Developing the Adult Child Interaction Inventory

A Methodological Study

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ABSTRACT

The Adult Child Interaction Inventory (ACII) was developed as part of a research to practice collaboration between the Boston Children's Museum and Evergreene Research and Evaluation. Preschoolers, Parents, and Educators: Strategies to Support Early Science Literacy (PPE), funded by the National Science Foundation and led by Boston Children's Museum aimed to better understand the range of *non-verbal* as well as verbal interactions that occur between adults and children during collaborative science investigation. Results of project research contributed to the development of an exhibit, Peep's World, at the Boston Children's Museum that was designed to optimize such positive adult-child interactions. The Adult Child Interaction Inventory was used throughout the project to help develop and ultimately evaluate the exhibit. The study examined adult-child interaction from the point of view of the adult, looking less specifically at what the child was doing. We identified six roles that appeared regularly, some with more frequency. Within each role we identified specific observable behaviors to aid in coding with the instrument. The list of behaviors was refined with each trial of the instrument. In addition to developing the instrument we also created training materials including a training manual and a DVD with video clips of families in the Peep's World exhibit. These video clips clearly illustrate the six identified adult roles.

TABLE OF CONTENTS

INTRODUCTION

Prior to the PPE project, the majority of family learning research had been conducted in science museums among families with verbally competent, school-age children in which the quality of "family talk" served as the gauge for an exhibition's success (Borun, Cleghorn, & Garfield, 1995; Borun, Dritsas, et al., 1998; Crowley & Galco, 2001; Crowley, Callanan, et al., 2001; Dierking & Falk, 1994). Valuable research on the quality of family conversations must not, however, lose sight of the immense social significance of non-verbal forms of communication, especially among adults and very young children. As the Harvard Graduate School of Education concluded in 2001, "studies that focus exclusively on verbal input to children may under-estimate the communicative input low-income parents provide their children" (Pan, Rowe, and Yont, 2001). In 1993, Rogoff, Mistry, Gonco, and Mosier found that middle-class parents tended to emphasize verbal interactions while low-income parents saw it as the responsibility of children to learn through shared participation in group activities.

Many researchers have uncovered significant categories of nonverbal behaviors that commonly occur among families. The Institute for Learning Innovation in cooperation with The Children's Museum of Indianapolis developed an assessment tool about learning in exhibitions with the following categories: *sharing basic information; engaging in thought-provoking experiences; interacting with artifacts in basic ways; using artifacts to explore topics in more depth; working together as a family when collaborating and problem-solving* (Dierking, Ellenbogen, Luke, et al., 2005). Other categories of non-verbal behaviors include: *gestures; gazes; facial expression; nodding and shaking heads; taciturnity; prompts or physical actions; demonstrating the uses of tools and materials; providing technical and physical assistance when needed, etc.* Adults can also support learning by: *teaching children to observe, imitate, and learn through repetition; modeling turn-taking, tool use, and sharing; being nearby and responsive to a child's needs; etc.* (Rogoff 1990; Rogoff et al., 1993; Rogoff 2003; Lamb, Pleck & Levine 1985; Marsaiglio, Day & Lamb 1997; Jones and Reynolds 1992; Dockser 1989; Beaumont 2002, 2003, 2006; Bernstein, Harris, Long, Iida & Hands, 2005). Sue Allen (2004), Director of Research and Evaluation at The Exploratorium highlighted the

need for understanding a more comprehensive range of learning behaviors among families: "the field badly needs more studies of nonverbal forms of learning because these may be dominant forms for three-dimensional physical interactions [with exhibits], especially for children."

Front-end research for a project about parent and teacher attitudes was conducted by Minda Borun of Museum Solutions, Inc. who found that both parents and teachers reported a lack of confidence in their abilities to support science learning among youngsters. Only one-third of all parents reported doing science activities at home. Less than half of parents intentionally seek out informal science learning experiences for their children; those who *did* tended to seek out experiences in the natural sciences. Parents desire to advance their own abilities in science skills and knowledge (Borun, 2004).

My dissertation research served as the pilot study that would inform the PPE project. My study focused on three children's museums: the Minnesota Children's Museum, DuPage Children's Museum, and Boston Children's Museum (Beaumont, 2006). At each site I observed interactions between mothers and their preschool aged children to determine the variety of roles mothers play in their child's experiences. In the study I identified five distinct roles that mothers played in their child's museum experience: 1) Player, 2) Facilitator, 3) Supervisor, 4) Student and 5) Co-learner. In addition, based on the elements of the six exhibits where I conducted my observations, I recommended that in order for exhibits to allow for the broadest variety of adult-child interaction, the overall exhibit experience should include:

- opportunities for the child to explore independently,
- opportunities for the adult to sit nearby and watch and learn about their child's capabilities, interests and ways of problem solving,
- opportunities for the adult to assume a role in the play
- opportunities that are challenging for the child and require the adult to scaffold and support the child, moving them through their "zone of proximal development."

The results of my study suggested a need to develop and refine an instrument based on the patterns of interaction I identified in this study. This instrument could be used as an observational inventory in museum studies with parents of younger children. It could be used in the exhibit development process, testing prototypes to assess levels and types of adult-child interaction that they elicit. However in order to expand the application of this instrument it needed to be tested with a wider sample of caregivers including fathers and grandparents. It also needed to be tested in a variety of museums other than children's museums – as long as there were exhibits designed for younger children. The instrument would continue to be applicable only to preschool aged children.

The Boston Children's Museum was interested in identifying the types of adult-child interaction that specifically supported early science learning. Thus, the development of the Adult Child Interaction Inventory as a research to practice study was very appropriate within the context of the PPE project and development of Peep's World exhibit. Ultimately we expected to develop a much more sophisticated instrument than the one resulting from my dissertation research. At the beginning of the study we also conceived it as a simple observational checklist. This seemed to be a more manageable and user-friendly instrument. The goal was that the behavioral codes would be easily identifiable through simple observation.

METHOD

This was a methodological study whose goal was to develop the ACII. As such, the report primarily discusses the methods and analysis of data that led to its development. Along the way some findings will be reported however we do not intend to make claims and generalizations about the findings except to the extent that they served to identify clearly the roles and behaviors that became part of the instrument. In terms of frequencies of roles, differences between caregivers, effects of ethnicity, length of observation, etc. we will describe those results within each phase. This is because with each phase conditions changed slightly. The instrument was refined, training was refined, data collection process was adjusted and refined and analysis process was refined. Thus we cannot in good conscience make claims across all three phases.

The study was conducted across three years 2007-2010 and will be reported as three distinct phases. Each phase had a unique goal, ultimately resulting in the development of the ACII and accompanying training materials. As part of the original project proposal to the National Science Foundation the research study was submitted to the Harvard University Committee on the Use of Human Subjects and was reviewed and approved.

Several abbreviations for project components will be used often throughout the report in order to avoid cumbersome repetition. These include,

- Preschoolers, Parents, and Educators: Strategies to Support Early Science Literacy (PPE)
- The Adult Child Interaction Inventory (ACII)

I will also frequently use the term "dyads." This refers to one adult and one child who are visiting together as part of a family group. The "dyad" was the unit of measure used throughout the observations and interviews.

The term "caregiver" is used interchangeably with "adult". As the study progressed and the sample broadened it included more than just parents. However the adult with the child was always an immediate family member.

The term STEM refers to content related to science, technology, engineering and mathematics.

Research Questions

The Adult Child Interaction Inventory (ACII) was designed to answer the following research questions:

1. What verbal and non-verbal interactions are families using to support preschool children's STEM learning?

2. What are the specific types of design strategies that support effective verbal and non-verbal interactions that can result in stronger STEM learning for preschool children?

A Research-to-Practice Study

As previously stated PPE utilized a research-to practice model in which the research study informed the development of the Peep's World exhibit at Boston Children's Museum. Results of the research were shared with the project advisory group and the exhibit designers several times in the first two phases of the project. Research results were applied to the exhibit in a variety of ways including layout, labels, seating, etc.

Preschoolers, Parents and Educators project evaluator Dr. Margarita Perez provided invaluable feedback during the development of the ACII instrument. Dr. Perez attended Head Start educator trainings, participated as a data collector alongside researchers and surveyed all data collectors after the fact to gather their feedback regarding the usability of the instrument, the training, and any recommendations for improvement of the ACII. Dr. Perez conducted parallel observations with researchers in order to test the instrument's reliability and validity.

The ACII was developed concurrently with the Peep's World exhibit, and early research findings were applied to the exhibit's development. Once Peep's World was completed, the ACII was again used as a tool to evaluate the exhibit. In this manner, the research that resulted in the development of the ACII was intrinsically woven into the thinking behind and creation of the Peep's World exhibit, and the development and use of the exhibit contributed to the testing and refinement of the ACII.

Validity and Reliability

Two important considerations in the development of any kind of assessment are its validity and reliability. Validity asks the question: does this measure what it's supposed to measure? Ecological validity is based on more naturalistic research vs. experimental research when it is done in natural settings using familiar people in the design. (Greig and Taylor, 1999)

By using museum staff and Head Start staff data collectors, and collecting the data in informal education institutions we increased the ecological validity of the instrument. This instrument may not be as valid if it were used to measure adult-child interaction at a

young child's soccer game or music recital for example. But it does measure interaction in a museum setting, and it has been tested in both children's museums and science museums. Babbie states that to decide what is valid:

Social researchers should both look to their colleagues and to their subjects as sources of agreement on the most useful meanings and measurements of the concepts they study. (Babbie, 2007)

In the case of the ACII and the meaning of the codes/interaction roles, we received input from the caregivers themselves, cultural experts and museum staff. In addition the ACII was used as a data collection tool for the summative evaluation of Peep's World. Dr. Margarita Perez writes in her final report:

With college student researchers who where blind to specific exhibit objectives, the ACII protocol was able to describe the types of behaviors visitors used to engage the exhibit. ACII data also provided a description of the adults' understandings about the exhibit. These data are consistent with the goal matrices listed for each exhibit component. Observations describe adults engaged with their children and the exhibit components, with the adult caregivers assuming a variety of roles that support their children's engagement. Almost all ACII adult roles specified in the exhibit goal matrices were observed. (Perez, 2010)

A second important construct in determining if an instrument is a good one is its reliability. Reliability is the degree to which a data collection instrument or assessment tool yields consistent results. This is important for generalizing. In the case of this research we only intended to be able to generalize about the interaction of caregivers and children ages 3-5 in museums. The instrument may be used with other audiences, however we could not assure its reliability since it has not been thoroughly tested and evaluated outside of this population.

Inter-observer reliability is a procedure in which two or more independent observers agree on the behavioral codes being observed using a particular instrument. The greater the agreement between the observers, the greater the reliability of the behavioral codes and instrument. While it is ideal to achieve perfect correlation or agreement, it is also

acceptable to have good or high levels of agreement because human behavior always entails an element of subjectivity and inconsistency (Greig and Jayne Taylor, 1999). Dr. Margarita Perez, the PPE project evaluator measured the instrument's reliability throughout the instrument's development, as well as when it was used for the summative evaluation of the Peep's World exhibit. She reported:

When the ACII was being refined in field trials, this evaluator confirmed the reliability of the instrument. While the instrument was used in two different children's museums, this evaluator conducted parallel observations using the instrument to obtain inter-rater reliability. The second of these field trials included using the instrument with culturally diverse families. Inter-rater reliability calculations were consistent at these trials with scores ranging from 77% at the first trial to 85% at the second trial (Pérez, 2008 and Pérez, 2009). For this summative report data collection, advanced Early Childhood Education undergraduate majors were trained for data collection. The researchers were unaware of specific exhibit goals. These observers were trained to use the ACII instrument with methods consistent with those used by Beaumont at the two sessions noted above. In parallel observation with the evaluator, each observer had to reach 80% or better agreement with the evaluator before they were allowed to conduct ACII observations and interviews. (Perez, 2010)

It is important to also note that high inter-observer reliability implies that the instrument has high usability and is easy to understand; important goals of its development from the beginning.

Sample

The respondents for the study were adult-child dyads, a caregiver and one child. The focus of the observation was always on the adult and how they interacted with the child. Across the study our goal was to observe a broad range of dyads. This included diversity of age and gender of child, type of caregiver (mother, father, grandparent), and ethnicity of the dyad. Table 1 describes the overall sample for Phases 1 and 2. A total of 288 dyads were observed and interviewed. The table does not include participants in the caregiver

focus groups that were part of Phase 1. Each group will be described in turn as we discuss the individual phases.

Table 1

Sample Characteristics for Phases 1 and 2

| | Phase I | | Phase II | | | | Total | |
| | | | COP | | Head Start | | | |
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Caregiver[a]								
Mother	-	-	70	42	27	44	97	34
Father	41	67	53	32	24	39	118	41
Grandparent	20	32	43	26	7	12	70	24
Aunt	-	-	-	-	3	5	3	1
Ethnicity of Caregiver[b]								
African-American	-	-	5	4	12	20	17	9
Caucasian	-	-	110	79	29	48	139	70
Latino/Latina	-	-	11	8	7	12	18	9
Asian/Pacific Islander	-	-	11	8	11	18	22	11
Native American	-	-	1	.5	0		1	0
Interracial	-	-	2	1	1	2	3	1
Gender of child								
Male	33	54	89	54	28	46	150	52
Female	28	46	77	46	33	54	138	48
Age of Child[c]								
1	-	-	-	-	17	28	17	6
2	-	-	-	-	13	21	13	5
3	24	40	74	46	8	13	106	38
4	22	37	42	26	3	5	67	24
5	14	23	44	28	1	2	59	21
6	-	-	-	-	6	10	6	2
7	-	-	-	-	6	10	6	2
8	-	-	-	-	6	10	6	2
10	-	-	-	-	1	2	1	0
Total Child/Caregiver dyads observed	61		166		61		288	

[a] Mothers were not sampled in Phase I of the study. [b] Ethnicity was not recorded in Phase I of the study.

[c] Children above and below target age range of 3-5 years old were included in Head Start Sample

Phase 1

Goal of Phase

Phase 1 of the PPE research was designed to replicate and expand on the pilot study I conducted in 2006 with mothers and their 3-5 year old children (Beaumont, 2006). Fathers and grandparents were added to the sample and a prototype of the Adult Child Interaction Inventory was tested and refined based on research conducted. Since Phase 1 was a replication of that study we returned to the same three sites: Boston Children's Museum, DuPage Children's Museum and Minnesota Children's Museum.

Description of Sites

The goal of selecting the three sites for the pilot study was to choose museums that had already embraced the importance of adult-child interaction in the family learning process, that targeted younger children and their parents as their main audience, and that had staff that was knowledgeable about the importance of adult-child interaction in the museums. The importance of knowledgeable staff was critical since they were the ones who originally identified high mother-child interaction exhibits for the pilot study.

Boston Children's Museum is the country's second oldest children's museum. At the time of the pilot study the majority of child visitors were between three and five and 90% of members had children under the age of five. Boston Children's Museum is located on Fort Point Channel in the city of Boston.

The DuPage Children's Museum was founded in 1987 and was the youngest of the three museum sites. The museum targets two- to eight-year-old children and offers programming for one-to-three-year olds, a growing population in their museum. It is located in the suburban setting of Naperville, Illinois.

The Minnesota Children's Museum, located in urban Saint Paul opened in 1981. Approximately 80% of visiting families have children between the ages of one to four.

Description of Exhibits

In the pilot study museum staff that worked regularly with visitors were surveyed and asked to identify exhibits that seemed to elicit the highest mother-child interaction. Perhaps not surprisingly two bubble exhibits were identified at two different museums. Especially interesting is that they were originally designed by the same person.

Boston Children's Museum Exhibit #1: Playspace

This 4,000 square foot exhibit was designed for zero-three-year-olds. Each play area offers unique opportunities for children to interact freely with the world in a safe environment that encourages play, exploration and learning. Adults are invited to share children's delight in themselves, their skills and discoveries. Since the exhibition is so large, two of the eight primary areas served as the site for observations of dyads: the Tree House Climber and the Train Set. The Tree House Climber is a multilevel structure equipped with ramps, pathways, slides and a birdcage climber. At the Train Set children can play side by side and learn about sharing and spatial relationships as they push trains over the bridge, through a tunnel or around the tracks.

Boston Children's Museum Exhibit #2: Bubbles

The Bubbles exhibit consists of a stretch-a-bubble station and other bubble tables that allow children to make bubbles using a variety of tools. Interesting labels on the walls pose questions and/or challenges to visitors, and are targeted especially to the adult to help them facilitate their child's experience. For example one label asks:

Explore Bubble Shapes: Are Bubbles Round? Can you put a bubble in a bubble? When do bubbles have flat sides?

DuPage Children's Museum Exhibit #1: The Construction House

The colorful, eight-sided Construction House is one of the signature exhibits of the DuPage Children's Museum. Inside, long, wooden workbenches of varying heights provide 20 individual "stations" for children to acquire and refine skills with tools, experiment with different building techniques and follow their own creative interests.

DuPage Children's Museum Exhibit #2: Bubbles

The exhibit "cluster" includes two under-lit, half-round bubble tables of different heights. One is a very low, round bubble table with a hula hoop-sized wand, and the Bubble Booth is a platform where a child can create a giant bubble around him/herself or around their adult caregiver. Each half-round table features different bubble-creating implements: one has coated-wire bubble wands in different shapes and sizes, and the other is equipped with hoses that create a constant, very gentle stream of air to dip into the bubble solution.

Minnesota Children's Museum Exhibit #1: Water Works

Children can manipulate gates to control the water flow as they race their boats down water slides. They can experiment with using the weight of water to move ping-pong balls through a hydraulic maze. Toddlers can explore variously weighted rings in a low tub, discovering which ones sink and which ones float.

Minnesota Children's Museum Exhibit #2: Sae Mot Korean Restaurant

This very realistic Korean exhibit is part of a gallery created to encourage children to explore their community. The restaurant has Shoji panels at the counter and a curved roof adding to the Korean look. This exhibit features thee distinct play areas: a To-Go Counter, a realistic looking kitchen and a main dining area where meals are ordered and served.

Because these exhibits were identified as having high mother-child interaction (vs. father or grandparent) in the pilot study we considered that to be a limitation.

Description of Respondents

In Phase 1 we added fathers and grandparents to the study in order to broaden the findings and begin to refine the instrument. With the addition of grandparents we gained a broader perspective on adult caregivers within a family relationship. The sample of caregivers in Phase 1 is described in Table 2.

Table 2

Phase 1 Adult/child Dyads

Dyad: Adult/child	Frequency	Valid Percent
Father/Son	26	42.6
Father/Daughter	15	24.6
Grandfather/Grandson	3	4.9
Grandfather/Granddaughter	7	11.5
Grandmother/Grandson	4	6.6
Grandmother/Granddaughter	6	9.8
Total	61	100.0

Table 3 describes the sample of focus group participants. The focus group method will be described in sections that follow.

Table 3

Focus group of caregivers by site

Site	# Fathers	# Grandparents
Boston Children's Museum	3	5
Minnesota Children's Museum	10	4
DuPage Children's Museum	8	4

Data Collection Process

Data collection took place across a variety of times: evenings (special discounted times for low income families), weekdays and weekends. Data collectors observed dyads at two exhibits at each of the three sites. Each observation was followed by an interview with caregivers to help expand upon and clarify the observer's notes. The data collectors analyzed their data by coding it according to the roles identified in the pilot ACII instrument: 1) Player, 2) Facilitator, 3) Supervisor, 4) Student and 5) Co-learner. They also noted with which Science Process skills the adult assisted the child. These skills are common basic skills for early science learners. The list used for our study was adapted from the work of Karen Worth (Worth & Grollman, 2003). See Appendix A for the list.

Data collectors at each site were either museum educators or volunteers; individuals familiar with museum-going behavior in young families. This helped to streamline the training. At each site data collectors received a 90-minute training session in which I provided background information about the development of the ACII, explained the purpose of the work, and explained all components of the data gathering and interviewing procedures. Data collectors were asked to conduct at least one observation and interview and then meet with me to debrief their process and findings. This helped increase inter-observer reliability throughout the study. Group debrief sessions were held at the end of each day of data collection. The purpose of these was to review findings and discuss any needed changes to the protocols or process.

In addition to the observations and interviews of caregiver dyads, I facilitated focus groups with fathers and grandparents just as I had with mothers in the pilot study (Beaumont 2006). The purpose of the focus groups was to bring together a group of people who were experts in their own world of experience – in this case visiting a children's museum with their child or grandchild. The goal was to have 10 participants in each group but that was difficult to achieve, especially with grandparents. In Minnesota a snowstorm on the day of the focus group greatly affected attendance. Blumer (1969) states that a well- formed, small discussion group with a few participants can do more to "lift the veil covering the sphere of life than a group of a hundred others who are merely unobservant participants." Criteria for participation was that participants had to be

frequent visitors, though not necessarily members – and that they had a (grand) child in the target age range of 3-5 years old. Focus groups were convened the first day of data collection at each site. I used the same protocol used for my pilot study to direct and facilitate the group's discussion. This protocol was open ended enough that it allowed for plenty of interaction between participants and potential new questions or themes to emerge. The goal of the discussion was to better understand how caregivers think about their role in the museum and what contributes to that. Groups met for 45-60 minutes and the conversation was audio recorded and later transcribed. Findings from the focus groups were triangulated with the observation and interview data to reveal common patterns about father-child and grandparent-grandchild interaction and help inform the continued development of the ACII.

Recommendations from Evaluation of Phase 1

The project evaluator observed training and participated as a data collector at the DuPage Children's Museum site. In addition to observing the process she was able to determine the inter-observer reliability for the instrument. Based on her parallel observations she calculated agreement as ranging between 75-92%. For context the evaluator read the pilot study report (Beaumont, 2006) and reviewed audiotapes of the focus groups held at the Boston Children's Museum. At the conclusion of Phase 1 the project evaluator sent a questionnaire to those who participated in the data collection. They were asked to respond to questions about the ease of using the ACII and the clarity of observing the coding categories contained within the instrument. The data collectors indicated that they felt confident in using the instrument after receiving training. They noted the importance of skill and concentration in conducting the observations.

Phase 2

Goal of Phase 2

Phase 2 consisted of two mini-studies. The first involved the Community of Practice, a group of 14 museums from around the country that had agreed to participate in testing and refining the ACII. They accomplished this in two ways. In order to address the first research question they conducted a study in their museum using the ACII with a small sample of approximately 15 adult-child dyads each.

1. What verbal and non-verbal interactions are families using to support preschool children's STEM learning?

In order to address the second research question in greater detail than the observational studies could do, they completed a survey regarding best practices for exhibit design.

2. What are the specific types of design strategies that support effective verbal and non-verbal interactions that can result in stronger STEM learning for preschool children?

One of the main goals of the PPE research was to identify the cultural nuances in adult-child interaction and include any of those behaviors in the ACII. Researchers such as Swartz & Crowley (2004) have emphasized the need for larger and more diverse samples of families from differing socio-economic backgrounds to understand how these factors shape parents' views of themselves as teachers. Ash (2002) looked at significant learning events in an aquarium and found that families whose first language was not English relied more heavily upon multiple modes of meaning making and communication. Thus the second mini-study in Phase 2 was focused very intentionally on diversity and cultural differences. The team was interested to see how the instrument would work in the museum setting with families from different cultural backgrounds. In addition to this the team was interested to see how applicable the instrument would be with slightly older and slightly younger children than our current sample of three-to-five-year-olds.

We will discuss each of these mini-studies in turn beginning with the Community of Practice study.

Phase 2 - Community of Practice

In the summer of 2008 the PPE Project's "Community of Practice," comprised of 14 museums across the country, each conducted a study of one science exhibit using the Adult Child Interaction Inventory (ACII). The museums were selected to represent a broad range of institutions, both children's museums and science centers. They varied in size, age, location in the country, and type of visitors. The goal of selecting a broad range of museums was to test the generalizability of the ACII as it was being developed. Would it be applicable to visitors in a science museum in the southwest as well as visitors to a large children's museum on the west coast? Would the ACII be easy enough to use after only a few hours of training at a national conference? Would the adult roles identified to date be the appropriate ones for all these different types of institutions and visitors?

Description of Sites

The following museums participated:

1) Oregon Museum of Science and Industry – Portland, OR

2) Minnesota Children's Museum – St. Paul MN

3) DuPage Children's Museum – Naperville IL

4) Children's Museum of Science and Technology- North Greenbush NY

5) The Discovery Museums – Acton MA

6) Providence Children's Museums – Providence RI

7) Children's Museum of Pittsburgh – Pittsburgh PA

8) Imagine It! The Children's Museum of Atlanta – Atlanta GA

9) Museum of Science and Industry – Tampa FL

10) St. Louis Science Center – St. Louis MO[1]

11) Explora – Albuquerque NM

12) Children's Museum of Denver – Denver CO[2]

13) Children's Discovery Museum – San Jose CA

14) Lawrence Hall of Science – Berkeley CA

Description of Exhibits

The exhibits used for the Community of Practice studies were selected using similar criteria used in Phase 1. Members of museum staff were asked to select an exhibit that was geared to preschool aged children and tended to have high adult-child interaction. Overall it seemed the exhibits tended to focus on physical science. Pictures and descriptions of each exhibit are featured in Appendix B. These were provided by the museums in the Community of Practice. Any images of visitors had previously been approved for distribution

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[1] Data from this site was received too late and the data collector did not receive training for conducting the study, so data was not used in the analysis for this report.

[2] Data from this site was accidentally destroyed and it was too late for the data collector to conduct a second study, so there is no data from this museum represented in this report.

Description of Respondents

The sample from the Community of Practice study is described in Table 4

Table 4

Community of Practice Description of Adult-Child Dyads

Dyad: Adult/child	Frequency	Valid Percent
Mother/son	40	24.1
Mother/daughter	30	18.1
Father/son	28	16.9
Father/daughter	25	15.1
Grandfather/grandson	8	4.8
Grandfather/granddaughter	7	4.2
Grandmother/grandson	13	7.8
Grandmother/granddaughter	15	9.0
Total	166	100.0

Fathers (32%) and mothers (42%) were almost equally represented in the data, with a few more mother-child dyads. Grandparents made up 26% of the sample of caregivers.

Table 5 illustrates the ethnic diversity of the COP museums.

Table 5

Community of Practice Ethnicity or Race

		Frequency	Valid Percent
	Did not respond	3	2.1
	African American	5	3.5
	Asian or Pacific Islander	11	7.7
	Caucasian (Non-Hispanic)	110	76.9
	Latino (Hispanic)	11	7.7
	Native American	1	.7
	Mixed Race	2	1.4
	Total	143	100.0
Missing	System	23	
Total		166	

Overall, 21% of the respondents in the Community of Practice were of an ethnicity or race other than Caucasian.

Data Collection Process

At the Association of Children's Museums (ACM) conference in Denver (spring 2008), members of the Community of Practice received several hours of hands-on training at the Children's Museum of Denver in preparation for the studies they would conduct at their own museums during the summer and early fall. This included a description of the overall study, the methods and the instrument (ACII). Data collectors then went out in pairs and conducted at least one observation and interview at the Denver Children's Museum where the training was held. The whole group reconvened afterwards to debrief with the PPE team (BCM and researcher) to discuss the process and findings. An outline of the training protocol used at ACM is included in Appendix C. As they conducted their

studies in the summer I supported via e-mail and phone as well as through a digital network set up by Tim Porter, co-principal investigator on the PPE project.

The reader will recall the second research question in this study:

What are the specific types of design strategies that support effective verbal and non-verbal interactions that can result in stronger STEM learning for preschool children?

Data to answer this question came from several places. One of the final interview questions in the ACII asked adults to identify the elements of the exhibit that either contributed to or detracted from their experience with their child. In addition observers looked at their field notes to identify ways the adults interacted to see if they noticed exhibit design strategies that had an impact. The most extensive part of the study that sought to explore this question was the Community of Practice survey.

In the fall of 2008 I administered a Best Practices study in order to detail specific exhibit design strategies that exhibit professionals identified as supportive of effective verbal and non-verbal interactions between adults and children. COP representatives were asked to share the survey with their main exhibit staff and any other exhibit or education staff who might have insight into design strategies. Seventeen staff from the Community of Practice museums completed the survey. More than half of those who completed the survey were the same individuals who participated in the PPE research study during the summer of 2008. In the survey one of the things we asked them to do was take a look at the list we had generated from our data collection to date (observations and interviews) and rank the exhibit design strategies by importance in order for us to narrow down the choices. Since we identified in Phase 1 that labels are an important design strategy we asked specific questions about the types of labels they found most effective. Ultimately this data was shared with the Peep's World designers to incorporate into the exhibit. The report is included in Appendix D in its entirety.

Recommendations from Evaluation of Phase 2 – Community of Practice

Throughout the development of the ACII the project evaluator surveyed the various users/testers of the instrument to determine how effective it was and make recommendations for its continued improvement. The Community of Practice gave very useful recommendations that led to some major decisions and improvements. In particular, the COP members unanimously agreed that the interview was a vital component of the instrument and should not be eliminated. I had originally conceived the ACII as an observational checklist, assuming that would make it less complicated and thus more user-friendly. Community of Practice members explained the need for the interview this way:

> *The observations only showed one part of what was really happening. The interview really gave some insight to what was going on in the adult's mind and what they think about child development and what their child was trying to accomplish.*

> *What we learned in the interview was some of the motivation behind the adult-child interactions we observed. Without that information we might have mis-coded some of the behaviors or mistaken lack of interaction for being disengaged, when it really was about encouraging independence in their child.*

As users became more familiar with coding for the roles, it became apparent that some roles were easier to recognize than others. Some could be easily identified through an observation. However, other roles were subtler and required an interview to confirm that the observer was interpreting the interaction correctly. One COP member described it this way:

> *The role of co-learner and student of the child involved more probing. The interpretation was less explicit than other roles as some of this could have been happening "inside their heads" where we couldn't observe it. Some of the interview questions helped.*

This was likely to happen, given that many of the interactions were non-verbal and the observer was relying on their ability to correctly interpret the adult's body language. The interview provided validity to the coding as adults elaborated on the interactions that were observed.

Another recommendation was regarding the listing of behaviors under each role. For example:

Role: Facilitator

Listing of behaviors: 1) Physically manipulates a part of the exhibit to cue the child to the next step, 2) Sets up or modifies environment to make it easier for the child, etc.

As I continued to receive feedback through the various trials of the ACII more behaviors were identified and these were added to the ACII. This made the roles clearer and easier to recognize.

Phase 2 - Head Start

A nationwide study of 683 culturally diverse families whose 3-6-year-old children were enrolled in Early Childhood programs resulted in a culturally-anchored Parent-Child Observation Guide that provides a set of guiding principles for the assessment of parent-child interactions at home and elsewhere (Bernstein, Harris, Long, Iida, Hans, 2005). An important goal of this phase of the PPE research study was to better understand the cultural influences caregivers bring to interactions with their children and thus create an instrument (the ACII) that was broadly applicable to culturally diverse families.

Description of Sites

The Head Start study took place at the Boston Children's Museum, focusing on several exhibit areas: Playspace, Science Playground and Boats Afloat. The Head Start sites that served as the primary respondents for this part of the study came from three Boston ABCD Head Start centers that have a long standing relationship with the Boston Children's Museum: Chinese Church, Dorchester and South Side. The families will be described in more detail in the following section.

Description of Exhibits

In order to cover the wider age range in this phase the data was collected in two specific areas of the museum: Messy Sensory Area and Science Playground. Messy Sensory Area, located in Playspace, is designed for children from birth to 3 years old. The Playspace exhibit was described in Phase 1 of this report. Science Playground is designed for children ages 5-10.

Description of Respondents

Because of Boston Children's Museum's longstanding collaboration with ABCD Head Start, as well as ABCD's dedication to promoting parent involvement in children's education, the research sample for the PPE study included families from three participating Head Start centers that represented ABCD's primary populations. Following is a description of each center's demographics.

- Chinese Church serves 92 children (91 of Asian descent and 65 speak Cantonese). Chinese Church HS has 27 staff; 26 speak Cantonese.
- Dorchester serves 163 children (97 African American, 34 Latino, and 16 of Asian descent). Dorchester has 33 staff; 7 are multi-lingual: Spanish, French, and African dialects.
- South Side serves 142 children (52 Latino, 47 African American, and 7 of Asian descent). South Side has 43 staff; 24 are multi-lingual: Spanish, French, Cantonese, and African dialects.

Table 6 describes the dyads studied in the Head Start study.

Table 6

Head Start Description of Adult-Child Dyads

Dyad: Adult/child	Frequency	Valid Percent
Mother/Son	14	23.0
Mother//Daughter	13	21.3
Father/Son	9	14.8
Father/Daughter	15	24.6
Grandfather/Grandson	2	3.3
Grandfather/Granddaughter	1	1.6
Grandmother/Grandson	3	4.9
Grandmother/Granddaughter	1	1.6
Aunt/Niece	3	4.9
Total	61	100.0

The percentage of mothers and fathers were nearly equal. As in other phases of the study grandparents are the least well-represented group. There were simply less of them to observe during data collection.

Table 7 represents the ethnic diversity of the Head Start sample. Because this phase of the study was intentionally focused on cultural nuances in interaction and because many of the respondents were specifically recruited for this phase, ethnic diversity is higher than in any other phase of the study.

Table 7

Head Start Description of Ethnicity

		Frequency	Valid Percent
Valid	Caucasian	29	47.5
	Latino	7	11.5
	African American	12	19.7
	Asian	11	18.0
	Interracial	1	1.6
	Declined to answer	1	1.6
	Total	61	100.0

Data Collection Process

The population for this observational study was the Museum's regular visitors and Head Start families that were recruited to participate. In order to increase inter-rater reliability in this phase, Head Start teachers served as data collectors. They greeted the families as they arrived at the Museum and directed them to one of the two exhibits. They observed families of their same ethnic group or language. They were able when necessary to conduct the follow-up interviews in the families' native language. Additional diverse families were identified at the admission queue and asked to go to one of the two exhibits we were studying before proceeding with the rest of their visit. All families in this part of the study were offered incentives to thank them for participating.

Debrief sessions were held each day with the Head Start teachers/data collectors and other members of the research team – sometimes including the project evaluator. These

sessions were tape recorded and transcribed in order to provide insights that would aid in the interpretation of the data and further development of the ACII, from the perspective of those who best understood the cultural nuances.

An important goal of the PPE research was to identify the cultural nuances in adult-child interaction and to include any of those behaviors in the ACII. During Phase 2 a small study was conducted at Boston Children's Museum. In addition to focusing intentionally on diversity and cultural differences, the research team was interested to see how the instrument would work with slightly older and younger children than the existing sample of 3-5 year olds. The study focused on adult-child interaction in two specific areas of the museum: Messy Sensory Area and Science Playground. Messy Sensory Area is designed for children from birth to 3 years old and Science Playground is designed for children ages 5-10. The population for this observational study was BCM regular visitors and Head Start families that were recruited to participate. In order to increase inter-rater reliability in this phase, Head Start teachers served as data collectors, and they received the same general training as data collectors in Phase 1. These data collectors observed families of their same ethnic group or language, and debrief sessions were held each day, tape recorded and transcribed in order to provide Dr. Beaumont insights that would aid in the interpretation of the data, from the perspective of those who best understand the cultural nuances. Diversity is represented in the table below.

Recommendations from Evaluation of Phase 2 – Head Start

One of the important lessons learned from this phase of the work was that the categories in the ACII needed to be broad enough to include all types of different families coming from diverse backgrounds. The expansion of the behaviors listed under each role in the ACII sought to account for these differences.

There were several limitations to the approach of this phase. One worth noting here was that most of the families observed in this phase were recruited and cued. Many of them had never been to the Children's Museum, so their interactions with their children may have been more indicative of a visitor unfamiliar with museums rather than indicative of a cultural difference. Another limitation was that Head Start teachers were used as data

collectors and were observing families from their own centers. While this made the families more comfortable with being observed and interviewed it also introduced significant bias into the process.

Phase 3 – Developing Training Materials

The research that led to the development of the ACII was completed at the end of Phase 2. A text version of the ACII is included in Appendix E. The goal of the third and final phase was to create training materials that museum staff and early childhood educators could use to learn how to conduct a study with the ACII. Phase 3 work included completion of the Adult Child Interaction Inventory, and documentation of adult-child interactions in the Peep's World exhibit in order to create a training product to accompany the ACII. A key component of the training materials was the Resource DVD that would illustrate all of the six roles and give those learning to use the ACII an opportunity to be observers themselves.

Process of Developing the DVD

The first round of videotaping families occurred soon after the opening of Boston Children's Museum's Peep's World exhibition in the summer of 2009. A second round took place in January 2010. The goal was to capture examples of the verbal and non-verbal interactions between adults and their preschool-aged children as families experienced the exhibition in real time. There was no script and families were not coached. The goal of the videographer was to follow the families through Peep's World as though he was an observer using the ACII.

I acted as the director for the videographer helping him to know when to begin filming. We essentially followed the same protocol used in Phase 1 and Phase 2 of the study. We began "observing" (videotaping) families once they entered the exhibit and followed them for approximately 20 minutes or until they left, whichever came first.

A sign was posted at both entrances/exits to the gallery. The text is included in Appendix F. In addition to posting a sign, a Boston Children's Museum staff member greeted each family before they entered the gallery. She informed them about the videotaping, its

purposes and intended uses and asked if they were willing to be videotaped. If they were not willing to be videotaped they were given a large neon sticker to wear so the videographer would be sure to avoid them in any filming.

Families videotaped during this phase were both BCM regular visitors and Head Start visitor dyads. Families from Head Start came from three centers that have a long-standing partnership with the museum: Chinese Church (predominantly Asian families), Dorchester (predominantly African American families) and South Side (predominantly Latino families). After families were filmed, they were invited to watch their videotape and with prompting from myself, they were asked to narrate what was happening. With their written consent, their narration was audio recorded. I used the ACII follow-up questions as a way to guide these conversations. These *video traces* provided the adults an opportunity to reflect with me about the video record of their visit and interaction with their child. In one section of the DVD the caregivers' narration serves as voice over. Once all videotaping was complete, the videographer and I edited the many clips into several examples to be included in the ACII Resource DVD.

RESULTS

As mentioned earlier in this report we do not intend to make claims and generalizations about the findings of this research except to the extent that they served to identify clearly the roles and behaviors that became part of the instrument. We did however learn some lessons about caregiver roles, etc. We will report these in the following section by each phase of the research. The purpose for reporting these findings is to demonstrate to the reader how the research informed the development of the ACII. In Phase 3 we will be describing the materials that resulted from Phase 1 and Phase 2 of the research.

Phase 1

Adult Roles

First and most importantly, behaviors under each adult role became more clearly identified and articulated in the ACII so that future users might be able to recognize them. At the end of Phase 1 the adult roles were described in this way:

Player: Adult plays individually or with the child in a child-initiated or adult-initiated role.

Facilitator: Non-verbal scaffolding through cues and prompts, setting up or modifying the environment and/or modeling a task.

Interpreter: Verbal scaffolding through cues and prompts, narrating the activity, asking or answering a question, explaining a concept, giving verbal instructions, or giving praise or encouragement.

Supervisor: Maintains careful watch over child to secure his/her safety, monitors child's interaction with others, monitors and controls child's frustration.

Student –of-the-child: Thoughtfully observes the child at play, thinks about the child's developmental needs and notes progress, plans for making connections or extending the experience after the visit.

<u>Co-learner</u>: Through playing/exploring with the child, the adult is reminded of concepts and/or skills he/she may have forgotten, works collaboratively with the child to accomplish a task or solve a problem relying in part on the child's own thinking to stimulate the adult's thinking.

Caregivers moved between multiple interaction roles. However, when the interaction at the exhibit was less than three minutes we found more adults acting in the Supervisor role. The adult's perceived goal of the exhibit influenced the interaction role they assumed. The longer the observation, the more roles were observed. Table 8 describes the frequency of particular roles displayed by caregivers.

Table 8

Phase 1 Frequency of Role Played

Role	Frequency	Percent[a]
Player	48	79
Facilitator	57	93
Supervisor	47	77
Student	43	71
Co-learner	8	13.1

[a] sum of percents is greater than 100 due to multiple roles played

This data began to reveal a bit of a hierarchical order for the roles. In other words, Facilitator was the role seen most frequently. Co-learner was the role seen least frequently.

In Table 9 we see the average amount of observation time it took to see the presence of a particular role. According to this data it takes a longer observation time to be able to see the Co-Learner role.

Table 9

Phase 1 Length of Observation by Roles

Role	Mean Observation Length
Player	12.54
Facilitator	12.42
Supervisor	12.60
Student	12.16
Co-learner	20.75

Our data indicated that several factors affected how quickly and easily adults could identify a role for themselves. First, it appeared that the relationship between the adult's perceptions of appropriate behavior influenced the degree and type of scaffolding that happened in the exhibits. That is to say that caregivers possess their own theories of children's learning, their own "ethnotheory" about play and learning (Parmar, Harkness and Super, 2004). This has a direct impact on the way they decide to interact. Secondly, the perceived goals of the exhibit affected what kind of a supporting role adults chose. If the exhibit seemed to them like one where a child should explore and discover independently, they tended to stand back. If the exhibit seemed more challenging they tended to do more direct scaffolding. The third factor was cultural differences. In this study we explored cultural nuances in interaction more intentionally in Phase 2, however differences became apparent even with the limited diversity of our Phase 1 sample. For example one Indian father responded in the follow-up interview that his children were playing, not learning science suggesting that to him play and learning were very different from each other.

Exhibit Elements that Support Interaction

In analyzing all of the data from Phase 1 we were able to come up with a preliminary list of exhibit elements that support interaction. We provided this list to the Peeps' World designers to help with their decisions.

Content

Exhibit should be about familiar scientific phenomena (water, bubbles, air) to help bring parents back to their own science learning, this affords easier explanations.

Exhibit should be enjoyable for both the adult and the child. Thus the adult will stay longer and the child will also have a better experience. It is wonderful for the child to see their adult caregiver having fun and playing.

In some cases the exhibit should be open-ended enough that the child can figure it out for themselves without adult support, the adult in this case can stand back, observe, and marvel at what their child is capable of – or how their child learns.

Exhibits that have familiar social scripts are fun for both the adult and child, such as a restaurant or grocery store.

Seating

We asked respondents to tell us which elements of the exhibit either contributed to or detracted from the interaction with their child. Seating came up often as an element that contributed positively, or else it was recommended. We made the following suggestions to Peep's World designers:

Provide seating for exhibits that are designed for more independent child exploration and thus may hold child's attention for an unusually long time. When seating is available caregivers will be able to 1) observe their child's play, 2) not hurry the child, 3) scaffold as needed.

Seating at exhibits that are designed to promote collaborative play between groups of children may not be scaled for adults. If the design intention is to have adults and

children collaborate then provide seating that is more obviously scaled for the adult, next to the child-sized seat.

Do not have much seating at exhibits that are designed for a more active participation from the adult or scaffolding/modeling, etc. (Construction House at DCM, Water Maze at MCM)

Exhibits that invite role-play from adults should have seating designed into the exhibit that can fit adults as well as children. (Restaurant at MCM)

Labels

The most effective labels seemed to be those that posed questions or challenges that helped the adult interact with their child. As a result of these findings we eventually identified a new adult role for the ACII: the Interpreter.

Environmental Factors

Sound and lighting, perception of safety (including presence of staff in the exhibit) and cleanliness of exhibit affected the adult's role.

Science Process Skills

In analyzing our data we also coded for the presence of Science Process Skills that the adult was encouraging. While all Science Process Skills were evident the ones occurring most often were 1) Communicating, 2) Observing and 3) Describing.

The ones occurring least frequently were 1) Categorizing, 2) Counting and 3) Predicting. The types of exhibits used in Phase 1 affected this outcome. There were few exhibits in Phase 1 of our study that involved any counting or categorizing.

Table 10

Phase 1 Frequency of Science Process Skills

Science Process Skill	Frequency	Percent
Describing	18	30
Measuring	9	15
Categorizing	3	5
Observing	25	41
Experimenting	15	25
Estimating	1	2
Communicating	32	53
Comparing	7	12
Counting	3	5
Predicting	3	5
Generalizing	4	7
Relating	13	21
Problem Solving	10	16

Phase 2

Community of Practice

The following is a brief overview of the findings from this Phase 2 mini-study. For the
purposes of testing the ACII, museums identified a total of 14 science exhibits for
preschoolers that elicited strong adult-child interaction. Interestingly, most of the exhibits
focused on physical science.

Findings from the survey administered in the fall of 2008 contributed useful information
for the ongoing development of the ACII. One of the most important findings was about
the use of labels in an exhibit to support the adult, either by explaining scientific
principles or suggesting a role for the adult. Many of the museums were prototyping new
and creative types of labels. A second finding was that many of the museums conducted
little evaluation of their own exhibit strategies. Using the ACII in their mini studies
showed them how important evaluation was to gaining a clearer understanding of visitors
and their use of exhibits.

COP Museums identified the following elements of their exhibits as contributing to adult-
child interaction:

- Materials that have multiple uses and allow for interaction and engagement at
  many different levels

- Components that clearly indicate when an adult's guidance is necessary

- Label copy with simple scientific explanations that help parents be more
  confident discussing the exhibit with their children

- Verbal prompts to facilitate questions

- Tactile materials

- Flexible design so that kids can use exhibits on their own and/or with grown-up
  help to extend their learning

- Fun, intuitive, attractive, engaging, open-ended design

- Design for social interaction (e.g., cooperative, parallel, multi-age, etc.)

Approximately 60% of the museums stated that they relied somewhat on labels and graphics to support adults. Several were in the prototyping stage with a variety of label and graphic approaches. Many were experimenting with approaches to "parent labels," those that either explained child development theory to help adults understand how children learn, or that described scientific principles behind exhibit components to help parents converse with their children. The results of the COP Survey of Best Practices are included in their entirety in Appendix D.

As we did in Phase 1 we asked several questions of our data. Table 11 describes the frequency of roles adults played in their interactions with children. The frequencies were very consistent with frequencies from Phase 1.

Table 11

Community of Practice Frequency of Role Played

Role	Frequency	Percent[a]
Player	141	86
Facilitator	130	79
Interpreter	138	84
Supervisor	129	78
Student	123	75
Co-learner	47	29

[a] sum of percents is greater than 100 due to multiple roles played

Table 12 describes the average time for observations that identified the various roles. In general throughout the study our observations ranged from 5-20 minutes. As in Phase 1 data, the Co-learner role appears after a longer observation time than the others.

Table 12

Community of Practice Length of Observation by Roles

Role	Mean Observation Length
Player	11.54
Facilitator	11.53
Interpreter	11.21
Supervisor	10.87
Student	11.43
Co-learner	14.62

Table 13 describes the presence and frequency of science process skills in the adult-child interaction. Ones occurring most often were 1) Communicating, 2) Observing and 3) Collaborating. The ones occurring least frequently were 1) Estimating, 2) Counting and 3) Measuring.

Table 13

Community of Practice Frequency of Science Process Skills

Science Process Skill	Frequency	Percent
Categorizing	24	16
Collaborating	57	38
Communicating	75	50
Comparing	46	31
Counting	9	6
Describing	51	34
Estimating	9	6
Experimenting	52	35
Generalizing	23	15
Measuring	14	9
Observing	64	43
Predicting	19	13
Problem solving	44	30
Recording	2	1
Relating prior experiences	30	20
Using tools	40	27

Head Start

At the conclusion of each day of data collection we held a "cultural conversation" with the data collectors. We were interested to hear their perspective on what they observed and whether or not it was consistent with their expectations. Below are some excerpts from these conversations. Italicized words are verbatim quotes from data collectors. We started the conversation by asking: what surprised you?

Chinese Church (Asian families)

> *I observed a grandmother with her grandchild. She was very engaged. It seemed to me she was there to make sure her grandson was safe. She gave some encouragement and did some teaching. She was also talking, listening. That's unusual. Grandmothers don't often teach, they just spoil the child.*

> *I watched a mother and child. She left the child alone was very laid back. She believed the child should be free to do whatever. She should not be watching and making him feel uncomfortable. She should give him space and let him explore freely. If he encounters a problem he will figure it out by himself. If she is nearby he will just make her do it for him. Most Asian mothers I know want to be next to the child to make sure he/she does what they "need to." I was surprised to see so much variation in style even within same culture.*

> *In Asian families the academic is on their mind – by the time the child walks and talks (1- 1 ½) all the way to college. Museum staff was very welcoming, not intimidating, made the families feel very comfortable. This is important. They like signs that are visible and easy to read and understand. Asians are not bothered by crowding, we are always crowded.*

Dorchester (African American families)

> *Someone other than the parent is bringing the child "the good time aunt." They are the "mother figure." Their job is to give the parent a break, it's*

important. They take children out to experience other stuff. It's not as important to the parents. African American families have a big network of friends. They think in terms of three levels of relationship: 1) strictly an outing, 2) I've got this child every other weekend, 3) I have custody of this child. To African Americans everybody is your godchild.

It's a Children's Museum so they expect everything is touchable, non-breakable. This is their place (for kids) so we (the adults) can stand back and let them do their "thing". When I visit with my kids and nieces and nephews I strategically move them around the building from the top to the bottom. We start at the top where it is not as crowded. I expose them to everything - let them play.

I observed a grandmother who had custody of her grandson. She let him have different experiences. Her role was to watch him. She was fascinated watching other kids interact, wasn't sure what to do being a first time visitor. She uses older children to watch younger children.

South Side (Latino families)

I observed a Mom with two sons (ages 3 and 4). There was minimal interaction. Her attention was divided between two boys, trying to get them to interact with the same thing. She did lots of gesturing, seemed concerned about their safety. She followed each boy with the other one in tow. She never let them out of her sight or touch. I found translating the [ACII interview] questions into Spanish kind of difficult. The Mom said you can't explain how young children learn science. They don't understand at this age. Later in Playspace I saw them again. The Mom seemed more relaxed; she and one of her sons were playing together. She got up when boy lost his car. She followed him around. Was concerned about him sharing.

I also watched a mother and daughter. The Mom did lots of explaining, asked lots of questions about science concepts. Mom was stuck about how

to explain the bubble wand. She said that children learn science through exploring and experimenting. I had expected her to say more like what the first one said – that they're too young to understand science at this age. I think that's more typical of culture.

I observed a father and son. The dad looked overwhelmed the whole time. His son was right there next to him. Dad told me, "There's just too many kids for me." He seemed overwhelmed by crowd. He played with his son, didn't do much talking. He did some modeling – hand over hand. The child was shy. When we were done Dad was ready to bolt out of there.

The last family I observed was in Playspace. It was a father with a 2 1/2 year old girl and also twins. He was right next to little girl; the twins were entertained by train set. He was playing alongside his little girl. He said that for young children to learn science let them explore and be busy, active.

Table 14 describes the frequency of occurrence of the six roles across our observations in this phase.

Table 14

Head Start Frequency of Role Played

Role	Frequency	Percent[a]
Player	35	57
Facilitator	56	92
Interpreter	41	67
Supervisor	45	74
Student	38	62
Co-learner	13	21

[a] sum of percents is greater than 100 due to multiple roles played

The most frequently observed roles in the Head Start study differed from Phase 1 and the Community of Practice. They were 1) Facilitator, 2) Supervisor and 3) Interpreter. The least observed roles were 1) Co-learner 2) Player and 3) Student-of-the child.

Table 15 describes the average length of time data collectors spent when they identified a particular role. As in previous phases of the study the Co-learner role continues to be the one that required a longer observation time to identify.

Table 15

Head Start Length of Observation by Roles

Role	Mean Observation Length
Player	14.73
Facilitator	14.85
Interpreter	15.31
Supervisor	15.31
Student	14.89
Co-learner	18.17

Table 16 describes the frequency of Science process skills in the interactions we observed.

Table 16

Head Start Frequency of Science Process Skills

Science Process Skill	Frequency	Percent
Categorizing	6	10
Collaborating	16	26
Communicating	13	21
Comparing	3	5
Counting	3	5
Describing	5	8
Estimating	1	2
Experimenting	10	16
Generalizing	4	7
Measuring	4	7
Observing	20	33
Predicting	5	8
Problem solving	6	10
Recording	1	2
Relating prior experiences	5	8
Using tools	9	15

Ones occurring most often were 1) Observing, 2) Collaborating and 3) Communicating. The ones occurring least frequently were 1) Estimating, 2) Recording and 3) Comparing and Counting (received same frequency). These also differed from the Community of Practice and Phase 1. We might attribute these differences to cultural nuances, but we cannot generalize without further study.

Phase 3

As described earlier, the goal of Phase 3 was to develop training materials to support users with the ACII. The section that follows is a complete explanation of those materials, including detailed descriptions of each of the six adult roles identified through this study. We developed three main items: the ACII itself, a User's Guide and a supporting resource DVD.

The ACII

The ACII is an observation/interview instrument that can be used for evaluation or development of exhibits when the role of the adult in the child's experience is key to the exhibit project. Through observation and an interview with the caregiver, the researcher utilizing the ACII can identify the variety of roles an adult caregiver may have played during a child's experience in an exhibit. The researcher can also identify what key design elements of the exhibit support adult-child interaction. While the ACII was originally developed for the purposes of exhibit evaluation and development, it has also been useful as a training tool for museum staff and preschool educators.

The User's Guide

The User's Guide provides background information regarding the ACII – a much-abbreviated version of the content of this report. It also explains the organization of the accompanying DVD. Finally, it includes supplemental background information about the PPE project to give context to the user.

Description of the ACII Resource DVD

One of the key training materials developed as a result of this phase was the ACII DVD. Its purpose is to provide the viewer with visual examples of adult-child interactions. It is divided into several sections: **Examples**, **Practice**, and **Sample ACII Interview**. The **Examples** section introduces each of the six roles of the Adult Child Interaction Inventory using video clips filmed in Boston Children's Museum's "Peep's World" exhibit. The **Practice** section has a brief introduction explaining its use, followed by two versions of several full-length visitor exhibit experiences. The first version of each experience contains footage of an entire exhibit visit by one caregiver/child dyad with only minor edits to retain the integrity of the actual experience. This will allow the viewer to watch and code the adult child interactions using the ACII in real-time. The second version includes audio of an interview with the filmed caregiver narrating the exhibit experience, giving the viewer more insight into what the caregiver was thinking as they interacted with the child.

The **Sample ACII Interview** is a video clip of myself using the ACII to follow-up with a caregiver following an observation. In this video the viewer will observe the process of conducting an ACII interview, and will learn techniques for possible probing questions that can help caregivers to elaborate more on their role and their child's experience.

Detailed Descriptions of Adult Roles

In the User's Guide that accompanies the ACII as well as on the DVD, we describe in detail what each of the adult-child interaction roles looks like. On the DVD in particular the role descriptions are supported by video filmed in the "Peep's World" exhibit.

The roles appear on the ACII in a somewhat hierarchical order. That is not to say that one role is more important than any other. Rather, we are suggesting that one will observe some roles more frequently than others. Also some roles are easier to code just from observation, while the roles later in the instrument such as *Student of the Child* and *Co-learner* can only be identified through an interview with the caregiver and often through a longer observation.

Our data across the study has consistently shown that longer observations result in a wider variety of roles to code, and conversely, shorter observations result in fewer roles. Although we suggest that one observe a family until they leave the area or the dyad splits up, in our research we kept our observations to a maximum of 20 minutes, in order to gather as much data as possible.

The following section describes each adult role.

Player

This is a role that is particularly fun to observe—an adult having fun in the museum, being playful, just like a child. In this role the adult may be playing alone or with the child. A caregiver might be having so much fun in the sand area that he begins to make up his own game. Or in the water area an adult might be observed spinning a water wheel (without any child nearby), just because it's fun.

Sometimes the adult is playing directly with the child in a role that the child has initiated. For example in a Light and Shadow area a child might tell her caregiver what to do: "Let's try to make scary monster shadows!"

At other times the adult might initiate the role by telling the child what to do. For example, "You go into the … and make some shadow puppets. I'll go on the outside and try to guess what they are."

Facilitator

The *Facilitator* role is one we tended to see most often, even in the shortest exhibit experiences. If a caregiver and child are only at an exhibit for a few minutes there is still likely to be at least one or two examples of the adult playing the *Facilitator* role.

The *Facilitator* is a non-verbal role where the adult is scaffolding and reinforcing what the child is doing through cues and prompts. For example the caregiver might physically manipulate a part of the exhibit to cue the child as to their next step. The caregiver might do something to modify the environment to make it easier for the child to accomplish their task. For instance, at the sand area the caregiver might empty a container that was filled with sand by a previous child and hand it to their child so that it can be filled again. In this role caregivers often model for the child how to accomplish a task or do an activity. For example, at a water area the adult might turn a water wheel, modeling for the child how to do it.

Sometimes a simple nod or smile from the caregiver will reinforce the child and let them know they are on the right track and using the exhibit component in appropriate ways. Caregivers also often use hand gestures as a way to encourage their child to persist or keep going. Even by simply moving physically closer to their child the caregiver lets him or her know that they are available if needed. Finally, in the *Facilitator* role the caregiver may need to lift up their child to reach exhibit components. This is especially true with children who are three years old or younger. The *Facilitator* is a key role that caregivers seemed to play throughout a museum visit, but what is notable is that it doesn't require any talking on the part of the adult.

Interpreter

The *Interpreter* role is similar to the *Facilitator* role. However while the *Facilitator* role was a non-verbal one, in the *Interpreter* role the caregiver used language to reinforce and cue the child.

Sometimes a child just needs a little praise or encouragement to keep going. You can walk through any museum and hear parents of young children exclaiming "Good job! Way to go! You did it! Wow!" This is probably one of the most common ways parents of young children use language and words to support their child' s experience–it is less intrusive and allows the child to discover on their own, while still hearing from their adult.

In some instances the adult might narrate what the child is doing, for example: "Now you're pouring the water into the cup to see how full you can make it." Or they might explain a concept to the child: " If you move farther away from the light your shadow will get bigger." The child might need the kind of support an adult can give through simple verbal instructions: "Push that print into the sand so you can see what kind of animal track it makes." Caregivers might also simply ask the child a question or answer a question the child poses: The adult might ask "What do you think will happen if?" The child might ask, "Why did that happen?"

Supervisor

The *Supervisor* role is one we saw to some extent in every exhibit experience. In this role the adult's main goal is to monitor the child. That may be as simple as watching the child and being sure he is safe and that the adult can see him. Sometimes an adult keeps physically close to the child; while at other times she may simply keep her eyes on him from a short distance, without having to keep in close proximity.

When an adult is concerned about their child's safety they may look around cautiously, taking in the environment. When an exhibit is particularly crowded you will notice parents doing more of this.

Another goal of the adult in this role is to monitor the child's interactions with others—both children and adults. They may need to help resolve a conflict, such as whose turn it is, or who had a tool first. The adult in the supervisor role also watches for signs of frustration from their child. She may be getting frustrated when something isn't working the way she expected, or she could just be tired and ready to go home.

Finally, there are times when an exhibit is particularly crowded and an adult doesn't feel comfortable with their child in the space for very long. An adult might be observed encouraging the child to leave, or move to a different area. Sometimes it is clear that this is the adult's idea, not the child's. The adult is simply acting as a *Supervisor* and looking out for the child's comfort and safety.

Student of the Child

In this role the adult is acting as a student and the subject is his or her own child. This is a non-verbal role and one that we learned can only be teased out through the ACII interview. An adult watching their child may not seem to be interacting, but we cannot be sure of this until we talk to him or her.

The adult acting as a student of his or her child thoughtfully observes as their child plays and explores the exhibit. The word "thoughtfully" indicates that they are thinking with some amount of purpose. They may be thinking about their child's development, how much they've grown or matured since the last time they were at this museum. For example their play may have become much more sophisticated and purposeful. Maybe the last time they visited they were only interested in feeling the water texture by running their hand through the water, but now they use the water to conduct experiments, move the water wheel or alter the water's flow.

Sometimes as the adult is observing their child they may engage in conversation with another caregiver nearby. Perhaps their two children are playing together. The adult may say something like "He loves to do this" or "She has trouble sharing" or perhaps "He likes to think of new ways to do things." All of these remarks indicate that the adult is thinking very specifically about the child's development or their needs.

Ultimately while the adult is observing and "studying" their child, they may be thinking about how to make a connection or extend the experience when they leave the museum to go home. For example an adult might decide to introduce some kitchen utensils into the child's bath time, so they can measure and pour water while they play.

This role is a subtle one and can only be clearly identified through specific questions in the ACII interview. It is a role that may be overlooked and considered not to be a real interaction, but in fact it is a very important role and can contribute to the caregiver better understanding his or her own child.

Co-learner

As a *Co-learner*, the adult caregiver is actually learning right alongside their child. As they play, the adult may be reminded of concepts or skills they had forgotten. A common example of this is when adults play in water with their child—the scientific concepts of density and displacement may have been far in the back of their minds, but as they are making predictions about which objects will sink and which will float, the principles came back to them.

Sometimes an adult caregiver will work with their child to solve a problem collaboratively, depending on the child in some way to help solve the problem. For example if an adult and child are successful in creating shadow puppets in a Light and Shadow area, the next time they try the activity, the adult may need to discuss with the child how they did it so they can make it happen again.

Sometimes when first encountering an interactive exhibit, adult caregivers can seem stumped and not know what to do. Museum staff will often hear the adult say "What do you do here?" While that could be interpreted as a prompt to get the child interested, it can actually be the adult asking the child what to do. Museum staff joke that when adults are confused about how to operate an interactive exhibit they tell them to "ask your child."

Descriptions of Exhibit Elements

The study's second research question asked:

What are the specific types of design strategies that support effective verbal and non-verbal interactions that can result in stronger STEM learning for preschool children?

Throughout the study, in all phases we have addressed this question. Sources of data for this were the observations and interviews conducted with the 288 dyads, focus groups with father and grandparents in Phase 1, and the Community of Practice survey. We narrowed the design strategies down to a checklist that is included at the end of the ACII. Below is the list:

- o Wide variety of materials available
- o Easy for adult to figure out
- o Easy for child to figure out
- o Open space with clear sight lines
- o Controlled exits
- o Plenty of materials available
- o Seating
- o Acoustic treatment to reduce ambient noise
- o Labels: pictures or photographs
- o Includes tables and chairs designed to accommodate adults
- o Other

The "other" category was included so museums using the ACII could continue to add to this rich pool of information and hopefully improve the instrument over time. This will be discussed in our closing section that follows.

DISCUSSION

Adults might be effective generators of relevant inputs; they might not choose to serve in this role. This suggests that we should expect variability to be the rule in observations of parent-child interaction. In our culture a parent might prefer to share or even divide the labor of knowledge transmission. (Gelman, Massey, McManus)

The quote cited above illustrates the importance of recognizing the variety of ways adult caregivers choose to interact with their children in a museum setting, and how our research needs to allow for the variability. The goal of the ACII was to create an instrument that was broad enough to allow for some of that variability. Of course nothing is ever perfect, and as in any research we end this study with some answers but many more new questions. We intended the ACII to be used in a museum setting with adult caregivers and preschool aged children. Our findings have been consistent enough that we feel confident the tools we developed are valid and reliable for this population.

We began during Phase 2-Head Start, to explore whether or not the ACII could be applied to a slightly older (above 5) and slightly younger (below 3) age group. It was successful even given the small sample size of this population that we studied. What we learned that was especially interesting was that the frequency of occurrence of particular roles shifted. For example, in families with children under the age of three we saw the highest occurrence of the Supervisor role. With families that had children over age five, there was a higher occurrence of the Interpreter role. It would be interesting to replicate the ACII study with an older population, perhaps caregivers and children ages 6-9, to see if new roles emerged or if some of the current ones no longer applied.

The Head Start study phase probably raised the most questions that we were not able to answer within the scope of this project. The following questions were raised during the evaluation and would make interesting questions for a future study. Some questions to explore include:

1) Are there cultural differences in the adult's perceptions of the "formality" of the setting? Are activity-based settings places of play or places of learning? Will the perceived difference have an impact on adults' behavior?

2) Do caregivers who attend children's museums have "scripts" of appropriate adult expected behaviors that allow them to support their child's behavior within exhibits? 3) Since both verbal and non-verbal cues are the focus of developing the ACII, could there be opportunities in the future to observe museum visitors who are speakers of another language, who engage their children in another language? This would require researchers fluent in the families' native language.

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APPENDIX A

SCIENCE PROCESS SKILLS

- o Categorizing: Grouping objects according to their different characteristics
- o Collaborating: Working in partnership with peers, older children or adults to investigate a phenomenon, accomplish a task, or investigate a question
- o Communicating: Sharing your ideas and discoveries with others
- o Comparing: Using observation skills to notice and describe similarities and differences between objects
- o Counting: Using numbers to accurately count a group of objects
- o Describing: Explaining to others what you've learned or observed
- o Estimating: Judging whether you have a LOT of something or a little
- o Experimenting: Engaging in simple investigations including making predictions, gathering and interpreting data, recognizing simple patterns and relationships, and drawing conclusions
- o Generalizing: Drawing conclusions and/or "making theories" about why something happened
- o Measuring: Using informal systems of measurement to establish length, time, area, capacity, or weight
- o Observing: Learning about the world around you by employing all the senses – hearing, smelling, touching, seeing, ad tasting
- o Predicting: Using prior experience in thinking about what might happen if/next
- o Problem solving: Brainstorming solutions, trying them out and learning from your mistakes
- o Recording: Representing data, ideas/or experiences using multiple methods (drawing, movement, words, etc.)
- o Relating to prior /and or current experience: Recalling past experiences and applying them in a new situation, applying new understanding and/or experience in different situations
- o Using tools: Thoughtfully manipulating simple tools (magnifiers, eyedroppers, etc.) in order to extend your senses

APPENDIX D

COMMUNITY OF PRACTICE REPORT ON EXHIBIT DESIGN STRATEGIES

EXECUTIVE SUMMARY

As part of Phase 2 of the Preschoolers, Parents, and Educators: Strategies to Support Early Science Learning (PPE) research, the following question was posed:

What are the specific types of design strategies that support effective verbal and non-verbal interactions that can result in stronger STEM learning for preschool children?

To answer this question, an extensive web-based survey was sent to all of the participating members of the PPE Community of Practice (n=14). All but one museum responded and some museums had multiple participants. Nineteen individuals began the survey and 17 completed it.

The following is a brief overview of the findings:

Museums identified a total of 14 science exhibits for preschoolers that elicited strong adult-child interaction. Interestingly, most of the exhibits focused on physical science.

Museums stated that most of the outcomes of these exhibits matched those originally planned.

Museums listed the following elements of their exhibits that contribute to adult-child interaction:

- Materials that have multiple uses and allow for interaction and engagement at many different levels

- Components that clearly indicate when an adult's guidance is necessary

- Label copy with simple scientific explanations that help parents be more confident discussing the exhibit with their children

- Verbal prompts to facilitate questions

- Tactile materials

- Flexible design so that kids can use exhibits on their own and/or with grown-up help to extend their learning

- Fun, intuitive, attractive, engaging, open-ended design

- Design for social interaction (e.g., cooperative, parallel, multi-age, etc.)

Museums rated the importance of design strategies to adult-child interaction as follows (with 1 being most important):

1. Wide variety of materials available

2. Easy for adult to figure out

3. Easy for child to figure out

4. Open space with clear sight lines

5. Controlled exits

6. Plenty of materials available

7. Seating

8. Noise level/sound/acoustics

9. Labels: pictures or photographs

10. Tables and chairs designed to accommodate adults

Approximately 60% of the museums stated that they rely somewhat on labels and graphics to support the adults. Several are in the prototyping stage with a variety of label and graphic approaches. Many are experimenting with approaches to "parent labels," those that either explain child development theory to help adults understand how children learn, or that describe scientific principles behind exhibit components to help parents converse with their children.

Approximately half of the museums conducted in-house evaluation of their exhibits, though much of it was anecdotal or informal. Few museums had examples of evaluation or research studies to support their claims beyond their participation in this PPE research.

Only a few museums have implemented methods for adults and children to reflect on their exhibit experience such as Talk Back Boards, or drawing and storytelling. Personal interaction with a museum staff person trained to elicit reflection from visitors seemed to be the most effective.

Most of the participating museums were successful in assisting parents connect their museum experiences to home. They did this in a variety of ways, including using familiar materials, providing parent guides or activity guides for museum and home use, creating experiences simple enough to be replicated at home, and offering on-line activities or downloadable resource materials on their web sites.

INTRODUCTION

The goal of the Preschoolers, Parents, and Educators: Strategies to Support Early Science Learning (PPE) research is two-fold. The primary goal is to identify the types of verbal and non-verbal behaviors adults use when interacting with their young children around a science exhibit. The secondary goal is to understand what it is about a particular exhibit that either contributes to, or takes away from, that positive adult-child interaction. In Phase 1 of the research we conducted numerous observations and interviews with adult-child dyads. Through the interviews, we have begun to identify what adult caregivers believe are the key elements of an exhibit that help them support their child's experience. We also want to learn from the experts in the field who are developing and designing exhibits. This report will summarize findings from a large-scale survey we conducted with the PPE Community of Practice regarding best practices in exhibit-design strategies.

Research Question

What are the specific types of design strategies that support effective verbal and non-verbal interactions that can result in stronger STEM learning for preschool children?

Methods

During Phase 2 of the PPE research, a web-based survey was posted through SurveyMonkey (www.SurveyMonkey.com) to all of the members of the Community of Practice (n=14). They were asked to share the survey with their main exhibit staff and any other exhibit or education staff who might have insight into design strategies. Nineteen persons started the survey and 17 completed it (89.5%). In some museums several staff members participated; more than half of those who completed the survey were the same individuals who participated in the PPE research study during the summer of 2008 (63.2%). The survey was available on-line between November 10 and December 3, 2008. Three reminders went out after the initial invitation to those who had not yet completed the survey. All but one museum in the Community of Practice participated. That museum had a staff change so there was no longer an appropriate person to contact for this part of the project.

FINDINGS

The Respondents

1) What museum do you represent?

Museum Name	Museum data code	# of Respondents
Discovery Museums Acton	01	1
Explora Albuquerque	02	1
Imagine It Atlanta	03	1
Lawrence Hall of Science, Berkeley	04	1
Children's Museum of Denver	05	1
DuPage Children's Museum	06	3
Children's Museum of Science and Technology, North Greenbush	07	1
Children's Museum of Pittsburgh	08	1
Oregon Museum of Science and Industry	09	3
Providence Children's Museum	10	2
*St. Louis Science Center	11	0
Minnesota Children's Museum, St. Paul	12	1
Children's Discover Museum, San Jose	13	2
Museum of Science and Industry, Tampa	14	1

* The St. Louis Science Center had a change of personnel, so the original member of the
  Community of Practice was no longer available to participate in the PPE study.

2) Did you help with the PPE research/data collection between May and September?

	Response Percent	Response Count
YES	63.2%	12
NO	36.8%	7

3) What is your job title?

Exhibits (42%)

- Exhibits Director

- Director of Exhibits and Programs

- Associate Director of Exhibits and Design

- Director of Exhibits and Education

- Shop Supervisor

- Creative Director

- Exhibit Production Director

- Exhibit Developer

Education (32%)

- Assistant Education Staff Manager

- Family Learning Manager

- Education Director

- Early Childhood Specialist

- Director of Education

- Associate Director of Education

Research and Evaluation (16%)

- Manager of Evaluation and Visitor Studies

- Vice President of Research

- Research Specialist

Management (10%)

- CEO

- Executive Director

The Exhibits

4) ***Please describe a science exhibit at your museum that seems to elicit strong interaction between 3- to 5-year-old children and their adult caregivers.***

The ***Chain Reaction Room***: The room contains two room-sized tracks in which balls can roll around the room. As they move, they interact with different items including chimes, dominoes, and bells. (01)

At ***Cup Copters,*** visitors make copters by cutting up paper cups or cutting whirlies out of paper and place them over a fan to see how they move (fly high, spin, hover, etc.). Materials at the table for immediate copter use are: cups, paper, scissors, tape, paper clips, brass brads, washer, rubber bands, and tin foil. (02)

Tools for Solutions is a ball machine that includes the six simple machines that make up all the complex machines and moves the ball around throughout the different possibilities or iterations. (03)

The ***Gravity Well,*** where visitors roll balls in a funnel-shaped well seemed to elicit some of the more interesting interactions. (04)

Airplay and electrical portions of our construction exhibit ***Junior Jobsite***. (05)

The ***Air Fountains*** have a strong air source that can be directed with various pipes to keep foam balls aloft (or shoot them). Children can just play with the existing structure or change it completely and try new configurations. (06)

Make it Move exhibits. (06)

Go Power engages children and their adults in exploring electricity and other energy sources and in tactile activities like completing a circuit. (07)

The ***Waterplay*** exhibit encourages families to experiment with a 53-foot river. Families can build a boat and try to successfully sail it from one end of the river to the other. This includes making it past whirlpools and navigating it through a lock and dam. Visitors also have the opportunity to build a pipe system and perhaps a fountain. (08)

Animal Secrets exhibit and in ***Science Playground***: Plastic ball activity area: Children can place 3" plastic balls in a variety of places and as a result various things happen to the balls, for example they can levitate with a blower, travel along an air tube, roll down a ramp, etc. (09)

Shape Space – unit blocks, Jovo toys, tessellations, storybooks, parquetry blocks, symmetry mirrors. (10)

Bubble water table (12)

The Wonder Cabinet Sand Laboratory (13)

Kids in Charge (14)

5) ***What are the stated goals or desired outcomes of this exhibit?***

Children will learn about cause and effect, motion and ramps (simple machines) as they play. (*Chain Reaction Room*-01)

There are no stated goals. We hope to see visitors having thoughtful interactions with the materials and other people (staff, family, or other visitors). (*Cup Copters*-02)

Tools for Solutions was originally designed to allow visitors to practice their creative and problem-solving skills and to learn that even the most complex problems can be solved step-by-step with a good strategy and tools. They learn about the efficacy of trial and error and the virtues of persistence. Original goals: Every day we use tools to solve problems creatively. Most times we use tools that are commonplace, whose use and usefulness are well understood. Sometimes we must figure out how to do something for which we have no set tools, and no previous experience. This exhibit seeks to provide visitors with opportunities to explore both kinds of problem-solving: Investigate and choose proper tools for finding solutions. Encourage visitors to learn strategies of problem solving and provide opportunities to apply them. Explore character building traits related to creative problem solving. Help children solve complex problems through persistence, creativity, teamwork, and strategy. (Target Audience is ages 6-12 (in reality ages 3 and up)) (*Tools for Solutions*-03)

The goals of this particular exhibit are wide. We are looking for children to learn about construction, building, etc. However we embedded science principles such as air, water, and electricity into different aspects of it. We really wanted children to work on their problem-solving skills and encouraged parents through modeling and signage to participate in their children's learning. (*Junior Jobsite*-05)

To address some common misconceptions that children have about air. For example, surveys found that many young children thought that fans made air rather than just move it. To increase children's science dispositions in the science of fluids. To get children to understand that air is a fluid. Children will better understand the way air moves and how it can be directed and that the pressures and forces of air can be changed. These components are supposed to help young children discover that moving air can have direction and that the direction is predictable. (*Air Fountains*-06)

In *Make it Move* visitors test, verify, and expand their understanding of the energy of motion, utilizing experiences geared towards physical, constructive, or goal-directed play. (*Make it Move*-06)

To engage children in the exploration of energy pathways and transformations and to see how energy impacts everyday life. (*Go Power*-07)

The goal of the exhibit includes introducing the visitor to real stuff, namely real experiences with water. Visitors should leave with an understanding of how a lock and dam work, the effects whirlpools can have on boats, the properties of water pressure, and how pipes function. (*Waterplay*-08)

To encourage discovery through play. (*Animal Secrets*-09)

Cause and effect. (*Science Playground*-09)

Facilitate exploration and bubble play with soapy water to spark curiosity about water's thin, stretchy skin. (*Bubble* water table-12)

We hope that children and their adults engage (for extended periods of time) in playful exploration of the texture , mass, and flow of sand, as well as experiment with volume and weight. Imaginative play connected to sand is also a desired outcome associated with this exhibit. (*The Wonder Cabinet Sand Laboratory*-13)

Target age is 5-11, but all of our exhibits are made to be accessible to all ages. The stated goals from the initial exhibit document are: to help kids connect their real world experiences with the often-abstracted study of geometry, by reinforcing 3-D experiences with shape and then reintroducing 2-D shapes as an abstraction or component of 3-D shapes, by inspiring the exploration of shapes around them and encouraging pattern seeking, to encourage kids to use shape and language of geometry to describe and understand their world, to provide good experiences for many different types of learners by including several different ways of experienceing shape and exploring the subject of geometry. (*Kids in Charge*-14)

6) ***What are the actual outcomes of this exhibit, and to what extent do they match your intended or desired outcomes?***

Actual outcomes match stated goals. (3 respondents)

The exhibit is pretty effective at attracting children to play and they are captivated by the motion of the balls down the ramps and the different objects the balls interact with, and the effects that occur. (*Chain Reaction Room*-01)

The children learn a little bit about cause and effect and how to move balls through the system. They interact with parents on how the machines work and how to get a ball from point A to point B. For older children, the goals of problem solving seem to match. (*Tools for Solutions*-03)

Children experiment with many different exhibits that move and redirect air in dynamic ways. In addition to laying inside the big Wind Tunnel, children will go back and experience the sucking action of the big fan as it pulls air/objects toward it. (*Air Fountains*-06)

Children and adults seem to work together to ensure their boat will make it down the river. The adults seem to help children when it comes to things like not being able to reach the handle. Sometimes adults take the opportunity to take a break in *Waterplay*, and given the proximity of benches to the basins and open sightlines this happens frequently. (*Waterplay*-08)

Play-based learning including social interaction. (*Science Playground*-09)

The things I observe in *Shape Space* for ages 3-5 are general manipulation of materials, including trial and error with balance, weight, and volume, pattern recognition, and exploration of what pieces fit toether. (*Shape Space*-10)

7) ***What is it about the exhibit that you think contributes positively to this kind of interaction?***

A small action can cause a big effect. The children simply place a ball in the opening of the track and the ball moves around the room interacting with different things as it goes. The children watch the ball until it comes to rest in the collection trough. Then the children send more balls down. This shows that the captivating part is not simply putting the balls in the track, the children also like watching the ball's journey. (*Chain Reaction Room*-01)

The exhibit is designed with materials that have multiple uses and allow for interaction and engagement at many different levels. A preschooler and a parent could interact with the same exhibit and both have a different outcome but have a shared experience. (*Cup Copters*-02)

The parent's/adult's guidance is necessary for the exhibit to help gather balls, to explain to the children where the balls go, and to facilitate the experience. We have added label copy to explain the six simple machines, which has helped parents to be more confident explaining the working of the exhibitions. (*Tools for Solutions*-03)

The exhibit is fun, easy, and intuitive. Kids will spend a lot of time at the exhibit rolling balls. This gives parents the time to read text and talk with their child. (*Gravity Wall*-04)

Not only were there parent pointers hidden through the exhibit's signage (verbal prompts to facilitate questions and learning with the children), but the exhibit was designed so that kids can use it on their own, and with grown-up help extend their learning even further. Everything from material placement, heights, and written plans were available that utilized grown-ups. (*Junior Jobsite*-05)

When properly set, the motion of the balls, some of which have ribbons, is very engaging. It's a puzzle children want to observe and figure out. Then, when they want to affect the action, it's just slightly too hard for them to change the configurations alone. Parents can see this and they offer to help or the child invites help. (*Air Fountains*-06)

Children can work at their own level, make choices, and have a great variety to choose from. This helps to keep their interest level up. For young children, it is important that they have a tactile experience with the exhibits and the manipulatives. (*Air Fountains*-06)

As visitors experience kinetic energy, they're drawn into tinkering to find out exactly which factors create change. (*Make it Move*-06)

Concepts easy for adults to understand, relative accessibility, and relation to everyday life. (*Go Power*-07)

If things are a little out of reach of the youngest visitors, this in a way forces the adults to interact and take a more active role. (*Waterplay*-08)

It's attractive and engaging. Children often interact with other children outside of their museum-going group and figure out ways to collaboratively play together, and thus learn from each other. Lots of different types of play, suitable for kids of all learning levels and interests. (*Science Playground*-09)

The types of materials are very open-ended. The jovo table is very social, it's a round table with a bin in the middle filled with Jovo pieces. Adults and children sit around it working. They can see each other's work, they can talk, adult and child can sit next to each other. It provides well for parallel play as well as for parents in an assisting role. (*Shape Space*-10)

The design of the table facilitates cooperative, multi-age experiences and the bubble wands work well. (*Bubble Water Table*-12)

Desired exhibit outcomes are encouraged by the nature of the sand itself (maleable, moveable, fluid, textured) and the number of variously-sized containers and scoopers available for use by visitors. (*The Wonder Cabinet Sand Laboratory*-13)

8) ***What are you basing your judgment on? Do you have any anecdotal or evaluative research related to adult child interaction in this exhibit?***

	Response Percent*	Response Count*
Anecdotal data	41%	7
Internal evaluation	12%	2
External evaluation	12%	2
PPE research	59%	10

* several respondents gave multiple responses

Designing with the Adult in Mind

9) *When you develop or design an exhibit for preschool-aged children, what kinds of considerations do you make to support the adult caregiver?*

We are struggling with finding an effective approach to supporting adults. Adults don't seem to be interested in adult-sized play items offered to encourage them to play. They also don't seem interested in signage. (01)

There has to be something of interest to the parent and the child. If one party is not interested it will cut short the engagement time of the other party. We try to select materials that are familiar to adults and fairly easy to manipulate (although we also see value in visitors learning and practicing how to use tools and materials, everything doesn't have to be easy). A key consideration is making sure there is seating for both the adult and child. The seating should be in enough proximity that the parent and child can sit and engage with the exhibit if they choose to be seated. (02)

Creating a positive experience that reinforces the power of the child and the parent to make changes. (03)

Our education and exhibits team work together to ensure both the child and adult get something from our exhibits. In the last three years we have made great strides in consulting with our adult visitors to better understand how to meet their needs. Everything from seating to making sure we meet the state building blocks for Early Childhood Education. Our adult visitors want to make sure that their kids are ready for school and that their children are prepared for what's to come. We now have staff that represents our adult caregivers and constantly works to meet their needs. (05)

What does early childhood tell us about the typical "scheme" in relation to the exhibit? If it's appropriate then the caregiver's role becomes easier. They (child and caregiver) have a choice about what level of interaction they have with each other given their mood. Even though there is research about furniture and whether or not to have it, a good designer will tend to get those things right by instinct and experience and getting a "sense" of the space. In short, books, seating, limited but not overly directive signage, enough space for an adult to help a child by standing next to them, pacing and layouts that lessen competition for specific exhibits, lively but not frantic environments that inspire and support the subject but don't overstimulate. Make the intent, goals, or challenges of the exhibit intuitively obvious to the child so that he or she can engage the parents. (06)

Some considerations would be a place to be near enough to help the child, whether seated or standing; sufficient open-endedness so that an adult can feel needed and that he/she can help, whether a sign with leading questions, or appropriate descriptive vocabulary would promote engagement. (06)

Is it truly open-ended and process- (not product-) oriented? Does it playfully engage our child-adult learning partners, encouraging cooperative problem-solving? Is the experience as authentic as possible, using real tools, materials, and equipment

whenever possible? Is it accessible, <u>inviting inclusion</u> without isolation or stigma? (06)

<u>Signage</u> and <u>hands-on</u> activities. (07)

<u>Seating</u> and <u>instructions aimed at parents</u>. (09)

Attempt to make all activities family friendly so a <u>parent can easily join in and participate with the child.</u> (09)

We want <u>adults to be physically comfortable</u>, some seating but not too much. They must be able to have <u>good sight lines</u> to keep an eye on their children. Our new philosophy is to <u>write labels that are open-ended questions or prompts that give parents cues to facilitate play and exploration</u>. (10)

<u>Comfort</u> in the exhibit space, <u>messaging, and clear roles for adults</u>. (12)

We try to provide room in and around the exhibit piece to <u>allow for multiple bodies</u> (in some cases multiple families) to engage with it, as well as <u>parenting messages to invite parents to engage with their children in developmentally appropriate ways</u>. We also carefully consider the <u>inclusion and positioning of adult seating to be supportive of interaction with their children</u>. (13)

10) Below is a list of exhibit elements caregivers have told us help support interaction with their child. Based on your experience as an exhibit professional, please rate how important you think the following elements are. Please assign a number 1-12 for each element with 1 being most important and 12 being least important.

1. Wide variety of materials available

2. Easy for adult to figure out

3. Easy for child to figure out

4. Open space with clear sight lines

5. Controlled exits

6. Plenty of materials available

7. Seating

8. Noise level/sound/acoustics

9. Labels: pictures or photographs

10. Include tables and chairs designed to accommodate adults

11. Lighting

12. Labels: Text

Additional considerations suggested by respondents:

- Exhibit aesthetics: colors, textures, natural lighting

- Facilitation by staff

- Safety considerations: Rounded corners, no choke hazards

- Multiple outcomes

- Inviting, original, enticing, of natural interest to children, fun for both child and adult

- Physical height of exhibit elements accessible to younger children

- Obvious effect so child can easily understand what happened

Labels and Graphics

11) When developing or designing a science exhibit for preschoolers and their adult caregivers, what kind of emphasis do you put on labels and signs in the exhibit?

	Response Percent	Response Count
No emphasis, tend not to use any labels in these kinds of exhibits	11.1%	2
Little emphasis	22.2%	4
Some emphasis	55.6%	10
A lot of emphasis, we rely heavily on labels in these types of exhibits	5.6%	1

Comments:

We use images only. Images can help with conversations and relating the exhibit experience to outside experiences. If we choose the right materials for exhibits we should not need labels. We do have books and articles by our exhibits. (02)

Fun, short labels that ask questions and provide prompts to learning. (03)

We have found that we tend to put a lot into our signage, but most folks don't read it. (05)

This museum used to have no labels; we are rethinking this based on success with math labeling. (06)

Enough to encourage exploration or give an idea about the exhibit but not so much that it's leading. (06)

We are exploring the possibilities of "parent prompts" and explaining why the experience is important. Some spaces lend themselves to no explanation, especially if the parent understands the concept. (06)

Instructions are needed occasionally, but you do not want to bombard the visitor with too much information. (08)

We rarely use the instructional labels. We often use written labels that give prompts, "What happens when you ___?" or "Trying new things builds skills." (10)

It depends upon the exhibit, but we like to minimize need for reading labels as it can distract from the activity. (13)

12) Do you use labels with photographs of people (adults and/or children) using the exhibit in ways you intended?

	Response Percent	Response Count
YES	13.3%	2
NO	86.7%	13

Comments

In 10 of our Playscapes, we have what we call "Play Modeling" photos of grown-ups and children interacting in each exhibit. These are intended to provide an example of ways to interact in the playscapes. (05)

Only when we are not able to design the exhibit well enough to give clues as to its use. (02)

13) Which of the following graphics do you use to illustrate the science content or principles of the exhibit?

	Response Percent	Response Count
Drawings	91.7%	11
Photographs	58.3%	7
Cartoons	33.3%	4

Examples:

Drawings of different types of windmills by the *Build a Windmill* exhibit. Photos of water striders and things floating on water by a surface tension/water exhibit. (02)

We use real-life photo examples as well as exhibit sketches for the construction aspects of the playscape. (05)

The block area has used both of these to suggest, but not direct, activity. (06)

Warehouse labels. (12)

We sometimes use simple text and graphics. (13)

14) Do you ever use "parent labels" that inform the adults about their role in the child's exploration giving cues or prompts?

	Response Percent	Response Count
YES	76.5%	13
NO	23.5%	4

Examples:

"Adults can play too!" Adult-sized costumes and smocks. (01)

We make "Children Learn by Doing" statements that prompt adults to challenge their children further in their play and learning. These prompts are accompanied by play modeling photos or something relevant to the exhibit. (05)

We are currently prototyping signs that inform visitors why the experience is important and what things they can do to support the experience for their child. (06)

Our *Math Connections* exhibit has labels that let parents know what their children are learning but that they don't "lead." (06)

Animal Secrets: labels suggest parent behavior and probing questions to ask. (09)

We provide this information in the form of parent take-home materials in the exhibits. (13)

We say, "Try this…" (14)

15) Do you ever use labels geared to the adult that explain principles of early science learning or child development theory that supports the exhibit content?

	Response Percent	Response Count
YES	56.3%	9
NO	43.8%	7

Examples:

There is a label [in the Math exhibit] that explains to parents why a full body experience on a large balance is important for the beginnings of learning what "equals" means in math. (06)

The Museum has a Resource Center with take home "Focus sheets" about this, but it hasn't been tried on labels. (06)

We do this through our take-home materials for parents. (13)

16) *Do you ever incorporate video in your preschool science exhibits to model behavior?*

	Response Percent	Response Count
YES	23.5%	4
NO	76.5%	13

Examples:

In our Building area we have video running of children using the tools and nails. The video was shot from the child's perspective. Visitors can watch the video while they wait for their turn in the building area. (06)

In our brand new exhibit, *Play Power*, that opened Nov. 6, we made a video of children playing in the exhibits. Each clip has subtitles talking about the type of play behavior the child is demonstrating (which often aligns with science learning behavior). Example: "She is testing each one seeing which sound she likes." (10)

17) *Have you formally evaluated the effectiveness of any of these labeling techniques?*

	Response Percent	Response Count
YES	23.5%	4
NO	76.5%	13

Reflection

18) *Do you ever provide opportunities for adults and/or children to reflect upon or report about their experience in the exhibit?*

	Response Percent	Response Count
YES	56.3%	9
NO	43.8%	7

19) *What methods have you used to provide opportunities for adults and/or children to reflect upon or report about their experience with an exhibit?*

Exhibits have some sort of archeology component where there is evidence of prior activity. It gives visitors some ideas for starting points, and also offers the physical reflections of prior visitors. Facilitation by staff and volunteers is also an important component and through these conversations visitors (as well as the staff) can reflect upon their experience in a particular exhibit. (02)

We recently conducted an on-line survey of our in-house exhibition on children's nutrition/physical activities. (03)

We often do exit interviews. (04)

We offer several opportunities for follow-up surveys within the museum and if a staff-led program was part of the experience, they receive a "Recipe for Play" card that has extension activities to be done at home or in the community. (05)

We've tried a computer set-up [for reflection], inviting children to draw [about their visit] in the Art Studio. We also have play facilitators on the floor who are trained to talk with children about what they are doing or have done. (06)

Visitors write on index cards, staff can then sort through the cards and post the most relevant. [Floor staff] also make an effort to personally ask the visitors how they like various activities and solicit ideas for improvement. (09)

Talk Back Boards, Play Guides – staff who interact with visitors in exhibits. (10)

Visitor surveys that capture general impressions of the Museum, including its exhibits. (13)

20) *Please comment about the effectiveness of methods you've tried.*

Respondents who mentioned surveys agreed that in general they are an effective way for visitors to report about their experience.

Facilitation is very effective because it is very comfortable for parents to be social as they reflect upon their children's experiences. The computer set-up [for reflection] didn't work well. Children were playing more with the technology than reflecting. (06)

We have had talkbacks for kids in our immigration/history exhibit, our pet care exhibit, and our teeth exhibit. In *Pets*, we asked kids to tell a story about their pet, and in *Teeth* we asked "what do you do with your tooth when you lose it?" Both generated lots of responses (some hilarious) from preschoolers and older children. (10)

21) *Did you conduct any evaluation regarding these reflective methods in your exhibit?*

	Response Percent	Response Count
YES	6.7%	1
NO	93.3%	14

Connection to Home

22) *In what ways do you try to connect visitors' exhibit experiences with experiences they can have at home?*

We try to use everyday materials to build our exhibits and for use in our programs to show that you don't need fancy, expensive materials to do science. (01)

Through the use of common materials presented in novel ways and by drawing on common experiences using novel materials. A staff member overheard a conversation between two dads discussing one of the dad's uses of a homemade version of a cup copter at his child's birthday. He had liked the experience so much at the museum that he tried it at home. (02)

For each exhibition we create a parent guide (available in Spanish and English) that has "in the museum" and "at home" activities for parents and children. When our new website launches, we will have these guides available as a download. (03)

This is our Museum's big push right now and we are proud to say that there are connection opportunities for every playscape and every program that we have and do at the Museum. Play and learning do not stop when you walk out of our doors. We

just want to make sure each of our guests are afforded opportunities to extend their learning experiences beyond the Museum. (05)

We connect the experiences of exhibits with programs and generally give quite a bit of information about what visitors can do at home. <u>Because our technology is fairly basic, it's easy for parents on a budget to replicate similar experiences at home</u>. For example, large sinks or bathtubs make excellent water tables. It's the ideas and the age-appropriateness of the activities associated with the experience that help parents and children enrich their home experience. (06)

<u>On-line activities</u> and <u>take-home guides</u> (07)

<u>Relevance of activities</u>, family <u>take-home guides</u> with activities such as a recipe for making flubber. (09)

Some of our exhibits have <u>parent resource sheets</u>. Our <u>newsletter</u> has a "try-it" every month. We write a <u>monthly column for parents that appears in two local parent magazines</u>. (10)

We have "<u>Homeplays</u>" available and our floor staff can deliver this information. (12)

Our <u>website includes activities</u> families can do at home that connect to their experiences at the Museum. Not all exhibit areas are represented however. The familiar and accessible elements of the exhibits themselves (bubbles, water, etc.) also offer natural links to at-home experiences. (13)

We have <u>activity guides</u> in many of our exhibits that give parents ideas about how to extend their experience. (14)

23) *To what extent were these efforts at connecting the visitor museum experience to home experience successful?*

82% of the respondents stated that they were "not sure" or only had "anecdotal evidence" that these methods were effective.

APPENDIX E

THE ADULT CHILD INTERACTION INVENTORY

This version is included in the report for informational purposes. The final version that is available for dissemination was graphically designed and available in color.

OBSERVATION

Date: _____   Exhibition: _____

Data collector initials: _____

Observation Time Begin: Observation Time End:

Dyad (circle one):   Mother/son   Mother/daughter   Father/son   Father/daughter
Grandfather/grandson   Grandfather/granddaughter   Grandmother/grandson
Grandmother/granddaughter   Other (please specify) _____

Gender and age of child: _____

Narrative Account:

INTERVIEW

(Optional intro) Hello, my name is _____. You may have noticed a sign as you entered the museum today telling you that research was being conducted in this exhibit. We are interested in looking at the ways parents (grandparents) and their young children interact and explore together at various exhibits. I have been observing you with your (grand) son/(grand) daughter in last few minutes here at the <u>name of exhibit</u> and I would like to talk with you about what the two of you were doing, if you don't mind. It will only take a few minutes. I need to let you know that neither you nor your (grand) child will be identified in any way in this study, so I will not be asking for your signature, just your verbal consent to talk with me. May I ask you a few questions?

<u>Introductory Questions</u>

1) Confirm gender and age of child:

2) Relationship of caregiver to child: MO   FA   GM   GF   AU   UN

3)) With which of these categories do you most strongly identify? (Check all that apply)

____White   ____Black or African American   ____Latino/Hispanic

____American Indian or Alaska Native   ____Asian Indian   ____Native Hawaiian

____Japanese   ____Chinese   ____Korean

____Filipino   ____Vietnamese   ____Samoan   ____Other Pacific Islander

____Other Asian (please specify) _____

____Other Race (please specify) _____

Please indicate if interview was conducted in a language other than English: _____

<u>Observation Follow-up Questions</u>

4) Tell me what **you were trying to do** as you were working with your (grand) child at name of exhibit?

Probe: I noticed that you were _____ (refer to observation notes)

5) What do you think your (grand) **child was trying to accomplish** when he/she was _____ (refer to observation notes)?

6) Tell me what **you were thinking about** while your (grand) child was _____ (refer to observation notes)?

Probe: What was going through your mind? Were there any particular questions you thought about asking your (grand) child as they were exploring?

7) How would you describe the **role you played** in his/her exploration?

8) If you had to explain to someone **how a child of his/her age best learns science**, what would you tell them?

9) What was it about the exhibit that made it easy or difficult for you to support your (grand) child's experience?

Potential responses: Labels, text; Good sight lines, safe, clean; Seating; Comfortable, inviting/attractive, compelling; Familiar, Clear goals, easy to figure out

10) Are there other things we could do to make your experience as a caregiver better?

➢ Thank you very much for letting me visit with you and your (grand) child today.

CODING INTERACTION

Adult Role (looking back at your observation and interview notes which of these roles did you see the adult demonstrating) Please make a tally for each occurrence of the role for which you have an example in your notes.

1) Player

_____ Individually (adult is playing independently)

_____ With child in child initiated role

_____ With child in adult initiated role

2) Facilitator (Non-verbal scaffolding and reinforcement through cues and prompts)

_____ Physically manipulates a part of the exhibit to cue the child to next step

_____ Sets up or modifies environment to make it easier for the child

_____ Models for the child how to accomplish a task or do an activity

_____ Smiles at child or nods to reinforce that he or she is using the exhibit components in appropriate ways

_____ Uses hand gesture to encourage child to persist and keep going

_____ Moves physically closer to the child to let him or her know they are available if needed

_____ Lifts child up to make it easier to reach exhibit components

3) Interpreter (Verbal scaffolding and reinforcement through cues and prompts)

_____ Gives praise or encouragement

_____ Narrates the activity

_____ Explains a concept

_____ Gives verbal instructions

_____ Asks or answers a question

4) Supervisor

____Maintains careful watch over child to secure his/her safety (close physical proximity, eyes on the child, looks around cautiously)

____ Monitors child's interactions with others, intervening to solve conflict (especially regarding turn taking or sharing)

____ Monitors and controls child's frustration

____ Removes child from exhibit due to crowding or perceived safety concerns

5) Student (of the child)

____ Thoughtfully observes child at play

____ Thinks about child's developmental needs and/or notes progress (use interview data)

____ Talks to other adults about what child is doing (ex: "He loves this part, she always does it that way, he has trouble sharing, he likes to think up new ways of doing things.")

____ Plans for making connections or extending the experience after the visit (use interview data)

6) Co-learner

____ While playing with the child, the adult is reminded of concepts or skills he/she may have forgotten

____ Works collaboratively with the child to solve a problem, relying in part on the child's own thinking to stimulate the adult's thinking

____ Adult asks child for help to accomplish a task or to figure something out

Science process objectives (looking back at your observation and interview notes which of the following science behaviors did you see the adult initiating, supporting, or engaging in with the child? When possible, provide an example from your field notes.

- o Categorizing: Grouping objects according to their different characteristics
- o Collaborating: Working in partnership with peers, older children or adults to investigate a phenomenon, accomplish a task, or investigate a question
- o Communicating: Sharing your ideas and discoveries with others
- o Comparing: Using observation skills to notice and describe similarities and differences between objects
- o Counting: Using numbers to accurately count a group of objects
- o Describing: Explaining to others what you've learned or observed
- o Estimating: Judging whether you have a LOT of something or a little
- o Experimenting: Engaging in simple investigations including making predictions, gathering and interpreting data, recognizing simple patterns and relationships, and drawing conclusions
- o Generalizing: Drawing conclusions and/or "making theories" about why something happened
- o Measuring: Using informal systems of measurement to establish length, time, area, capacity, or weight
- o Observing: Learning about the world around you by employing all the senses – hearing, smelling, touching, seeing, ad tasting
- o Predicting: Using prior experience in thinking about what might happen if/next
- o Problem solving: Brainstorming solutions, trying them out and learning from your mistakes
- o Recording: Representing data, ideas/or experiences using multiple methods (drawing, movement, words, etc.)
- o Relating to prior /and or current experience: Recalling past experiences and applying them in a new situation, applying new understanding and/or experience in different situations
- o Using tools: Thoughtfully manipulating simple tools (magnifiers, eyedroppers, etc.) in order to extend your senses

IDENTIFYING EXHIBIT DESIGN ELEMENTS

Indicate which of these design elements helped support the caregiver's interaction with their child (refer to Interview Question #9)

- o   Wide variety of materials available

- o   Easy for adult to figure out

- o   Easy for child to figure out

- o   Open space with clear sight lines

- o   Controlled exits

- o   Plenty of materials available

- o   Seating

- o   Noise level/sound/acoustics

- o   Labels: pictures or photographs

- o   Includes tables and chairs designed to accommodate adults

- o   Other _____

APPENDIX F

SIGN TEXT - ACII VIDEOTAPING

Sign Text for ACII Videotaping

You may be videotaped at this exhibit – now.

Videotaping in Progress

When: Saturday and Sunday we are videotaping between 9-12 and 2-4 today. If you do not want to be videotaped, please come back during the hours of 12-2 or 4-5.

Why: The Boston Children's Museum is trying to learn how visitors interact in the new Peep's World exhibit, in order to develop training materials for museum staff. Please proceed normally and enjoy yourselves.

For questions or concerns please see the guest services staff or speak to anyone with museum identification.

The videos will be edited and used to train museum staff in how to better understand families' use of exhibits.