

# Examining Values: An Analysis of Nine Years of IDC Research

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## ABSTRACT

Explicitly examining the values held by a research community provides a tool in which participants can define its culture, conduct informed research, and reflect on their design process. We conducted a content analysis of the values expressed in the full text of IDC papers between 2002 and 2010, as well as a survey of the first authors of these papers. We discuss the types of contributions IDC papers make, the behaviors and qualities they seek to support in children, the audience for which IDC designs, the role of the child in creating these designs, the theories and models that inform this research, and the criteria that inform IDC's technical design choices. Based on our findings, we discuss trends, core values, and implications for the community and highlight opportunities for future IDC contributions.

## Keywords

Values in research, meta-analysis

## ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI):  
Miscellaneous.

## General Terms

Human Factors

## INTRODUCTION

In sociology, values are defined as “the ideals, customs, and institutions of a society toward which the people of the group have an affective regard.” [1] Our values as a research community play an integral role in motivating our design and research choices. They influence the conversations and exchanges that we have as a community and affect the adoption, use, and impact of the technologies that we design [12]. Values in science and design are often implicit and backgrounded, because our assumptions and philosophical perspectives are woven into the fabric of our everyday thought and discourse [3]. Even in seemingly objective scientific investigations, the discourse is often shaped by the paradigms and conventions of the community [10].

The scope of this paper is focused on understanding the

values that are expressed in all the full-length papers during the nine years from the first *Interaction Design for Children* (IDC) conference in 2002 up to and including 2010. While the IDC community has expressed interest in understanding and discussing community values and philosophies [7], this is the first formal analysis holistically examining the values expressed in IDC work to date. This paper does not survey the results or findings nor does it seek to offer an analysis of the methods used at IDC. Please refer to existing meta-analyses for these types of reviews [8,9].

We make three contributions in our analysis. First, we hope to provide IDC newcomers with a clear description of the type of work that has traditionally been published at this conference. This may help a newcomer understand the context in which they present their design and research decisions and may help identify assumptions that require more detailed explanations when presenting their work. Second, we hope to encourage the community to explicitly acknowledge values implicit in their design, and acknowledge that artifacts carry with them a set of agendas and assumptions [17]. Foregrounding these assumptions may inspire reflective design that brings old patterns of thought into question and leads to new insights [15]. Last, we hope to provide data to reflect on our core values from previous years and identify trends and opportunities that may extend into future research because reflective surveys have been valuable to other design communities in the past (e.g., [2]).

There are five general classes of questions that we address in this paper:

1. What types of contributions do IDC papers make?
2. What kind of behaviors and qualities does IDC research aspire to support in children?
3. For whom does IDC design? What is the role of the child in the design process?
4. What theories and learning models inform IDC research?
5. What criteria inform IDC's technical design choices?

We begin by reviewing our methods in conducting this analysis. Next we discuss our findings in five sections addressing the above research questions. Finally, we discuss possible implications of these findings and opportunities for the IDC community.

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## METHODS

The full text of each IDC long paper published in or before 2010 was reviewed by at least two investigators and qualitatively coded for the values expressed in the text. We also contacted the first author of each paper to survey them about the values inherent in their work.

### Review Process

In total, we read and coded the full text of 137 long papers that constitute the body of IDC work to date. The four investigators divided into two pairs (based on geographic location). The first pair was responsible for reviewing IDC years 2002, 2003, 2005, 2007, and 2009, while the second pair looked at years 2004, 2006, 2008, and 2010. Each paper was read by at least two investigators. First they summarized the values and motivations explicitly expressed in the paper and any other issues that may be of interest later in the analysis. Then, each pair met to discuss the notes for each paper, and agree on a summary of key issues. During this process, there were four group-wide videoconferencing meetings to discuss and adjust the process of reviewing and taking notes.

We only coded for values explicitly expressed in each paper. As such, some of the values expressed may not actually represent the actual views of the authors. Conversely, the authors may not have explicitly expressed all of the values that drove their work in the text of the paper. To supplement this study, we conducted a follow up by directly contacting the first author of each paper with questions about the values they sought to express with each piece of work. We asked:

- What are the values inherent in the work?
- What were your motivations in conducting the work?
- What kind of change do you want to make in the world with this work?
- How do you see this work fitting into the larger IDC community?

We received replies about 40 out of the 137 papers. This may not be representative of the entire IDC community because of response bias, so rather than providing an overall quantitative analysis of the codes contained in these emails, we use quotes from these emails to illustrate some of the content analysis points and provide a general discussion comparing these responses to the values discovered in the content analysis.

### Analysis

At least two investigators reviewed the notes and abstracts for each paper, focusing on conducting open coding for the values expressed in each work. This yielded an initial list of 240 codes. Through iterative group discussion, this list of codes was refined and clustered by similarity, yielding a list of 78 codes. Decision-making was driven by an effort to reach consensus on any conflict in coding or interpretation of the codes. We made an effort to arrive at a shared understanding of the meaning of each code and when it should be applied so that our coding could be as consistent as possible. The investigators then conducted another

review of all of the papers, assigning applicable codes from the refined list to each paper. The emails received from first authors were coded using the same set of codes, while also noting values that may have been left out of our content analysis.

To demonstrate that we were assigning codes in a consistent manner, we conducted an inter-rater reliability analysis by independently coding 5 randomly selected overlapping papers. The Cohen's Kappa value of agreement between the coders was 0.84 (for 49 codes assigned to 5 papers), which is classified as outstanding agreement [11].

### Limitations

Our approach has inherent limitations. Qualitative analysis is inherently subjective and we come to it with our own values and biases. We tried to minimize these by providing multiple reviewers for each paper, reaching a consensus on code lists, and conducting the research with investigators from different institutions. However, it is possible that a different group of reviewers would find other conclusions important or worth reporting in the same data. Therefore we would like to provide a contextual background of the four investigators:

- One author is a Ph.D. candidate in an HCI-related Ph.D. program at a public university in the U.S. Her background is in Psychology and Computer Science. She considers herself a qualitative researcher first and a designer of new technologies second.
- Another author is a Ph.D. candidate in a Media Arts and Sciences program and has a background in studio art and cognitive science. He has designed social and experiential interfaces that incorporate technology. He has begun designing interfaces for children during the last three years of his studies.
- Another author is a Ph.D. candidate in Media Arts and Sciences in the U.S. His undergraduate background is in Psychology, Neuroscience, and Education. His research focuses on play, learning, representation and music improvisation.
- Another author is a Ph.D. candidate in an HCI-related Ph.D. program and has a background in Computer Science and identifies himself as a technologist, building technology for technology's sake, with an interest in learning and cognitive science.

We represent two research universities. Some of the biases we share are: we are all attending universities in the United States, we all have experience in Human-Computer Interaction, and we are all relative newcomers to the IDC community, each having attended between one and three IDC conferences.

The differences between the finding of the content analysis and the values discussed in correspondence with authors point to the fact that values are difficult to identify and categorize. Our findings should be taken as general trends rather than a complete and objective analysis of the values in the IDC community.

Paper Contributions		
Code	%	Trend
Contributes a Study	45	-0.14
Contributes a System	43	0.64
Contributes a Reflection	12	-0.38
Paper Contribution Values		
Code	%	Trend
Examine our Methods	21	-0.73
Understanding Children's Models	17	-0.12
Makes an Explicit Appeal to IDC	10	-0.70
Conflict between Goals and Methods	8	-0.34
Design and Evaluate in Authentic Context	6	-0.66

**Table 1. Final codes addressing contributions, the percent of papers that were tagged with this code, and trend over time.**

## FINDINGS

In this section, we discuss the findings as they relate to our five research questions. In all sections, we report trends over time by showing the correlation coefficient of the percentage of papers per year that have this code with the year (trend over time). We point out moderate and large positive and negative trends with the disclaimer that trends may be less meaningful for codes with a smaller number of papers.

### What types of contributions do IDC papers make?

We tagged each paper with one of three primary contributions. We acknowledge that there is actually quite a bit of overlap in these categories that we are not representing in our coding. For example, almost every paper provides some reflections for the community in its related work and discussion sections.

Papers that contribute a system focus on the design (and often the evaluation) of a novel system for children. These constituted 43% percent of the IDC papers and seem to show a strong trend towards increasing in number in the later years of the conference (see Table 1). Papers that primarily contribute a study were slightly more common at IDC, comprising 45% of all published full papers. Interestingly, 37% of these papers focused on examining or comparing the methods that we use to design and evaluate with children, which implies that IDC as a field values explicit discussion and improvement of our methods. However, it seems that there is a strong trend that indicates a decline in papers that examine methods in the later years of IDC. This may be problematic, as 7 of the first authors that corresponded with us discussed the importance of examining our methods:

*A part of the IDC community has always been sharing design methods. We believe that the more papers published about design techniques and methods with children, from researchers working with children in a variety of ways, the better. We can all benefit from hearing what works (and doesn't work!) for designers of children's technology.*

In addition, authors emphasized that IDC contributions need to go beyond mere description of the method to “putting it through a critical analysis.”

The last category of papers draw together work across multiple investigations and design experiences, or sought to bring information from other fields to IDC. These were labeled as “reflection” papers and constituted 12% of published work. This indicates that IDC reviewers value the role of reflection in the community. 10% of all papers make explicit appeals to the research community about ways that they could improve methods and designs. However, it seems that both reflection papers and papers that make explicit appeals to the community show a general trend declining in frequency in the later years of IDC. Again, this trend may not represent the actual values towards which the IDC community aspires, as several of the authors that corresponded with us emphasized the importance of being “more critical towards ourselves,” exploring more “mature conceptual approaches,” and “reflecting more deeply on impact issues.”

### What kind of behaviors and qualities does IDC research aspire to support in children?

The meaning of childhood and the activities that are considered important and appropriate for children have changed dramatically over the past two centuries [16]. As IDC authors discuss the motivations for their designs and investigations, they reveal which qualities and behaviors of children they aspire to support as a community.

#### *Social Interaction and Connectedness*

Supporting social interaction and connectedness is one of the big themes in what drives our designs for children. Forty percent of all the papers made explicit statements that value and want to support social interaction. There are specific types of social interaction that the community seems to value more than others. For example, it seems to emphasize collaboration over competition—28% of papers encourage cooperation and only 3% encourage competition (see Table 2). Out of those that value competition, 80% also value collaboration. References to competition and social interaction both increase moderately over the nine years of the conference.

Family connectedness is value that has recently become more popular as a domain of research in the IDC community. Although only 4% of total papers address family connectedness, there is a large increasing trend in this work.

#### *Learning*

IDC has not historically focused exclusively on education, but there is a strong emphasis on learning as an activity to support. Although only 13% of papers explicitly listed learning as a primary goal of their investigation, a number of other papers emphasized specific learning-related outcomes, behaviors, and qualities. Fifteen percent of all papers valued qualities related to exploration and wanted to support the attributes of exploration and discovery. As a related behavior, 7% of papers valued the behavior of

inquiry—children asking and answering questions about the world. Six percent valued the activity of reflection as an important component in learning. In several papers, the authors hoped to encourage growth on the part of the child that may be different from typical school-based interventions. Five percent of the papers focused on children learning real-world skills (e.g., the ability to navigate in a space) and 7% focus on supporting underlying aspects of cognitive development such as language skills and spatial reasoning. Supporting cognitive development has generally increased as a value in IDC research.

There are specific skills that seem to be more emphasized in the IDC literature. Supporting literacy is the focus of 8% of all papers; however, there seems to be a trend at IDC to do less work in this domain. Additional clusters in the skills to support in the child are related to technology. Eleven percent of all papers address teaching children programming or computational thinking. While 7% emphasize the importance of a general fluency with technology. IDC is an ACM conference and influenced by Computer Science research, so the emphasis on these values may be unsurprising.

However, in our correspondence, one author suggested that skill acquisition might be less in the spirit of IDC than taking a larger view of learning:

*I never cast my own work in terms of skill acquisition ...  
Children need purpose, not skills. If they have purpose,  
the skills will develop.*

Our content analysis has little evidence that this is the current emphasis of IDC, but perhaps this is a vision of where IDC might want to move in the future.

*Expression*

Many of the papers emphasized the value of children expressing themselves or being creative. Eighteen percent of all papers include self-expression as a positive characteristic to encourage in children, though there does seem to be a negative trend in papers expressing this value in the later years of IDC. A particular type of expression is encouraged particularly frequently—18% of papers discuss narrative or storytelling as an activity to support in children. Overall, creativity is explicitly discussed in 18% of IDC work. Imagination and fantasy are subsets of creativity that are explicitly valued in 6% of the papers and seem to be discussed more frequently in the later years of the conference.

*Play*

In general many IDC papers support children’s play and the quality of playfulness in children. Ten percent of all papers explicitly express this value. A specific type of play that has been getting more attention recently is physical activity. Eight percent of all papers discuss supporting physical activity in children and this category is showing a strong increasing trend.

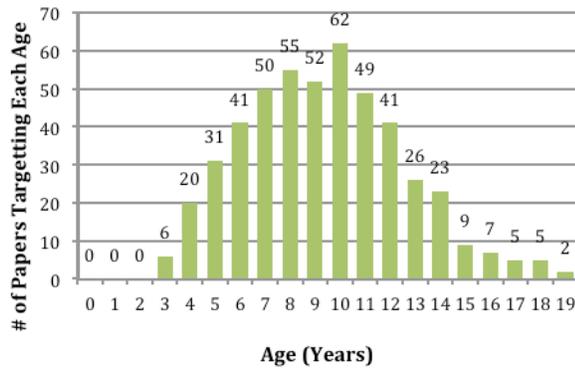
*Personal Growth*

There are several other attributes valued in IDC research that we have loosely grouped together as “personal

Social Interaction & Connectedness		
Code	%	Trend
Social Interaction	40	0.45
Collaboration	28	0.44
Family Connectedness	4	0.56
Competition	3	0.06
Learning		
Code	%	Trend
Exploration	15	-0.17
Learning	13	-0.11
Programming	11	0.17
Literacy	9	-0.51
Fluency with Technology	8	-0.12
Inquiry	7	-0.03
Reflection	6	0.06
Support Cognitive Development	6	0.72
Learning Real World Skills	5	-0.36
Expression		
Code	%	Trend
Self-Expression	18	-0.62
Narratives	18	-0.02
Creativity	16	0.01
Imagination	7	0.52
Play		
Code	%	Trend
Playfulness	10	0.36
Physical Activity	8	0.57
Personal Growth		
Code	%	Trend
Autonomy & Identity	6	-0.59
Equity of Participation	5	-0.46
Attitude & Motivation	3	-0.07
Morality & Ethics	2	-0.41
Other		
Code	%	Trend
Have Children Buy Products	1	-0.13

**Table 2. Final codes addressing qualities IDC aspires to support in children, the percent of papers that were tagged**

growth.” There are relatively few papers in this group and that number seems to be falling across all of the categories that comprise this group as the conference progresses. Six percent of all papers encourage children in developing autonomy and identity. Three percent value equity of participation, whether it is about everybody getting a chance to contribute equally in a small group or encouraging children to participate more fully in social structures that affect them. Equity of participation seemed to be more emphasized in the emails we received from the first authors than in our content analysis, as several authors emphasized that their work was motivated by providing “equal access to technologies” and “leveling the playing field for children.” Three percent of all papers seek to



**Figure 1. The number of papers that involved studies or systems intended for children of each age (when an age range is given, each year in the range is counted).**

change children’s attitudes on specific issues (e.g., perception of HIV) or increase motivation to participate in a specific community (e.g., motivate girls to create technological artifacts). Only 2% of all papers focus on supporting children in developing morally and ethically. Perhaps, this is because of the inherent controversial aspects of these qualities – whose ethics and attitudes would we encourage? Or perhaps, it is because of the difficulty of achieving or evaluating change in this domain.

*Behaviors IDC Doesn’t Encourage in Children*

Perhaps as important as the characteristics and behaviors that IDC authors aspire to support in children, are characteristics that they do not want to support. IDC as a community does not view children as simply consumers of technology or media. Only 1% of papers focused on selling a product to children or families (see Table 3). Additionally, two of the first authors were particularly committed to the idea of encouraging children “to use technology to build and share, not just consume.”

To summarize, the diversity of attributes that were valued by these papers indicates that as a community IDC supports a broad range elements in a child’s life including social interaction, learning, self-expression, play, and personal growth. This broad focus differentiates IDC from conferences on educational technologies and its focus on children as producers rather than consumers of media may differentiate it from much of the work in the industry. Recent trends at IDC favor social interaction and play topics while focusing less on topics of personal growth.

**For whom does IDC design? What is the role of the child in the design process?**

It is clear that most papers submitted to IDC focus on designing for the child. We looked in more detail at which ages are most investigated (see Figure 1). It seems that as a community there is very little interest at targeting technology or investigating children under the age of two. This may be due to the fact that it is difficult to evaluate or get feedback from this age group. This may also be due to the fact that many people do not think that it is appropriate

for children under two to use some technologies, as evidenced by the American Academy of Pediatrics recommendation that children under two do not participate in any screen time (e.g., television, video games) [6]. Three of the authors that responded to our correspondence were particularly committed to the idea of supporting younger children, such as those in pre-school. However, currently research targets older children, peaking around 10-years-old. There are a few investigations that include teenagers in the target range; however, there seem to be almost no papers that focus exclusively on teenagers (age 13 – 19).

Many papers indicate that the researchers at IDC view design as more than just the process of creating an artifact and having children use it as intended. For example, some authors view children as active agents ( 28%) in how the design is created, interpreted, and used often taking measures to make sure that the content of the system also reflects children’s voices (10%) (see Table 3). In our correspondence, authors referred to this as “giving children a voice in the design,” providing them with “ownership of creation,” respecting that “their perspective is critical,” and “empowering children as co-developers.” Several IDC authors expressed that the process of co-design needs to be not only productive, but also enjoyable and valuable to the child. As one author puts it:

*...we don’t see our “subjects” [or] “participants” as lemons to get the juice out of.*

However, while many authors agree, “children should be

Role of Child in Design		
Code	%	Trend
Children as Testers	26	0.86
Children as Design Partners	13	-0.82
Children as Informants	3	0.08
Codesign Values		
Code	%	Trend
Reflect Children's Voices	13	-0.79
Children as Active Agents	12	0.07
Equalize Power between Child & Researcher	8	-0.67
Diversity Values		
Code	%	Trend
Design for Multiple Interaction Styles	14	-0.24
Design for Special Needs	12	0.75
Gender Awareness	10	-0.39
Engaging the Underserved	7	0.17
Design for Both Genders	5	-0.65
Culturally-Appropriate Interventions	4	0.01
Role of School and Other Stakeholders		
Code	%	Trend
Curricular Integration	13	-0.05
Balance Multiple Stakeholder Interests	8	-0.50
Including Teachers	5	-0.42
Whole Class Activities	2	0.67

**Table 3. Final codes addressing for whom IDC designs, the percent of papers that were tagged with this code, and trend**

Theories		
Code	%	Trend
Embodiment	22	0.40
Informed by Theory	15	0.71
Philosophies on Learning		
Code	%	Trend
Constructivism	24	0.28
Constructionism	15	0.25
Learning through Play	15	0.11
Games for Learning	10	0.26
In Situ Learning	9	0.16
Learning through Embodied Interaction	9	0.12

**Table 4. Final codes addressing theories and models, the percent of papers that were tagged with this code, and trend over time.**

involved in the design process,” the level of this involvement seems to vary greatly in different investigations. We used Druin’s framework for classifying the role of children in the design of technology [4]. Of the papers that contribute a system design, 31% were designed with children as design partners. Of these papers, 25% have an explicit discussion of how the investigators took special care to equalize the power between the children and the researchers. The majority of the systems published at IDC (59%) involved children as testers. Only 7% of the papers explicitly discussed using children as informants. 5% of papers involved children both as informants and as testers, but not explicitly as design partners. This number may be deflated due to the tendency to publish formative studies as separate publications. In other words, children may have informed more of these systems, but it may not be clear from the text of the publication on the system designed.

The data on the role of the child in the design of new technologies reveals a large decreasing trend in papers where children participate as partners in design, papers that emphasize reflecting children’s voices in the artifacts designed for them, and papers that encourage equalizing power between children and researchers. Conversely, there is a strong increasing trend in papers where the children play the role of testers.

Some authors consider children as different individuals where not every child has the same abilities and needs. 14% of papers explicitly discuss designing for multiple interaction and learning styles. 12% explicitly aim the design at children with special needs and this number is showing a strong increasing trend in the recent years. 10% of papers explicitly discussed that different genders may have different needs and issues. However, we respond to gender in divergent ways. Half of these papers seemed to think that it is very important that we design in such a way that the system works equally well for both genders, while the other half acknowledged the differences but didn’t discuss whether this would influence their design in any way. In both cases, explicit discussions of gender are showing a declining trend in the community.

Within IDC, some authors also acknowledge that some communities are not being served by currently available industry interventions, such as children in developing countries or low-income families. As such, 7% of papers focus on engaging the underserved and 4% of papers explicitly take the time to discuss the ways that such interventions are made to be culturally appropriate.

Many authors discussed how their interventions integrate into the existing infrastructures of classrooms. 13% of papers explicitly talk about the importance of integrating into the existing curriculum. 2% focus on involving the entire class in the activity planned. However, only 5% of papers explicitly stated that they involved teachers in the design of their systems. An additional 4% of papers talk about balancing interests of multiple stakeholders other than children, such as parents. However, papers that balance the needs of multiple stakeholders seem to be on the decline in the later years of IDC.

Integrating into existing infrastructures to support real-world adoption is important to IDC authors as eight of the authors explicitly referred to this idea in their correspondence with us: “real-world activity has something to tell to the IDC community;” we should “promote the adoption of technology we develop.

#### **What theories and learning models inform IDC research?**

Overall, only 15% of the papers at IDC explicitly mentioned being informed by developmental psychology theories (see Table 4). The majority of these (52%) are papers that have contributed a system. This may indicate an opportunity for authors conducting a study to be more explicit about the theories that inform their research. 22% of all papers at IDC seem to align with the cognitive theory of Embodiment—that our thought is shaped by our bodies and our action in the world. 9% of all papers discuss the idea that children learn in-situ while participating in everyday life. There may be an increasing trend toward valuing theory in the community. Both developmental theory and embodiment as a cognitive theory appear with increasing frequency in later years of the conference.

We looked explicitly at the papers where learning is the primary objective (which constitute 13% of all papers). The majority of IDC papers on learning align with a specific set of learning models. 84% of all learning papers follow the philosophy of Constructivism—children learn by discovering and constructing their own knowledge systems [14]. 36% of all learning papers also ally with the learning model of Constructionism—children learn by creating personally meaningful projects [13]. Many IDC designers believe in leveraging play to help children learn. 42% of all learning papers focus on learning through play. Of these, 37% focus on creating games that help children learn. The idea of embodiment is also strongly expressed in some of the learning papers, with 21% explicitly discussing learning through embodied interaction.

Attributes Valued		
Code	%	Trend
Engagement	24	0.69
Enjoyment	24	-0.30
Naturalness	20	0.12
Desirability	13	-0.55
Feedback	8	0.12
Challenge	6	0.17
Efficiency or Task Completion	5	0.50
Customizability	4	0.42
Multiple Senses	4	0.08
Simplicity	3	0.29
Designing for the Experience	3	-0.18
Learner-Centered Design	3	0.27
Aesthetics	2	0.15
Engagement in the Longterm	2	0.24
Cost Effectiveness	2	0.50
Technical Choices		
Code	%	Trend
Tangibles	26	0.30
Mixed Reality	14	0.58
Bridging Physical and Digital	10	0.54
Innovate and Explore Novel Technologies	8	-0.51
Relation to Current Practices		
Code	%	Trend
Leverage Current Practices	11	-0.29
Concerns about Technology Negatives	5	0.22
Transform Current Practices	2	0.07

**Table 5. Final codes addressing values relating to technical design, the percent of papers that were tagged with this code, and trend over time.**

#### What criteria inform IDC’s technical design choices?

The most important design criteria for new technologies at IDC seem to mirror classic HCI ideas. 20% of papers found it important that the system be natural and intuitive to use (see Table 5). 4% also discussed the importance of the classic HCI principle of customizability, especially as it may relate to parents and teachers being able to customize a given technology to better meet a child’s needs. Only 4% of papers explicitly talked about designing for multiple senses, however that may be because most systems take multimodality as an assumption and don’t find it necessary to explicitly discuss it.

Not all of the papers focus strongly on usability. 3% of all papers (comprising 15% of all learning-focused papers) subscribe to Learner-Centered Design, which focuses on designing to improve the user’s understanding rather than improving usability. Additionally, some researchers emphasize challenge as being more important to the child’s experience than usability. 7% of papers explicitly valued challenging the child.

IDC papers indicate less focus on classical design ideas. Simplicity and reducing feature creep was mentioned to be important in 3% of the papers. Aesthetics and beauty were

only mentioned in 2% of the papers. Some at IDC have adopted the Interaction Design idea of designing for the users’ experience rather than a specific outcome and this value is articulated in 4% of the papers. However, these low numbers may perhaps show that the community involves fewer designers than technologists or educators, despite the focus on design in the name of the conference.

The IDC community has close ties to Computer Science and therefore emphasizes opportunities for design with new technologies. In 8% of papers the simple fact that a technology was novel or innovative was enough to warrant more in-depth examination by the community. Several of the authors with whom we corresponded phrased this value in a slightly different way as being “aware of the opportunities of new technologies,” “leveraging the technologies that are out there,” and “building up a picture of what might be possible.” On the other hand, another corresponding author emphasized that design should be “people’s needs driven rather than technologically driven.” Whether for better or worse, there is a decrease in seeing the novelty of new technological opportunities as a sufficient reason for further investigation in the later years of IDC.

As a community some authors have a particular interest in technologies that allow us to bridge the physical and digital. 10% of papers talk about this explicitly as a goal. This is further highlighted by the fact that 14% of papers strongly encourage the use of mixed reality (e.g., floor-based projection) and 26% of papers strongly encourage the use of tangibles in the design. All three of these categories are showing moderate to large increasing trends; this may be because the technology to make such designs possible is more widely available to developers.

IDC rarely discusses concerns about possible negative aspects of new technologies. Only 5% of papers discussed possible negatives such as concerns about increasing amount of screen time for children or concerns about online safety. There seemed to be evidence for this in correspondence with the authors as well:

*... we take a positive stance towards technology use ... rather than towards things that can go wrong or the negative effects of it.*

We also examined how technology related to current practices. Eleven percent of papers talk explicitly about leveraging current practices in order to drive the design. On the other hand, 2% of papers explicitly view technology as an opportunity to transform current practices and create opportunities for something entirely new.

Many authors mention intrinsic motivation and engagement that the child may have in using a particular technology. 13% of all papers found it important that the system designed be inherently desirable for the child or viewed as “cool.” 24% percent of papers addressed related concepts of enjoyment and fun. However, both of these values seem to be declining in the later IDC papers. It’s possible that these are becoming given assumptions that are no longer

explicitly discussed. It's also possible that similar ideas are now being evaluated under a different construct. For example, the number of papers that discuss or evaluate systems based on how engaging they are seems to have increased over the years. Twenty-four percent of all papers addressed the construct of engagement with a particular system. However, only 2% of papers discussed or evaluated whether the artifacts we design stay engaging after repeated use; perhaps, because of the difficulty of evaluating engagement over long term. In our correspondence with the authors, this value seemed to be more prominent as two authors called for more "mature" deployments that look at longer-term use "beyond initial pilot evaluations" and one specifically mentioned valuing "satisfaction rather than craving for the next new thing" as an experience with technology.

IDC may be different from other technology-focused communities because it seems to downplay the importance of efficiency and task completion—only 5% of papers focused on this (though there has been an increase in the later years of IDC). Additionally, only 2% of papers discuss the cost of their systems or worried about cost effectiveness. Appropriately, these papers appeared in years 2008 and 2009, which coincides with a time of economic recession for the authors of those papers.

## **DISCUSSION**

We present an interpretation of the findings of our analysis to compare self-ascribed and content analysis values, to identify the core values of the IDC community, and to present opportunities for IDC to grow and improve as a research community.

### **What IDC Authors Say vs. What IDC Papers Say**

We cannot provide a complete analysis comparing self-ascribed values with those discovered through our content analysis, because not all authors contacted have provided a response about their values. However, we looked at the value codes for those authors that did respond to our survey.

The survey was conducted over email so some of the authors may not have given as long a response as necessary to discuss all of the values inherent in the papers they have written. We wrote to the authors to explicitly inquire about inherent values in the work, motivations for conducting the research, the kind of change they want to make in the world and the context in which they see their work fitting into the IDC community.

While in the content analysis we assigned an average of 12 codes to the papers by responding authors, their emails contained an average of 6 different value codes each. The overlap between the self-expressed and content analysis values was not perfect. 22% of the total values for a given author were not ones that we identified through the content analysis. This can be due to the fact that we are not ideal coders, but this can also be due to the fact that it is not currently a common practice at IDC to clearly express the values inherent to the research in the body of the paper.

Values often go unspoken and thus undetected by our content analysis.

More specifically, authors tended to be more likely to discuss seeing children as active agents and valuing reflecting children's voices in the design in correspondence rather than in the text of their papers. On the other hand, the content analysis often assigned codes that may be more representative of practical constraints rather than personal values, such as including children only as testers in the design of technology (as opposed to design partners).

The emails also tended to focus more on the ideas of enjoyment, engagement, fun, and playfulness. They were also more likely to admit the work sometimes explored new technologies for the sake of novelty. In their emails, authors were more apt to discuss the benefit of formally examining our method than their body of work may suggest. In the correspondence, the authors were less also likely to discuss values that are taken for granted in the community, such as constructivism and the idea that tangibles are a particularly appropriate technology for children.

Overall, this points to the relative strengths of asking the authors directly about their values versus conducting a content analysis of their work. Self-report by the authors allows them to discuss values that may not have been explicitly expressed in the papers. On the other hand, the content analysis may uncover values that authors might not discuss in self-report because they find them to be obvious or uninteresting. The content analysis focuses more on what IDC investigators currently do, whereas self-report gives more glimpses of what IDC investigators find important and aspire to do. We hope that the combined approach taken in this paper gives a more complete idea of the values of the IDC community than would have been possible with just one method.

### **IDC Core Values**

Our analysis has allowed us to foreground some core values about who we are as a community. These are aspects of the conference that have remained fairly immutable through the nine years of its existence:

- Study and system contributions are represented fairly equally at IDC.
- IDC researchers are self-reflective and innovative in the methods they apply.
- IDC investigators are dedicated to supporting the child in social, intellectual, and creative growth.
- IDC authors distinguish the child as an active agent in the adoption of technology and the investigators design and/or evaluate their systems with children.
- IDC aligns strongly with the theories and models of Embodiment, Constructivism, and Constructionism.
- In our systems, we most value the technical constructs of naturalness and engagement.
- Technologically, we are drawn to designs that bridge the physical and the digital.

It may be helpful for new researchers to consider whether their work fits within this core set of values. While IDC is not static and is willing to accept change, investigations that do not fall within these core values may need to be more explicit and self-reflective about these differences.

#### **Opportunities for IDC**

After clustering the coded values, the authors of this paper discussed opportunities that emerged as the result of critical questions about how to inform the reflective process of stating motivations and values. The authors suggest the following for the purpose of discussion within the IDC community:

##### *More Widespread and Explicit Use of Theories and Models*

There are many other fields that focus on developing theories about how children learn, think, and relate to others. However, only a small portion of papers at IDC makes explicit references to such theories or models. This change may be emerging as more authors explicitly refer to motivating theories in the later years of the conference. However, it still seems that relatively few papers that contribute a study are informing their work with existing theory.

##### *Design for a Larger Variety of Ages*

The majority of IDC papers were targeted to children between the ages of 6 – 12. There were no IDC papers focusing on children under the age of two and few papers focusing on teenagers. These children have different needs than other children and may require new ways of designing and evaluating technologies. Investigating and addressing the needs of these groups would expand the body of IDC work and provide avenues for new insight and innovation.

##### *Better Alignment of Motivation and Evaluation*

In 8% of the full papers published at IDC, the introduction or motivation section introduces values and constructs that are not evaluated later in the paper. For example, the introduction may talk about the importance of learning to read, and the paper may describe a system aimed at teaching children to read, but the evaluation may focus on a construct like engagement with the system or usability rather than evaluating actual changes in the child's reading ability.

##### *Designing for the Entire Socio-Cultural System*

Some IDC papers seem to focus only on designing for the child that uses the system and not enough on designing for the entire social ecology that needs to be in place for the child to successfully learn and connect. The practice of involving multiple stakeholders in designing systems shows a generally declining trend at IDC. We are not suggesting that designers decrease emphasis on the child, but that they also be as passionate about partnering with the educators and parents who will help the system the child make the most of their experience.

##### *More Long-Term Evaluations*

The difficulty of deploying and evaluating a system over a longer period of time cannot be underestimated, however neither can the importance of doing so. Perhaps because

our evaluations are often short-term deployments, we focus on evaluating usability and engagement rather than long-term effects such as learning. Additionally, IDC rarely investigates whether the technologies we design remain compelling to the child after the novelty has worn off.

##### *Reflect and Explicitly Reveal Values that Drive the Work*

One of the main takeaways of this paper is that there are diverse ranges of values that drive our work. Many of these values go unnoticed (perhaps even unspoken, at times) because we share them. The values that are explicitly spoken in the work may be different from the core values held by the investigators. This may make it difficult for new researchers to interpret and evaluate IDC's contributions, understand its biases, and contribute meaningfully to its academic discourse. A danger of leaving the values in research unspoken is that researchers may fall into the trap of what Richard Feynman jokingly called "cargo cult science," as they mirror the rituals of rigorous work without an understanding of the underlying reasons or assumptions [5]. The outward appearance that research is not explicitly driven by values may create the illusion of objectivity.

Additionally, explicit foregrounding of values may allow us to better discuss value trajectories over time. Some of the core values members advocate now may be somewhat different from what they were at the onset of this conference (for example, the shift in emphasis from children as design partners to children as testers). These changes sometimes occur gradually and in the background rather than being made explicit and available as a topic for community discourse. To foreground these discussions, we encourage investigators to be explicit about their values when presenting their work to the IDC community.

#### **CONCLUSION**

We have presented an analysis of the values explicitly stated by authors in the papers during the nine years of 2002 to 2010 at IDC. We identified critical questions regarding the values that motivate the author's contribution, attributes fostered in the child, the populations they design for, the theories that guide research, and the evaluate criteria for the design of technologies.

This analysis may be valuable to existing IDC researchers to reflect on their process and consider explicitly identifying core values. It may also serve as a reference to new designers to orient and identify critical issues when considering how to approach designing for children.

IDC papers are generally thoughtful, explicit, and innovative. They create, evaluate, and put into practice new research methods for designing and evaluating technologies with children. Researchers at IDC aspire to design for many aspects of the child's life, not just learning in the classroom. They are consistently passionate about designing novel technologies that allow them to marry the familiarity of the physical with the opportunities of the digital. They are consistently conscious of giving the child a central role in designing and testing new technologies.

There are also a number of suggestions that could improve about how the community conducts and presents their research. IDC can design for a larger variety of ages, rather than focusing primarily on children ages 6 – 12. They could be more explicit about their theoretical perspectives and use more theories and models from other fields. They could work to better align their motivations and evaluations. They could partner more closely with the parents and teachers who affect how children adopt and use technologies. They could work to have more long-term evaluations of the technologies they design. Finally, we encourage IDC to be more reflective and explicit about the values that drive their research.

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