PD process. In *Proceedings of the 13th Participatory Design Conference* (PDC'13), 79-82.
20. Franca Garzotto. 2008. Broadening children's involvement as design partners: From technology to "experience". In *Proceedings of the 7th International Conference on Interaction Design and Children* (IDC'08), 186-193.
21. Judith Gregory. 2003. Scandinavian approaches to participatory design. *International Journal of Engineering Education.* 19,1: 62-74.
22. Mona Leigh Guha. 2010. *Understanding the Social and Cognitive Experiences of Children Involved in Technology Design Processes.* PhD Dissertation. University of Maryland, College Park, MD.
23. Mona Leigh Guha, Allison Druin, Gene Chipman, Jerry Alan Fails, Sante Simms, and Allison Farber. 2004. Mixing ideas: A new technique for working with young children as design partners. In *Proceedings of the 2004 Conference on Interaction Design and Children* (IDC'04), 35-42.
24. Mona Leigh Guha, Allison Druin, and Jerry Alan Fails. 2013. Cooperative Inquiry revisited: Reflections of the past and guidelines for the future of intergenerational

co-design. In *International Journal of Child-Computer Interaction* (IJCCI). 1,1: 14-23.

25. Elin Irene Hansen and Ole Sejer Iversen. 2013. You are the real experts!: Studying teenagers' motivation in participatory design. In *Proceedings of the 12th International Conference on Interaction Design and Children* (IDC'13), 328-331.
26. Juan Pablo Hourcade. 2008. Interaction design and children. In *Foundations and Trends in Human-Computer Interaction.* 1,4: 277-392.
27. Yasmin B. Kafai. 2003. Children designing software for children: what can we learn?. In *Proceedings of the 2003 Conference on Interaction Design and Children* (IDC'03), 11-12.
28. Andrew Large, Valerie Nesset, Jamshid Beheshti, and Leanne Bowler. 2006. "Bonded design": A novel approach to intergenerational information technology design. In *Library & Information Science Research.* 28,1: 64-82.
29. Tak Yeon Lee, Matthew Louis Mauriello, June Ahn, and Benjamin B. Bederson. 2014. CTArcade: Computational thinking with games in school age children. In *International Journal of Child- Computer Interaction* (IJCCI). 2,1:v26-33.
30. Stephan Lindsay, Daniel Jackson, Guy Schofield, and Patrick Olivier. 2012. Engaging older people using participatory design. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI'12), 1199-1208.
31. Brenna McNally, Mona Leigh Guha, Matthew Louis Mauriello, and Allison Druin. Children's Perspectives on Ethical Issues Surrounding Their Past Involvement on a Participatory Design Team. *In Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems* (CHI'16), pp. 3595-3606.
32. Brenna McNally, Mona Leigh Guha, Leyla Norooz, Emily Rhodes, and Leah Findlater. 2014. Incorporating peephole interactions into children's second language learning activities on mobile devices. In *Proceedings of the 2014 Conference on Interaction Design and Children* (IDC'14), 115-124.
33. Karyn Moffatt, Joanna McGrenere, Barbara Purves, and Maria Klawe. 2004. The participatory design of a sound and image enhanced daily planner for people with aphasia. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI'04), 407-414.
34. Jamie Montemayor, Allison Druin, Allison Farber, Sante Simms, Wayne Churaman, and Allison D'Amour. 2002. Physical programming: designing tools for children to create physical interactive environments. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI'02), 299-306.
35. Neema Moraveji, Jason Li, Jiarong Ding, Patrick O'Kelley, and Suze Woolf. 2007. Comicboarding: Using comics as proxies for participatory design with children. In *Proc. of the SIGCHI Conference on Human Factors in Computing Systems* (CHI'07), 1371-1374.
36. Michael J Muller. 2003. Participatory design: The third space in HCI. In *Human-Computer Interaction: Development Process.* 4235: 165-185.
37. Leyla Norooz, Matthew Louis Mauriello, Anita Jorgensen, Brenna McNally, and Jon E. Froehlich. 2015. BodyVis: A New Approach to Body Learning Through Wearable Sensing and Visualization. In *Proceedings of the Annual ACM Conference on Human Factors in Computing Systems* (CHI'15), 1025-1034.
38. Partnership for 21st Century Learning (P21). 2016. Framework for 21st Century Learning. Retrieved September 16, 2016 from www.p21.org
39. Alex Quinn, Benjamin B. Bederson, Elizabeth Bonsignore, and Allison Druin. 2009. StoryKit: Designing a Mobile Application for Story Creation By Children and Older Adults. Tech. rep. HCIL-2009-22, Human Computer Interaction Lab, University of Maryland, College Park.
40. Karen Rust, Elizabeth Foss, Elizabeth Bonsignore, Brenna McNally, Chelsea Hordatt, Meethu Malu, Bie Mei, and Hubert Kofi Gumbs. 2014. Interactive and live performance design with children. In *Proceedings of the 2014 conference on Interaction Design and Children* (IDC'14), 305-308.
41. Michael Scaife, Yvonne Rogers, Frances Aldrich, and Matt Davies. 1997. Designing For or Designing With? Informant Design for interactive learning environments. In *Proceedings of the ACM SIGCHI Conference on Human Factors in Computing Systems* (CHI'97), 343-350.
42. Mike Scaife, and Yvonne Rogers. 1999. Kids as informants: Telling us what we didn't know or confirming what we knew already. *The Design of Children's Technology,* 27-50.
43. Anthony J. Viera and Joanne M. Garrett. 2005. Understanding interobserver agreement: the kappa statistic. *Fam Med*. 37,5: 360-363.
44. Greg Walsh, Allison Druin, Mona Leigh Guha, Elizabeth Foss, Evan Golub, Leshell Hatley, Elizabeth Bonsignore, and Sonia Franckel. 2010. Layered Elaboration: A new technique for co-design with children. In *Proc. of the SIGCHI Conference on Human Factors in Computing Systems* (CHI'10), 1237-1240.
45. Greg Walsh, Elizabeth Foss, Jason Yip, and Allison Druin. 2013. FACIT PD: a framework for analysis and creation of intergenerational techniques for participatory design. In *Proc. of the SIGCHI Conference on Human Factors in Computing Systems* (CHI'13), 2893-2902.