Parents, Science, and Interest

The Role of Parents in the Development of Youths' Interests

Heather Toomey Zimmerman, Suzanne Perin and Philip Bell

Abstract

We develop the Parental Facilitation of Children's Interests in Museum Environments as a framework and tool for research and practice that highlight the role of parents in the development of youths' interests. We create the framework by combining empirical data from our research study with three theoretical perspectives from the psychological and informal learning literatures: (1) interest development, (2) parental roles to support learning outside of school, and (3) everyday expertise in science. We draw from video-recordings of families during visits to a science center to elucidate how parents use talk and gesture to focus on children's interests for more extended engagement with science and math content across the museum visit. Implications drawn to practice include rethinking parental roles in museums during training for museum education professionals and when designing spaces.

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As youth explore their worlds, adults mediate new learning experiences through social facilitation practices (Rogoff, 2003), which connect new knowledge and interests to youths' existing knowledge. Parents use museums as sites for generating interest and building knowledge (e.g., Crowley & Jacobs, 2002), yet the facilitation practices that parents use during museum visits are under-specified. In fact, Schauble and Bartlett (1997) argue that facilitation is often missing or "invisible" from theories of museum learning—meaning that too often learning in museums is considered without careful consideration of the role of mediation (also called teaching or facilitation) provided by parents, signs, exhibit layouts, museum staff or volunteers, and other structures provided to the learners. The consequences of this undefined understanding of how parents facilitate youths' interest leave museum professionals without needed tools to guide their designs for family learning.

Related to this, after an exhaustive review of the literature in science learning in out-of-school settings, a National Research Council panel recommended that learning goals be expanded from a traditional focus on content to also include the development of interest and identity towards science (Bell, Lewenstein, Shouse, & Feder, 2009). This same report also concluded that further research on the naturally occurring behavior thought to provide evidence of interest in informal learning activities is needed—including studying how interest is displayed and valued among participants in informal learning environments. These researchers then identified another gap: a gap in researchers' accounts of youths' interest development in non-school settings.

This article addresses these two theoretical gaps (of parental facilitation and of interest development) by examining interactions during visits to one science center. Through crafting detailed analytical accounts of interest facilitation by parents, we also derive implications for informal education practices and learning sciences theory. We aim to make the work that parents do to support, encourage and expand youths' interest an explicit analytical focus. To that end, our article has two goals. First, we developed a framework on how

parents support and maintain youths' interests in museums. This framework was meant to inform practice and learning theory as well as advance a new line of research that seeks to understand interest development in science centers. Second, our goal was to provide design principles and suggestions to museum professionals who may want to begin to purposely incorporate elements into programs and exhibits that support interest development and parents' roles in facilitating it.

Analytical Framework

We used the existing literature to develop an analytical framework to guide our data analysis with the intention of testing and refining the model through applying it to video records of parents facilitating interest in one museum. We developed the initial analytical framework by combining three theoretical perspectives: (1) psychological perspectives on how interests develop (Hidi & Renninger, 2006; Renninger, 2009), (2) parental roles to support learning outside of school (Barron, Martin, Takeuchi, & Fithian, 2009; Palmquist & Crowley, 2007; Rogoff, 2003; Swartz & Crowley, 2004; Zimmerman, Reeve, & Bell, 2008), and (3) how families develop everyday expertise in science (Bell, Bricker, Lee, Reeve, & Zimmerman, 2006; Bell, Bricker, Reeve, Zimmerman, & Tzou, in press).

The framework focuses on the role of parents to foster interest in out-of-school environments. The informal learning literature has long focused on the social aspects of learning (Falk & Dierking, 1992) and the importance of the family as a site for learning within museum settings (Ash, 2002; Ellenbogen, 2002; Ellenbogen, Luke & Dierking, 2004). We focus here on the socio-cultural accounts of learning which show that parents, across many cultures, actively facilitate learning through *guided participation* (Rogoff, 2003). In guided participation, parents structure youths' learning by providing opportunities for observing and for engaging in cultural practices (or in child-friendly versions of practices). The roles we documented parents taking in our study are one kind of guided participation.

We highlight the social supports needed to pique and maintain early *interest* for youth (Hidi & Renninger, 2006) around science—and we link those social supports to parents through everyday participation in activities (Rogoff, 2006) such as museum-going. Interests emerge and develop (Renninger, 2009) and, in the case of children, are often facilitated by others. Renninger (2009) suggests that the youngest learners, due to challenges in understanding new content, would rely most on their parents (and others, like teachers) to support them as they develop interests. In this article, we analyze how families talk about science together in museums to examine how and when parents spark and maintain youths' interests.

Parents have ideas about their *roles* as teachers in museums (Swartz & Crowley, 2004) and in their homes. Barron and colleagues (Barron, Martin, Takeuchi & Fithian, 2009) have shown that parents take on complex roles as learning partners to support their children's interests in technology (e.g., programming teacher, providers of computers). These learning partner roles occur over many months or years to support and sustain a youth's interest related to computers. In relationship to science learning in museums, parents take on intellectual roles such as idea-suggester, critic, and explainer (Zimmerman, Reeve & Bell, 2008) to support their children in short-term learning moments.

While in the museum environment, parents attend to children's areas of developed competencies (Crowley & Jacobs, 2002) called *islands of expertise*. Within these islands of expertise, parents provide more sophisticated explanations (Crowley & Jacobs, 2002) and provide youth the opportunity to demonstrate their obtained knowledge (Palmquist & Crowley, 2007). Our work here looks at the start of interest—situational and emerging interests—that may develop into islands of expertise and with a more specific focus on how parents cultivate that development through the conversations they have with their children in museums.

Finally, through longitudinal studies of youth learning in homes, schools, and communities, the Everyday Expertise construct (Bell, Bricker, Lee, Reeve & Zimmerman, 2006) shows that parents can act as bridges from youths' prior experiences to their

developing science, technology, engineering and mathematics (STEM) expertise. We posit that parents can act as a bridge that connects a new experience to another experience to help youth negotiate STEM meanings, but parents can also act as a barrier to learning through reinforcing negative STEM-related stereotypes (Bhanot & Jovanovic, 2005; Crowley, Callanan, Tenenbaum & Allen, 2001).

Methods and Subjects

The research team recruited 15 ethnically and linguistically diverse families who were members of one science center, Pacific Science Center in Seattle. Families had at least one child between 5 and 12 years old. These 15 families consisted of 44 people: 14 mothers, eight fathers, 10 girls, and 12 boys. Eleven families were Caucasian, one was South Asian, one was biracial, and two were Chinese American. All families were fluent in English; three families were bilingual.

The overall data collection strategy was family-driven, so that we could understand, from the family's perspective, how they experienced the museum. Families were interviewed before they toured the science center. Families then navigated the science center as they chose, and the research team video-recorded them as they interacted with exhibits. Families participated in a short interview at the visit's end.

Our video-recording methodology documented the parents' role in fostering conversation elaboration (Ash, 2002) because conversation elaboration considers families' talk as both a means of learning and an outcome of learning—requiring detailed recordings. To analyze the data, researchers made fieldnotes and created logs of the video records, which were later transcribed. We iteratively read the fieldnotes, logs, and transcripts to conduct a thematic analysis of family interactions.

We used two research questions to guide our inquiry within these cases:

- What facilitation practices do parents use to support the development and maintenance of children's science-related interest during science center visits?

- How do parents facilitate science and math engagement through assisting youth to connect non-science related interests to science and math topics?

Data and Results

Through a thematic analysis of the video records from the science center visits, we found three social practices that parents employed to facilitate interest:

1. Parents support existing interests through gesture and conversations that connect interests to exhibits;
2. Parents make observations and read museum signage (or encourage youth to read and observe) to bring in new information;
3. Parents evoke and support familiar social practices in the museum.

To illustrate these three practices, we created two case studies of family learning. These cases focus on ways that parents fostered and maintained youths' interest. Both cases employ the first practice; case one also demonstrates the second practice, while case two also shows the third practice.

Case 1

Parents support existing interests through gestures and conversations that connect interests to exhibits, make observations, and read museum signage (or encourage youth to read and observe) to bring in new information.

Within one family's visit to the museum, the parents used gestures and movement to show how new science content connected to their children's prior knowledge and interests. The parents also made observations from skeletons and models and read museum labels aloud to connect the children's interests to science content. The Case 1 family included a mother, a father, a daughter Megan (10 years old), and a son Sam (7 years old).

Within this case, we highlight two brief episodes of parental facilitation. Episode 1 lasted one minute and three seconds.

The father demonstrated, with Sam's body, the different ways that animals walk. The father bridged Sam's interests and knowledge of his own body by comparing Sam's legs to an alligator's legs through movement.

Episode 1

1. Sam: ((referring to robotic animal models)) Are these real or what?
2. Dad: This is interesting, don't you think? What does this say?

Excerpt - Sam and his father spend the next 49 seconds sounding out words "alligator" and "reptile" on the museum label.

3. Sam: Stand this way. Dinosaurs stood this way like modern mammals.
4. Dad: Very good.
5. Dad: Do you see how the legs work differently?
6. Sam: Yes.
7. Dad: See. ((Redirects Sam to the museum label.)) Your legs come straight out of your body! ((Pats his hands on Sam's legs twice.))
8. Dad: Alligators, they come out from the side and then down. ((Moves Sam's arms so that humerus is parallel to ground and his lower arm is perpendicular. [See figure 1.])). Like that.

In this episode, Sam showed interest in the robotic models ("Are these real or what?") in line 1. His father took his interest in the robotic animal models and channeled it to encourage reading the museum label underneath the models. Together, Sam and his father spend 49 seconds reading aloud a few sentences, because Sam slowly sounded out each word. When Sam finished reading (line 3), his father asked if Sam understood. Sam quickly answered "yes" (line 6), but his father persisted to connect Sam's interests in the robots to biological form-and-function concepts.

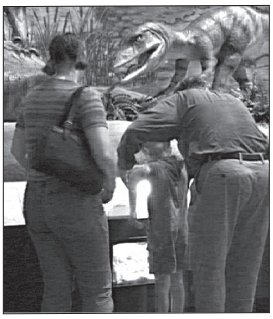

Figure 1: The father used Sam's arms to illustrate how an alligators' legs come out horizontally from the hip, before coming down vertically. *Photo courtesy of authors.*

He reinforced what Sam read aloud through both touching and manipulating Sam's arms and legs (figure 1). In this way, Sam's father took Sam's triggered interest in the model and maintained it through talk, gesture, and movement—allowing Sam to connect his knowledge of, and interest in, his own body to an alligator and dinosaur.

The second episode in case 1 involved the mother and daughter (Megan). The mother used the same two facilitation practices of (a) supporting interests with gesture and conversation (through humor) and (b) making observations or using labels. This whole episode lasted three minutes and 17 seconds; two excerpts that illustrated facilitation processes are shared. In these two excerpts we see the mother use her knowledge of Megan's interest to first engage her in science content (first excerpt) and then maintain and sustain her interest (second excerpt) when it begins to wane.

Episode 2, Excerpt 1

1. ((The mother and Megan see a moveable cart that features models of human bones. Megan walks past the cart. The mother stops at the cart.))
2. Mom: ((Picks up hand from the bone cart, taps Megan on the shoulder with the skeleton hand.)): Let me give you a hand.
3. Megan: Ahh!
4. Mom: Hhhh ((Laughs)).
5. Megan: You just surprised me! ((Megan and Mom come to the bone cart.))

The mother used a joking genre of interaction to interest Megan in the bone cart activity—an activity Megan initially walked by. Her mother's humor became an interest entry point for Megan. Like the prior episode, Megan's mother used gesture, movement, and talk to maintain Megan's interest in the activity.

Episode 2, Excerpt 2

The bones on the cart interested Megan; she picked bones up to examine them—counting the bones on the hand model. However, Megan was less interested in answering the staff member's questions. Megan's mother tried to maintain and extend Megan's interest in learning science content, not just physically manipulating and exploring the bones:

1. Museum staff: What does your skull protect?
2. Megan: Your brain.
3. Museum staff: Anywhere else in your body where it protects something?
4. Mom: ((Megan silent.)) Ribs protect your heart. Lungs. ((Points her hands to her ribcage.))
5. Museum staff: Lungs and all those organs in there.
6. Megan: Really soft organs.
7. Mom: ((Picks up bone off the cart.)) Where does this go, Megan?
8. Megan: ((Doesn't answer; looks at her mom and holds another bone.))
9. Mom: ((Puts bone in front of her hip while Megan watches.)) My guess is ((pause)) it goes like this?
10. Museum staff: Yeah, it is part of your pelvis.

In this second portion of the bone cart interaction, Megan is less interested in participating in the museum staff member's question-and-answer session. The mother works to maintain Megan's interest in the bones, not just as objects but also in their larger scientific role in human anatomy. She

provides an explanation on the importance of ribs (line 4) and demonstrates where the bones of the pelvic girdle are located. Through the mother's bridging interactions, these bones become not just interesting objects but also related to science. The mother knows her daughter's interests, and because of her knowledge, she is able to maintain and extend Megan's initial interest in the specimens to have more discussion about the science. The facilitator, due to the nature of short-time frame interactions, does not have prior knowledge of Megan's interests or capabilities. The museum facilitator is asking test-like questions, which do not interest Megan like the physical artifacts (the bones) do.

Case 2

Parents support existing interests through gestures and conversations that connect interests to exhibits and evoke and support familiar social practices in the museum.

A shared family interest related to games provided a means for a parent in Case 2 to extend and engage her son's learning of math. In this case, game play practices were used by all family members to interact with each other and with multiple exhibits throughout their visit—regardless of whether gaming was an intended exhibit activity. The family's game play became a bridging tool to engage the youths' interest in science content.

This family of four included Mom, Dad, Mike (9 years old) and Charlie (7 years old). They indicated in their pre-visit interview that they play games together. Game play as a strategy for engaging with biological content was noted in prior work (Zimmerman, Reeve & Bell, 2010), but in the case presented here, competitive, social game play was not a designed feature of the exhibit. Instead, the family appropriated the museum's learning agenda about probability by building on an established gaming interest.

Charlie and his mother spent seven minutes at an exhibit about probability that focused on how trends help people make predictions about the future. A visitor was to flip a coin (through pushing a button) and predict whether the result would be heads

or tails. The exhibit label stated that "the larger the number of events, the more accurate the prediction." Charlie and his mother turned the solitary activity into a competitive game. This repurposing of the game, based on Charlie's interest, meant the family engaged with this activity long enough to flip the coin in the exhibit 109 times—until the exhibit's coin flip counters were maxed out and could not record any additional heads-tails results. The two excerpts are from the beginning and the mid-point of the pair's interaction at the exhibit.

Episode 1

1. Charlie: Which one do I be, heads or tails? //
2. Mom: ((Reads the museum label.)) //Oh, oh I get it.
3. Mom: I'm gonna be tails.
4. Charlie: I'll be heads. ((Charlie pushes the button to flip the coin.))
5. Charlie: Tails. ((Mom slides flip counter on the exhibit for each head and tail flip.))
6. Charlie: Tails.
7. Charlie: Heads! I get two.
8. Mom: You get one.
9. Charlie: No, because of here. ((Points to tails row that has two counters.))
10. Mom: No, that was tails. I have two; you have one.
11. Charlie: Tails.
12. Mom: ((Smiles and turns to look at Charlie.)) I'm winning.
13. Charlie: Heads.
14. Charlie: Tails. ((Charlie looks at the flip counter.)) You have two more ahead of me.
15. Mom: Yup.

Thirty-five seconds of coin flipping (heads and tails are uttered plus other small conversation) continues before the next line.

16. Mom: Hey ((Smiles)), you're not telling me all those tails! ((Mom tousles Charlie's hair, figure 2.))
17. Charlie: ((Whispers)) Yes.
18. Mom: That was a heads, right?
19. Charlie: Heads.
20. Charlie: Heads. ((Charlie flips coin twice.))
21. Mom: You gotta say ((Rubs Charlie's back.)) tails or//
22. Charlie: //Heads.
23. Mom: Are you just hoping I won't notice the tails?
24. Charlie: No.
25. Mom: Hhhhhh ((Laughs)).

Immediately, Charlie was interested in this activity because he could evoke gaming practices. After she was asked to claim "heads or tails" (line 1), Mom confirmed this competitive game by selecting a side, "tails" (line 3). The mother used game play rules to facilitate an interest in probability by using the rules to ensure accurate data recording.

The game was intended to be solitary, yet in lines 4 and 5 the pair set up responsibilities for a competitive game. The mother used the flip counter to record data; Charlie flipped the coin in the exhibit and called out "heads" or "tails". Charlie made a move to catch up to his mother through not calling out loud all the coin flips. The mother did not allow this game rule digression, yet she maintained his interest in the activity by continuing the game. With Mom scoring again with a tails flip, she tried to lighten the situation by smiling and indicating competition in line 12, which was well received when Charlie won the following coin flip. He noted that he was not too far behind and Mom agreed (lines 14–15).

After a series of coin flips that were not in his favor, Charlie stopped recording results although Mom was still tallying "heads" and "tails" from her observations of the coin. Mom indicated that he may be cheating (line 16) in an indirect mode but softened the rebuke by tousling Charlie's hair (see figure 2). When Charlie

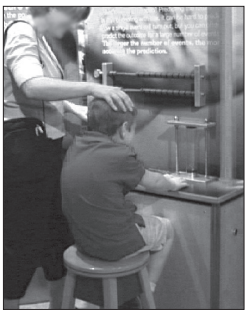

Figure 2. Mom supported Charlie with an affectionate hair tousle while they remained interested in a coin flip exhibit that illustrated probability concepts. *Photo courtesy of authors.*

was silent again, the mother told Charlie he has to say (line 21) "heads" or "tails".

Appropriating the exhibit for their own gaming helped this pair to maintain interest for 109 coin flips. Although Charlie was behind for much of the game, the mother used touch and game play rules to keep Charlie interested in the probability learning moment. The competitive gaming practice may have hindered the family's engagement with the intended probability content because most of the talk revolved around winning, not cheating, "heads" and "tails"—rather than on prediction or trends. Yet, at the end, the mother returned to the math content, albeit very casually. She said, "But they were pretty close huh? There were sometimes when there were a lot of tails and a lot of heads." Due to the mother's graduate training in biology and her explicit teaching noted throughout her visit with both sons, we interpret her statement as an attempt at a developmentally appropriate explanation for Charlie to show the trend was for an equal number of heads and tails.

Implications

Understanding the details of parent facilitation of youth interest is of key importance to exhibit designers and educators who develop museum programs so that the programs they design can include elements parents can use to support youths' interests. Findings emerged from our analysis about the social practices parents used to sustain and support youths' interests during science center visits. Our findings empirically support the recognition of parents as key facilitators of youths' interests—they encouraged prolonged and sustained engagement with activities that the youths in our study were ready to give up on. The role of the parent as a bridge to science, technology, engineering and mathematics learning was

shown through these cases and has key implications for the design of learning environments, the training of museum facilitators, and learning theory. We first discuss our findings and then the implications for the museum field and for theory.

In our first finding, both families used gesture, movement, and manipulation or use of physical objects to pique and maintain interest. The families used physical space to act out movements and read aloud, including direction and labels on exhibit signage, to encourage youths' engagement with science and math. Second, parents brought their own additional narratives and social practices (Roberts, 1997) such as humor and game play to the exhibit. In the case of Megan and her mom, the mother used humor to interest Megan in the bone cart, which was otherwise a straightforward science demonstration. In the case of Charlie and his mom, they used their existing game play practice, which kept Charlie interested in the task of understanding the likelihood of a heads or tails result from a coin toss. The designed spaces within these exhibits did not prescribe only one way for interaction; the exhibits were open enough to allow the families an alternative narrative structure that suits the families' own museum-going agenda (Hilke, 1989). The multiplicity of familial narratives that parents foster has an impact on how parents trigger or sustain interest in these cases.

Implications to Museum Design and to Facilitator Training

Schauble and Bartlett (1997) propose a model to design exhibits built on the metaphor of a funnel. In the funnel design model, exhibits on the periphery of a museum are designed to be widely attractive to a wide range of learners' interests (the largest part of the funnel), but then throughout the gallery space the funnel narrows from general interest to increasing opportunities for specialized, detailed learning. This funnel metaphor includes ideas of repeat visitors and even at-home continuation of the exploration sparked at the museum. Our analysis of parents engaged with their children to support their interest reinforces this metaphor and funnel framework for consideration in museum designs

that support the development of science-related interests, in addition to science-related concepts. In this study, parents and youths participated in quick, easy-to-access exhibits, but then in applying the Schauble and Bartlett funnel metaphor, parents were observed to work with youths to fine-tune their interest more in-depth. Taking the case of Sam and his dad from Family One, Sam expressed interest and excitement first at the large robotic animal models. This interest became more focused as Sam's father encouraged Sam to both read the museum labels and make an observation from the model. In Family Two, after spending time working through a nearby exhibit on risk, Charlie and his mother engaged in sustained inquiry in another exhibit component on a related topic. Charlie's mom kept Charlie focused on the probability concepts of the game long enough to flip a coin 109 times through gestures, head rubs, verbal encouragement and redirecting to the concepts provided in the museum's signs. A funnel-like design model where exhibit components around the periphery are widely but generally interesting, but then provide specialized spaces for in-depth inquiry in more particular interests could be a tool adapted by other museums because the funnel design can provide tools to help parents sustain and expand upon their children's interests.

A second implication for design comes from the Megan and her mother (Family One); it is related to the way that the design allows parents to interact with exhibits. To move Megan into an exploration of the human body, Megan's mother removed a model of a human hand from a cart (staffed by a museum facilitator) and brought it to her daughter to play a joke. Often museum exhibit components in science centers and natural history museums are behind glass or attached—thereby limiting the movement of the object. By being able to manipulate and touch the bones on this cart, Megan and her mother were able to move the bones from the cart to their own body directly comparing the model pelvis to their own pelvis. The structure of this activity allowed for two things that helped Megan's mother sustain interest. First, by touching and moving the objects, Megan's mother was able to create a new narrative, not related to science—tying to a family joke—that drew Megan to the cart for further engagement in science topics.

Second, by being able to touch and move objects to compare to their own bodies, both the parent and child were able to compare science specimens to themselves, a topic often of interest to children and adults alike. The carts with their more touchable objects provided a platform for Megan's interest, and then Megan's mother extended and sustained Megan's interest to demonstrate the connections between Megan's everyday experience with her own body and to normative science understandings of the role of bones and muscles in the body.

A final implication to museums from this study (and other work related to families) is that parents can be seen as partners in reaching museums' educational goal with youths—not only another audience to reach. Across these cases, we saw evidence that parents know their children's interests, and they enact social practices to support their children's interest throughout the museum. In the cases (and others in our data set) we find parents translating scientific vocabulary, making connections to interests beyond science, and leveraging prior experiences to foster connections to the activity or science content. Considering Family One with Megan and her mother at the bone cart gives us implications for training staff to work with parents and youths. When training facilitators to work with families, museums need to consider components that coach museum facilitators in how to work with parents and follow their lead. For example, if parents begin providing definitions for the words that they are saying or making connections, this may cue a facilitator that she is speaking beyond what the youth knows or is interested in. If parents begin to make connection to books, documentaries, or other family trips, "Remember this is like…," this may cue to the facilitator that he is on-track to the child's interest and experiences. In this way, the training programs for museum facilitators can consider parents as partners in reaching their educational aims with youths, like parents have been demonstrated to do in technological fields (Barron et al., 2009). Parents and other adult caregivers already lead inquiry experiences for their families, yet designers do not often leverage this to its full advantage. When parental resources are combined with signage or museum facilitators

(Allen & Gutwill, 2009), these combinations may enhance the overall effectiveness of the learning in museums. Here we are then considering a dual role of parents in museums that is more complex than is often considered: parents as learners with families but also as facilitators of youths' interests and learning.

Implications to Learning Theory and to Research

This analysis provided empirical details on how families used the museum and other resources to support interests that emerged and were maintained on the exhibit floor with implications to theory. Specifically, returning to the starting analytical framework, we now have additional evidence about the nature of parent interest facilitation practices in museums. We use this to broaden the model that is descriptive of museum interaction regarding the facilitation of interests (figure 3). Through detailed accounts of how parents (a) support existing interests through gesture and conversations that connect interests

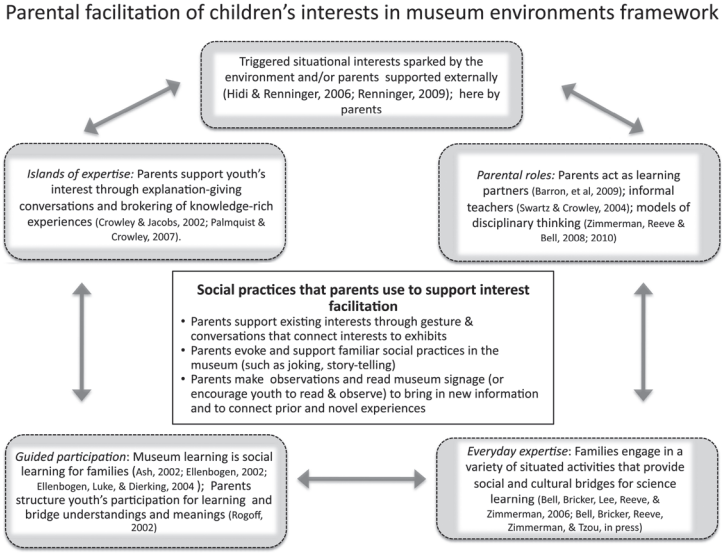

Figure 3. Framework: parental facilitation of children's interest in museum environments.

to exhibits (and programs), (b) make observations and read museum signage (or encourage youths to read and observe) to bring in new information, and (c) evoke and support familiar social practices (e.g., humor, game play) in the museum, researchers can better understand the mediated nature of interest and its relationship to learning outside of school. Through looking at the social practices that parents use to pique and to sustain interest, the social aspects of interest development are highlighted. Prior work has acknowledged the social nature of youths' expertise development (Crowley & Jacobs, 2002); here we highlight the social nature of interest development.

At the start of this article, we offered that we intended to develop a framework that could be utilized to support more in-depth inquiry into interest development and into facilitation practices. We hope this framework can be used as a jumping-off point for further inquiry into interest development that occurs in the everyday moments of science and mathematical learning that families do together. It would be important to continue to refine the model and empirically ground this with data from other families from wide-ranging backgrounds and interacting in other types of museums.

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