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Child-based personas: need, ability and experience

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Abstract Interactive technologies are becoming ubiquitous in many children's lives. From school to home, technologies are changing the way children live. However, current methods of designing these technologies do not adequately consider children's needs and developmental abilities. This paper describes and illustrates a new approach for creating user abstractions of children called the child-persona technique. Child-personas integrate theoretical concepts, empirically generated data and experiential goals. An analysis of the utility of this technique provides insights about how this technique can benefit designers by generating realistic child-user abstractions through a process which supports designers in child-centric design.

1 Introduction

Children are becoming frequent and experienced users of new technologies (Druin 2002). Meeting children's needs in deep and fulfilling ways requires that children be adequately considered in the design of technologies targeted to them. In response, researchers have begun to experiment with ways that participatory design techniques can be modified for work with children. While some progress has been made, there are often significant policy, legal or ethical issues which prohibit the active participation of children in the design process. A second option for representing children in the design process is the use of rich, realistic and specific representations or abstractions of children. However, child-specific methods for creating such representations, which are both systematic and responsive to the design context, have yet to be developed. User representation techniques which have been specifically adapted to model the age-specific characteristics of children are required.

Another motivation for this research was the search for ways to draw on the rich theoretical foundation of information about children in ways that could be used in design. Using theory to inform design practice is challenging (Rogers 2004). Piaget's stages of cognitive development are commonly over-generalized or misapplied in interaction design for children. Guidelines and analytic frameworks based on theory often have limited utility in design. Alternative approaches which translate theory into forms which can guide design, focus on process and support designers in ways which work for them are required.

This paper describes, illustrates and analyzes a new approach for creating user abstractions of children called the child-persona technique. The child-persona technique began with practice-based explorations of how to use developmental theories in the design of children's online play and learning environments. This work was carried forward into a project to redevelop the CBC4Kids.ca web site for the Canadian Broadcasting Corporation (CBC) [as described in Antle (2003, 2004)]. In response to the initial lack of access to children as design partners (Druin 1999) or informants (Scaife and Rogers 1998), Cooper's method for creating and using adult personas was investigated. During the CBC4Kids.ca project, the method was significantly modified to make it suitable for creating abstractions of child-users. It was further refined during subsequent work at Simon Fraser University. In this paper, the

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technique is illustrated in the context of the CBC4Kids.ca redevelopment project.

The technique is expected to reduce designer's assumptions about children by providing a theoretically, empirically and experientially grounded framework for creating child-personas. It is also expected to result in engaging, complex and realistic representations of child-users which support designers in child-centred design. Research questions stem from these expectations and previously stated motivations.

1. Do the resulting artifacts (i.e., child-personas) accurately represent children in the context of use for a particular design situation?
2. Does this technique support designers in the process of child-oriented design work?

Investigation of both the technique and the resulting artifacts is important. For example, it is possible that a specific instance of child-personas could misrepresent children or misinterpret theory, while at the same time the process itself could have a beneficial impact on design through the mechanisms of awareness and education. The paper concludes with a qualitative analysis of this technique using a set of criteria derived from social sciences research: objectivity, reliability, credibility, praxis validity and transferability.

2 Related work: adult-user abstractions

Abstract representations of users originated in marketing and were later modified for use in design. In ''Crossing the Chasm'' Moore (1991) discusses the idea of target customer characterizations, which are broad, archetypal descriptions of user groups. Others have presented methods to generalize and personify demographic and market segment information in ways which can be used in design (Grudin and Pruitt 2002; Mikkelson and Lee 2000; Pruitt et al. 2001, 2003). Cooper has been attributed with the popularization of the use of personas in design (Cooper 1999; Cooper and Reimann 2003). In Cooper's terms, a persona is essentially a user archetype created in a design context (Cooper and Reimann 2003). Since their introduction, others have built on Cooper's work (Beyer and Holtzblatt 1998; Grudin and Pruitt 2002; Pruitt et al 2003). Personas have also become a popular component of scenario-based design approaches (e.g., Rosson and Carroll 2002).

To date, methods for creating user representations have not been systematically applied to work with children. There are several barriers which make the direct application of these methods to child audiences either difficult or unrealistic. First, these methods rely on market research and field work. Market research for children is rarely segmented beyond broad age ranges and gender. Field work often relies on the interpretation of adult-caregivers and teachers and can lack a true ethnographic focus, leaving interpretation susceptible to observer's assumptions and biases. Second, it is hard to reveal children's needs, attitudes, and behaviors using interviews or participatory techniques. Children that are less than 10 years old have great difficultly with abstraction and conceptual problem solving (Piaget 1971; Singer and Revenson 1996), skills which are integral to most interviewing and participatory design techniques. Problems introduced because of the power imbalance between adults and children have been well noted (e.g., Druin 2002). As well, designers not trained in child development often have difficulty interpreting children's behaviors and articulations. Third, these methods are often based on the assumption that users' actions are goal-directed and task-driven and that the context of use is productivity oriented. Lastly, the methods rarely incorporate theoretical information—which is arguably more important with child audiences since children's needs, abilities and skills are not the same as adults and change as children age.

3 Child-persona framework

One of the key differences between existing techniques for creating adult personas and the method presented here is the use of a child-persona framework. The term framework can be used to refer to a model, a description, a prescription or a form of guidance. Traditionally, a framework is derived from a theory or set of assumptions about a phenomenon. In design, frameworks have recently been based on design experience and generalizations from user studies (Rogers et al. 2006). The child-persona framework was derived from theories (about children) and practice-based experience (about what it is important to know about children in design). It can be used to help designers understand children and provide a systematic yet responsive way to inform, guide and document the creation of child-personas.

The three dimensions of the framework are:

1. Childhood needs
2. Developmental abilities
3. Experiential goals

The first two dimensions of the framework are reusable for multiple projects. They are based on theoretical understandings and empirical findings taken from children's developmental psychology. The third dimension is project specific and explores experiential product goals.

3.1 Dimension 1: childhood needs

Several authors have pointed out that most successful products for children are not so much goal or task oriented (as many adult products are) but instead meet specific needs which are common to large groups of children in a particular age range (Antle 2006a; Fishel 2001; Just Kid Inc 2000). The focus of the ''childhood needs'' dimension of the framework is used to create personas which represent broad groups of children by identifying, describing and understanding themes which capture the interplay between common childhood needs and children's behaviors, thoughts and feelings.

A review of child development literature revealed agreement on the importance of the following four themes of childhood (Antle 2006a; Bee 1995; Berger 1986; Brazelton Greenspan 2000; Just Kid Inc 2000; Myers 2005; Pringle 1986; Wartella et al. 2001):

- Theme 1. The need to balance love and security with independence
- Theme 2. The need for positive social relationships
- Theme 3. The need for mastery in learning
- Theme 4. The need to attain power and control

These four themes are not the only needs of children. For example, identity is another important theme. Nor are they exclusive to children. For example, teens and adults also have a need for positive social relationships. However, these four themes provide a solid framework for designing many play or informal learning products targeted to children including the CBC4Kids.ca web site redevelopment [as described in Antle (2006b)]. The framework can be used to focus on one or more themes as relevant to a specific design situation.

Reflection on personas created during the CBC4Kids.ca project suggested that incorporating theoretical explanations as well as descriptions of children's needs would help designers better understand children. As a result, an analysis of specific, complementary theoretical frameworks in developmental psychology was done to provide theoretically and empirically based explanations for these themes. This information supports designers to create personas which contain both descriptive and explanatory narratives rather than simple descriptions. This framework dimension is meant to guide designers and give them ''things to think about'' rather than provide comprehensive coverage of these rich topics. A brief summary of the theories drawn on are detailed below.

3.1.1 Theme 1. Love, security and independence

Children's need for love from their caregivers and the security of stable family relationships are in juxtaposition with their need to be independent (Bee 1995; Brazelton Greenspan 2000; Grossmann 1995; Just Kid Inc 2000; Pringle 1986).

This theme can be explicated using attachment theory which provides an ethological perspective on development. Pioneering work by Bowlby and Ainsworth provides empirical evidence that children's need for love from their caregivers and the security of stable family relationships are fundamental to a successful childhood (Grossmann 1995). The strength of a child's initial attachment to one or more dominant caregivers determines the quality and nature of much of their later interactions with peers and adults. Another important attachment factor is the way children are treated when they return from exerting their independence.

What children need are ways to cope with leaving the security and safety of home and parents to enter to the riskier but more exciting world of peers, school and other extracurricular activities. To develop successfully, they must have the opportunity to safely explore beyond the world of their families, be exposed to a range of new experiences and be welcomed back when they are ready to return.

3.1.2 Theme 2. Positive social interactions

Equally important to children's development are their needs to have positive social interactions and develop rich social relationships with family, caregivers and peers (Rubin et al 2005; Schneider 2000).

Cognitive social learning theory and recent findings from cognitive neuroscience suggest that children acquire knowledge and behaviors through social interactions by observing and imitating the actions of family and peers (Bandura 1977; Blakemore and Frith 2005). The nature and quality of social interactions is important to development. Sociocultural theory proposes that the social world mediates individual cognitive development. Through social interaction with older peers and adults a child learns to problem solve, first together and then individually. Social competence and self-perception develop for a lifetime from childhood encounters (Van Der Veer 1994).

What children need in order to develop into healthy, secure and mature adults are positive social interactions and opportunities to watch others as they act and interact. The need for positive, nurturing social interactions emerges from this context.

3.1.3 Theme 3. Mastery in learning

Children need the opportunity to actively participate in learning experiences and to develop a sense of competency, called a mastery orientation, in doing so.

Piaget's constructivist theory explains children's need for active participation in learning. It is widely agreed that

it is through interaction with their environment that children construct knowledge. Differences in the way that children respond to challenges in learning have been explained by Heckhausen and Dueck [as described in Hetherington et al. (2006)]. Children can respond to new learning situations in one of two ways: *helpless* or *mastery-oriented*. Mastery-oriented children view intelligence as incremental and built up through practice. Children labeled *mastery-oriented*, respond with sustained or improved performance on difficult tasks. *Helpless-oriented* children view intelligence as a preset entity which they either have or do not have. When presented with a difficult problem, children labeled helpless responded by giving up easily or showing deteriorating progress. The structure of the learning environment, nature of feedback and level of challenge are key factors which promote or inhibit the development of a mastery approach to learning.

What children need are active opportunities to develop mastery in learning in order to carry this attitude with them throughout their life.

3.1.4 Theme 4. Control and responsibility

Children crave experiences where they can play out control and have power over their environment or others. The wild commercial success of action figures with superpowers (e.g., Power Rangers, Transformers, Rescuers) attest to the need for children to imagine they are extraordinarily powerful.

In part, this is because children have little control over the events and routines of their lives. Often surrounded by adults and older children, children rarely have opportunities to exercise power or control, either physically or socially (Bee 1995; Pringle 1986). According to Turner and Weisz, children's beliefs about their abilities to exert control over a situation strongly determine their coping strategies [as described in Hetherington et al. (2006)].

How this need is met is critical to healthy emotional, social and moral development. What children need is to learn to take responsibility for their decisions, to be given opportunities to be in control and understand the consequences of their actions.

3.2 Dimension 2: Developmental abilities

Children's developmental abilities and limitations are included in the framework to ensure that the product is matched to the age of its audience (Baumgarten 2003; Bruckman and Bandlow 2002). The initial version of the child-persona framework included generalizations based on Piaget's age-dependent stages of cognitive development. For example, for a target audience of 8–12 year olds, children were assumed to need concrete examples of concepts and operations. Abstraction and metaphors were avoided in design. Experiences with children and a deeper reading of the cognitive development literature led to a revised approach. Researchers of children have criticized Piaget's almost hegemonic influence on developers of interactive media and educational technologies for children (Graue and Walsh 1998; Inagaki 1992). While few challenge Piaget's constructivist view that intellectual development consists of a series of constructions, many researchers have challenged Piaget's structuralist view that development proceeds through invariant sequential stages regardless of domain. An alternative perspective is that a child's competence may vary from domain to domain (Inagaki 1992). For example, Gelman (1979) suggests that preschool children have domain specific organizing structures which make them more competent in a specific domain than Piaget's stages would suggest. In addition, although Piaget acknowledged the role of socio-cultural context, many interpretations of his work ignore this facet (Robbins 2005).

Recent findings from neuroscience have been interpreted to suggest that children have critical periods of neural development and need enriched stimulation in these periods. However, a closer reading of the literature reveals support for the idea of flexible, non-rigid sensitive periods of development (versus pre-set critical periods) (Blakemore and Frith 2005). For children to develop normally, they must receive appropriate sensory input from the environment at each stage. The implication is that children with sensory abnormalities which cause deprivation may have lasting difficulties. There are no implications for normal children. The amount of stimulation required is readily available in children's everyday environments. It is also important to understand that the animal studies upon which these ideas are based compared rats in normal and deprived environments. Findings were that normal environments lead to more synaptic connections than deprived environments. There is no support for the necessity of environments enriched beyond the normal everyday world most children experience (Blakemore and Frith 2005).

While researchers recognize that all children develop differently and that individuals may differ substantially, general developmental characterizations are still useful for creating personas. Instead of characterizing children only by development stage, the framework identifies the areas of motor, social and cognitive development where age specific limitations may exist. Children's limited abilities are important because they can be used to constrain and refine designs. Limitations and age cues, derived from literature on children's abilities (e.g., Bruckman and Bandlow 2002; Fishel Fishel 2001; Hourcade et al. 2004) were outlined by major category (e.g., social, motor, cognitive) in framework so that they would be incorporated into persona profiles. However, rather than viewing these as preset rules,

they are viewed as areas for exploration. This framework dimension is meant to alert designers to things to watch for rather than provide a set of rules.

3.3 Dimension 3: Experiential goals

The first two dimensions of the child-persona framework can be used to create personas across a range of design situations. To be useful in a particular design context, the personas must be contextualized. During adult-oriented persona creation, this happens when product goals, as defined by marketing, are translated into life, experience and end goals. The end goals are the primary focus of persona creation and are typically task-oriented (Cooper 1999). For the design of children's products which support play or informal learning, the goals can be formulated as experiences that the product should support. The third dimension of the framework describes experiential goals using action modes. An experiential goal is an experience that children will have using the product (McCarthy and Wright 2004). *How* the product might support children to have this experience was described using action verbs called *action modes*. The experiential goal and action modes are not the goals of children per se, but goals and actions which have been envisioned based on product goals and contextual and interview data. This dimension is used to provide designers with examples of archetypal ways that children might experience a particular product or designed environment.

4 Procedure: creating child-personas

Reflection on the CBC4Kids.ca process resulted in the identification of the following activities. These activities can be begun once the first two dimensions of the framework (which are reusable) have been completed.

1. Determine experiential goal(s) and action modes
2. Tune framework to design situation
3. Operationalize framework through questions
4. Data collection (interviews, observation)
5. Pattern analysis informed by framework
6. Synthesize patterns into personas characteristics and develop narratives of personas
7. Document sources
8. Compare personas and reduce in number
9. Check for completeness
10. Validate through usage-revise as necessary

Cooper's procedure begins with the creation of persona hypotheses (Cooper and Reimann 2003). The child-persona technique begins with an exploration of the experience goals. In parallel, the first two dimensions of framework are fine-tuned to the design context. Then concepts and categories from all three dimensions are operationalized as questions. The resulting framework ''template'' is used to support data collection, pattern analysis and information synthesis. The resulting information is crafted into persona narratives. A good deal of writing skill is required to make these narratives rich, believable and realistic. During narrative creation, sources of information are documented. Personas are consolidated into the smallest representative set possible and validated with child-experts and with children in design sessions.

4.1 Respond and repeat

Child-personas are not created using an exact linear sequence of steps. The activities listed above can be initially sequenced in a linear fashion. However, they can also be repeated in order to respond to specific unknowns, design tradeoffs or opportunities in the persona creation process. In this way, the procedure involves an investigation of children in the context of a particular design situation (Wakkary 2003).

4.2 Time commitment

The first time child-personas are constructed may be time intensive. Creating the framework required team members to read and re-read a broad range of developmental literature (as summarized here). The data collection phase can also be time consuming. However, having rich sources of contextual information and deep understandings of children's needs and abilities may result in decreased time spent during design and re-design. For example, idea generation draws on this wealth of information. In addition, the ability to reuse support documents and data collected for the first two dimensions (i.e., needs and abilities/limitations) makes subsequent persona construction more efficient.

5 Illustration: Cbc4kids.Ca personas

The process of creating child-personas during the CBC4Kids.ca redevelopment is detailed here to illustrate this method. The technique was used in the development of online storytelling, mentoring and news activities for Canadian children, aged 8 to 12. Bricolage involves using materials at hand to solve a problem (Papert 1992). For the CBC4Kids.ca project, bricolage was as important as structured and logical process. For example, data collection and analysis on specific aspects of peer-mentoring yielded rich, context specific information. It also provided the insight that children wanted an active, independent way to experience mentor profiles. This information was included in personas and reflected in the design of a mentoring

activity where children could actively explore a day in the life of young adult mentors using a movie timeline (Antle 2006b). The main interface for WalkAbout is shown in Fig. 1. In order to avoid persona plasticity, the validation and documentation activities were critical.

5.1 Experiential goal and action modes

A two day workshop with 30 CBC Children's television and new media employees and 20 children, aged 9–11 was held as part of a teambuilding exercise at CBC. The workshop was held at a children's play-based theme park, called Playdium (Toronto, Canada). Teams of children and adults competed for points throughout the workshop. Points could be accumulated through play-based activities in the theme park or through adult-oriented challenges which required solving clues and navigating through the city of Toronto. A week after the workshop, a group of six senior producers and executives participated in a brainstorming and affinity diagramming session. This resulted in the identification of the following experiential goal: The CBC4Kids.ca site should support children to have the experience of being part of the world. The group also envisioned ways (action modes) that children could have this experience. Two additional action modes were added based on results of contextual and intra-generational interviews. The final action modes included:

- To know: knowing about the world
- To do: doing or making in the world
- To shape; shaping or impacting the world
- To belong: finding a sense of belonging in the world
- To connect: connecting to others in the world
- To dream: dreaming about their place in the world.

There are many ways (some much less time intensive) to identify experience goals for a project. Post-project analysis revealed three important characteristics of the process which can be generalized. First, activities and information that immerse team members into children's worlds are a prerequisite to creating experience goals from children's perspectives [see Antle (2004) for other team immersion exercises]. Second, the goals should be about one or more *felt* experiences not only about *actions*. However, it is also important to envision *how* children might achieve each experience. For example, children can be supported to feel that they are part of the larger world using the action mode of doing (or making). In the story telling activity, children collaborated to make stories and publish them on the CBC4Kids.ca site which had over 100,000 viewers. Third, the goals should be validated with real children for authenticity. None of the goals concerned the oft cited design goal of ''engagement.'' We predicted that if children were involved in activities which met their core needs and allowed them to feel connected to the world, they would be engaged. Summative evaluations including observational sessions with children and analysis of server data provide support for this assumption (Antle 2003, 2004). For example, the CBC4Kids.ca web site received over a million visits with an average session time of 20 min during the first 3 months of its pilot phase.

Fig. 1 Explore dancer mentor

5.2 Operationalize framework

The framework was operationalized by transforming the content in each of the three dimensions into questions. These questions are used to inform and guide designers as they create personas. The experience goals and action modes were operationalized as questions in the context of each of the three online activities. For example, two action modes were translated to questions specific to the online mentoring activity as shown in Table 1.

The childhood needs themes were operationalized by combining explicating concepts with need descriptions and translating them to questions. The wording of questions in the templates was intended to direct designers to notice behaviors as well as make interpretations. The template excerpt shown in Table 2 exemplifies how Theme 1 and concepts from attachment theory were operationalized.

The developmental abilities categories were operationalized by creating questions to explore limitations that

Table 1 Sample online mentoring questions for action modes

To know
How does s/he find out about people in the world?
Where does s/he look for mentors?
To shape
When does s/he feel like s/he's made a difference to others in her/his world?
How does that feel to him/her?

Table 2 Sample general questions for childhood needs

Need for independence
How does s/he express his independence?
When does s/he feel independent?
When does s/he feel confined? How does s/he respond to this?
Need for security
When does s/he feel safe?
What behaviors exhibit his/her attempts to find safety?
What makes her/him feel insecure? How does s/he cope with feeling insecure?
How have these feelings and behaviors changed in the last year?

Table 3 Sample general questions for developmental abilities

Fine motor skills
Does s/he have difficulty selecting iconic targets?
Reading ability
How much text is he/she comfortable reading?
Social skills
Does he/she cooperate in online activities?

children, aged 8 to 12, might face when using a complex flash-based web site, as shown in Table 3.

5.3 Data collection

Data collection was the part-time focus of five development members for 4 weeks and involved a range of techniques. Using the framework as a way to respond to and take advantage of specific opportunities is more important than the use of any one data collection technique. However, the triangulation of data gathered through contextual observations, interviews with children and sessions with child-experts provides some assurances of objectivity. Data was also repeatedly collected during the design phase using informant based sessions. The sessions were designed in response to specific questions about personas and issues related to design. For example, an exploration of the use of comix style speech and thought bubbles in a graphical interface showed that both boys and girls were comfortable writing their thoughts and feelings using this approach (shown in Fig. 2) (Antle 2004). Comic books were then added to a male persona as a concrete example of how boys can meet some of their needs to balance security with independence and feel powerful through the action mode of knowing (reading at an age appropriate level).

5.3.1 Contextual observation

Studies of children in homes, schools and public spaces provided contextual information. Pairs and trios of

Fig. 2 Comix style interface

designers visited six pairs of children, aged 9–11, in the homes of friends and family in the evenings after work. One designer was designated as the facilitator and interacted with the children. He/she asked the children to show and talk about their favourite toys, web sites and games in order to gain insight into how these products met children's needs. The other designer(s) remained in the background and took notes using the framework questions to interpret observations. Team members alternated between facilitator and observer.

A team of three designers visited a classroom of 25 grade 4 students, aged 9 or 10. They worked with groups of children to explore the experiential goal, action modes and again asked them about their favourite activities related to storytelling, mentoring and news. As suggested by Beyer and Holtzblatt (1998) they took time immediately after these sessions to debrief, expand and annotate notes. Ideas for subsequent sessions were noted.

The team also had weekly homework assignments which involved observing children in public spaces (e.g., science centre, public transit, playgrounds). They gathered notes on their observations of the kinds of games and activities children played, how they talked to each other and how they related to adults. They compared their estimates of children's ages, discussed any discrepancies between expected age-related developmental abilities and their observations.

Together, these approaches resulted in rich, specific information about children's needs and abilities in the experiential context of the design activities.

5.3.2 Artifact and activity analysis

For each of 4 weeks, the team analyzed successful children's artifacts or activities in the context of the experiential, developmental and childhood needs dimensions of the framework. For example, after a classroom visit the ''add-a-sentence-to-the-story'' activity was presented as an

example of an activity where children worked together in a positive way to create a fun story. Analysis indicated that the activity afforded children the age appropriate ability (i.e., non-written storytelling) to interact positively with peers (Theme 2), have success at an activity (Theme 3), create a story (shaping), be in control of the story (Theme 4) in an active way (doing).

5.3.3 Adult interviews

Six parents and five experts (e.g., teacher, librarian, education researcher) were interviewed. Questions explored how children behave as they try to meet the four childhood themes in the context of the experiential goal. This activity was also important to validate previous findings from contextual observations and artifact and activity analysis. For example, notes from contextual sessions had identified children's complete absorption in reading (e.g., Lemony Snicket) and story-time (e.g., Wizard of Oz). An interview with a children's librarian elucidated how these particular stories provided examples of protagonists that help children deal with the dueling forces of love, security and independence (i.e., Theme 1).

5.3.4 Intra-generational interviews

Exploring childhood need themes with children was much more difficult than asking adults about these themes. To reduce the power imbalance inherent when working with children, seven children (aged 9–11) were interviewed and videotaped by a 15 year old (Fig. 1). The 15 year old provided us with an edited video tape of these sessions. The interviews were based on open ended questions related to the experience goal and action modes. For example, ''How do you know when you *belong* in the world? How does that feel?'' The results were surprisingly candid and emotional. The footage validated the relevancy of the experience goal as approached through the action modes. We also used this data to look for verbal and behavioral examples we could include in our personas (Fig. 3).

5.3.5 Informant-based design sessions

Details of informant based sessions are discussed in (Antle 2003, 2004, 2006b).

5.4 Pattern analysis

As the team interacted with children and collected data, they were guided by the operationalized framework. After 4 weeks of part time data collection activities, a brainstorming session was conducted. Seven team members used sticky notes to cluster recurrent patterns of behaviors

Fig. 3 Intra-generational interview closeup

and verbalizations taken from the observational and interview data according to framework categories. That is, instead of focusing on clusters of like behaviors, behaviors were associated with the underlying needs, abilities or experiential goals which produced these behaviors. The framework provided a means to group juxtaposing patterns into similar themes. For example, verbalizations about longing to grow up and leave home (girls) or run away from home (boys) and behavioral observations of attempts to get adult attention and feedback (both positive and negative) can all be interpreted in the context of Theme 1.

The results of the pattern analysis exercise allowed the team to connect concrete behaviors and verbalizations with underlying understandings. This process brought richness, realism and believability to the persona narratives.

5.5 Synthesis and development of narratives

Synthesis involved integrating information from the three dimensions. For example, data revealed that children met their needs for positive social interactions in the context of doing activities (playing tag), shaping (co-creating stories) and connecting (often through physical rough-housing and teasing). It is difficult to identify archetypal patterns of behavior using small numbers of children. The framework provided understandings which helped us cluster different behaviors around the same need themes and action modes.

A set of fifteen personas was fleshed out by seven team members following guidelines based on (but not limited to) Kim Goodwin's suggestions in the article ''Perfecting Your Personas'' (Goodwin 2002). Details of each persona included: name, photograph, age, hobbies, specific socio-economic situation, family structure, school, friends, talents and aptitudes. Sections on each childhood need theme included exemplars of ways that children behave, think and feel in response to these themes in the context of the experiential goal, action modes and online activities. Details from the developmental abilities questions and field

data which were relevant to each online activity were incorporated into persona descriptions to ensure that interactions were well-matched with children's abilities. For example, Rachel, a feisty, intellectual 11-year old persona gained insight into the security versus independence theme through reading novels about protagonists leaving the safely of home, having a great adventure and then returning home. Dodge, a 10-year old male persona met the same need by voraciously reading comic books. Personas were further fleshed out by writing a narrative of 1 day in each persona's life.

5.6 Documentation

Documentation of data sources has been identified as a key aspect of validity (Grudin and Pruitt 2002). The framework was used to organize and relate specific persona characteristics with source data.

5.7 Compare and reduce

To reduce the number of personas to a usable set, they were combined eliminating some while still preserving the comprehensiveness of the set. We used the Myers Briggs to check that the persona set was balanced across the four criteria:

- Extraversion–Introversion
- Sensing–Intuition
- Thinking–Feeling
- Judging–Perceiving

The end result was six personas. The two personas which represented the widest difference across many characteristics (personality, level of abilities, socio-economic class, family status, gender, etc.) were designated as primary as described in (Antle 2006a, b).

5.8 Completeness and validation

The six personas were highlighted in the team office by posting their photos and profiles, imagined quotes and preferred artifacts. The practice of thinking and talking about the primary personas Rachel and Dodge in all team discussions was instilled. Team members were encouraged to say things like ''I do not think that Rachel would understand what that meant.''

As the personas began to be used in design, we identified places where the personas were incomplete. These were addressed by using child-informant-based sessions to solicit missing information from children (e.g., What do you think Rachel does when she does not feel safe?) as well address particular design issues (e.g., naming activities, exploring comix-based interface styles).

Personas were validated by using them as a design tool during design sessions with children. We introduced groups of children to one or two personas and then asked the children how they thought the personas would react to a particular design. This helped the children work together, provided immediate feedback on the validity of the personas and reduced the power imbalance common in work with children. The value of personas as a tool for design is one of the most important contributions of this method to child-oriented design and evaluation work (Antle 2006b).

6 Analysis

It is difficult to quantify how well this technique produces realistic abstractions of children or how well the technique supports designers in child-centred design. However, a qualitative analysis can elucidate the ways in which the technique accomplishes these goals. Following from Svanaes and Seland, the quality of a design method can be analyzed like a social science research method (Svanaes et al. 2004). Here the object of study is children in particular contexts (i.e., as users of story telling, mentoring, and news online activities). The child-persona technique produces representations of these children which can be used by designers to create online activities. The quality of the technique can be assessed using similar criteria as that used to evaluate social science research.

There is some agreement that objectivity, reliability, and internal and external validity are important evaluation criteria. Guba and Lincoln (1989) argue for more naturalistic conceptions of validity in the social sciences. For example, they suggest replacing internal validity with credibility and external validity with transferability. Credibility refers to establishing that the results of qualitative research are believable from the perspective of the participant in the research. Transferability refers to the degree to which the results can be generalized or transferred to other contexts or settings. These definitions make sense in the context of interaction design work. Gruae and Walsh describe praxis validity in contextual research as validity which refers to how much ''good'' the research will do.

6.1 Objectivity

Does the technique support the creation of representative (i.e., archetypal) groups of children? Does this technique help designers overcome their personal subjective constructions of children?

The role of designers is to use the theoretically informed framework to create personas. While it is impossible (and undesirable) to eliminate all creative input from the persona narratives, the goal of the technique is to reduce

designer's reliance on assumptions and personal experiences with children or as children. The use of expert reviewers and a video-taped intra-generational interview technique creates a triangulation which supports objectivity in data collection and interpretation. Linking specific aspects of persona narratives to source data reduces subjective interpretation. Including the entire team in the process of persona review, combination and consolidation reduces the impact of individual personalities on both the content and process. However, the interpretation of data, creation of person narratives and usage decisions all remain subjective.

6.2 Reliability

To what extent will the application of this technique produce similar personas for similar design contexts? Can this technique be consistently used?

The use of the framework supports reliability in its role of guiding collection and interpretation of data. Before comparative studies can occur, this technique must be applied by other teams. In part, the goal of this paper is the communication of the method for this purpose.

While the quality of personas may vary from project to project, the impact of the personas on design is expected to be more reliable and repeatable. By exposing the team to this process, increased awareness and understanding of common characteristics of children are supported. Thus, team education is a reliable outcome of this process.

6.3 Internal validity (credibility)

Are the resulting personas accurate in their contextual interpretations of theories of child development? Are the resulting personas believable by children?

It is difficult to determine if personas realistically represented archetypal characteristics of children without some form of expert review. Instead of reviewing personas directly, experts were used to assess design outcomes. Again, this provided valuable information on both the design and the persona set. Information from this process can be used to modify designs and adjust personas. The weakness of this approach is the possibility for over-generalizing a single expert's comment and using it to modify or create a description of an archetypal characteristic. The use of the framework as an explicating tool may reduce this tendency.

The framework supports the theoretically informed study of children in the context of their everyday lives. The quality of outcome is dependent on the skill of team members during data collection, pattern identification and construction of narratives. Resource and time constraints will also determine the quality of outcome.

The child-persona technique explicitly includes a validation step by using personas in children's informant-based sessions. Rather than asking children directly what they thought of personas, the personas were used to generate feedback on design issues. Children were involved in informant-based sessions where designs were explored from the perspective of the personas. For example, during an exploration of the core mechanic for the story telling activity, three groups of four children were each asked ''Do you think Rachel would like this story creation activity?'' This approach generated data which either supported or challenged both the design and the persona. It also provided a mechanism for revision. We avoided asking children directly if they related to and liked a persona because children often like and relate to fictional characters that are not representative of real children (e.g., Daffy Duck, Charlie Brown). For example, the persona may appeal to children because of the way it characterizes or exaggerates only certain qualities.

6.4 Praxis validity

Are the personas impacting important aspects of the design process? Will this technique be both dependable and responsive to a design situation?

The childhood needs and abilities dimensions of the framework provide reusable content across design projects. The inclusion of the project specific experience goal and action modes provides a contextual approach to data collection and interpretation. It is a lens through which designers can view children in the context their everyday activities related to design themes. The process of responding to and repeating certain activities in the persona creation process allows designers to adapt and use this process in ways that support their own work processes. However, it is the responsibility of designers to reference personas accurately, identify gaps and respond to these through further data collection, analysis, application and validation. The team approach to persona review and consolidation as well as the external validation with children provides a guard against subjectivity. In this way, this technique is both systematic and responsive.

Another way to assess praxis validity is to compare when and how personas, child informants and child testers were of value to the design process. Results of this brief analysis indicated that the personas were much more valuable during the generative phase of design than during the evaluation sessions (Antle 2006b). Since idea generation is where participatory sessions with children often falls short, personas fill an important gap. During usability testing, child-personas were used as actors in cognitive

walkthroughs. The results of persona walkthroughs revealed attitudes towards exploration but did not identify developmentally based problems with flow or labeling. Conversely, user testing sessions with children revealed many serious usability problems which had not been flagged during persona walkthroughs.

6.5 External validity (transferability)

Can the personas be reused in other design contexts?

This technique supports reuse through structure and documentation. The separation of structure (framework and questions) and content (data) is expected to result in reuse of the questions derived from the framework and substantial portions of the data. The separation of variable experiential goals from invariant developmental needs and abilities also supports reuse. The focus of persona creation may be on different childhood needs themes from those used for CBC4Kids.ca. These themes would have to be described and explicated through analysis of theoretical approaches before persona construction can begin.

7 Discussion

The implementation of the child-persona technique is not without difficulties. It is challenging to translate theories from psychology to concepts that can be used in interaction design. The development of the child-persona framework by necessity involves simplification of complex theoretical constructions. However, the identification of descriptive themes of childhood needs in conjunction with underlying explanations may minimize the negative impact of these simplifications.

The process for creating experience goals is context dependent and more synergistic than systematic. The value of the experience goals should not be underestimated. Designers often found that questions based on the action modes and experience goal produced more tangible descriptions than questions about children's needs, which were often latent and not easily revealed. The intra-generational interviews helped to address this difficulty. The summary of the kinds of data collection activities used in CBC4Kids.ca provides some guidance for future teams.

The success of personas in design has, in part, been attributed to the vibrancy of their narrative details (Antle 2006a). It is the small details, such as Dodge's habit of eating Spagetti-O's one at a time, that brought him to life and reinforced his presence through a 6 month long design cycle. This requires the imagination of a skilled writer. It is suggested that if this talent does not exist on a design team, that the work be outsourced. This can occur after the informational aspects of the core persona set are completed. These details are the finishing touches.

The analysis of how well this technique represents children in the design process is interpretative and qualitative. While there is a distinction between the technique for creating child-personas and the methods for using them in design, the two are interwoven and may be hard to separate in practice. For example, it is difficult to determine if the process of revising personas after design sessions with children is part of persona creation or use. The process of re-creating them results from using them and thus the two are linked through a kind of circular causality. It is also difficult to determine if the value in this technique comes from the framework or from the persona set. It is specific aspects of the persona (e.g., photograph, day in the life narrative) which make the information contained in the framework accessible in the design process. However, the process of creating personas using the framework is highly educational for the design team. It is difficult to attribute causality to either in isolation. For example, it is likely that the visual presence of personas reinforces the learning from the process of creating them using the framework. An initial attempt to illustrate the impact of personas as a design method is outlined in (Antle 2006b).

8 Conclusions

The analytical assessment of the child-personas technique reveals both strengths and challenges. This technique provides a new way to use theoretical information to create child-user abstractions or archetypes. It may also be an important technique to use when designing experiences for adults that rely on needs rather than work or productivity goals. The technique is educational for designers. It allows them to be responsive to a design situation and gather information that supports specific design ideas, issues and challenges throughout the design process. One challenge is to find ways to reduce subjectivity of creating experience goals, operationalizing the framework and synthesizing information into personas.

Next steps involve developing experimental situations in which designers and researchers can apply, replicate, compare and assess this technique for child-persona creation.

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