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Parents' and experts' awareness of learning opportunities in children's museum exhibits

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ABSTRACT

Informal learning outside of school is crucial for a child's development. Children's museums, in particular, are environments conducive to this sort of learning, especially when parents guide children's exploration. However, research suggests a gap between parents' and experts' perceptions of the value of informal learning. In Study 1, we asked groups of parents and experts (i.e., individuals in the community connected with the field of education or those with training in child growth and development) to rate the presence of learning opportunities available in two museum exhibits, finding that parents consistently provided lower ratings. In Study 2, we explored whether signage aimed at orienting parents toward the learning potential in these exhibits would have an impact on their ratings. Results suggested that signage made parents' ratings look more like those of experts. Taken together, these studies show that a simple intervention can help parents perceive the learning opportunities in children's museum exhibits as experts do.

Children under age 13 in the United States spend only about 26 h per week on average in school or daycare, leaving a significant part of their time to learn in informal settings (Hofferth & Sandberg, 2001). This important fact has led to a growing body of literature on informal learning that occurs outside of the school environment. It has increased interest in venues where informal learning takes place and highlights the importance of learning opportunities outside of school (Anderson, Lucas, Ginns, & Dierking, 2000; Putman & Walker, 2010; Tofield, Coll, Vyle, & Boldstad, 2003). In fact, within the Directorate of Education and Human Resources at the National Science Foundation, an organization has been established dedicated to understanding the way in which informal learning venues – like libraries, parks, and museums – encourage children's active participation in exhibits and promote learning.

Informal learning can occur in any setting where children can explore and investigate their surroundings to learn new things. The National Research Council's (2009) report on learning science in informal environments describes informal learning as "learner-motivated, guided by learner interests, voluntary, personal, ongoing, contextually relevant, collaborative, nonlinear, and open-ended" (p. 11). The report further notes that informal learning experiences lead to further inquiry and are enjoyable for children. Importantly, these experiences give them a sense that learning can be both relevant to their own lives and under their control.

Children's museums, in particular, are environments conducive to informal learning. Borun, Chambers, and Cleghorn (1996) report a relationship between children's learning levels and their behaviors in museum exhibits. When children engaged in behaviors such as making observations and asking and answering questions, they learned more than when they did not engage in these behaviors. Additionally, more learning occurred when children interacted with adults rather than only exploring on their own (Crowley et al., 2001; Crowley & Galco, 2001; Puchner, Rapaport, & Gaskins, 2001); when parents discussed the contents of the exhibit after the visit with their children (Benjamin, Haden, & Wilkerson, 2010; Haden, 2010); when parents connected museum exhibits to the child's life (Anderson, Piscitelli, Weier, Everett, & Tayler, 2002); and when parents were metacognitively aware that their knowledge of their children's learning processes influenced their interactions with their children (Thomas &

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Anderson, 2012). When children explored science exhibits with their parents, they were more focused and explored much longer than on their own (Crowley et al., 2001). They also generated more complex scientific hypotheses through evidence collection and construction of theories with their parents (Crowley & Galco, 2001), and were able to think about exhibits more conceptually (Fender & Crowley, 2007; Rigney & Callanan, 2011).

These findings are especially encouraging given that 40% of museum visitors are families (Doering, 2004). Of crucial importance, however, is that the parents realize the potential for learning opportunities in the children's museums so that they can encourage the sorts of behaviors and interactions with exhibits that foster learning in children (Knutson & Crowley, 2005). Appreciating the impact that exhibits may have on children's learning may lead to different parental behaviors than if parents see the exhibits merely as frivolous entertainment. Parents who think that the exhibits have educational merit may be more likely to engage in the scaffolding behavior necessary to augment and contribute to their children's learning.

Yet, according to an online questionnaire about children's play (Fisher, Hirsh-Pasek, Golinkoff, & Gryfe, 2008), there seems to be a conceptual split between parents' views on informal learning and those of child development professionals (e.g., researchers, educators, child psychologists). Parents who participated in the survey tended to view structured activities, such as using flashcards or reading a book, as more "playful" than did experts. In addition, parents were also more likely to associate these structured activities with learning than were experts, who instead put higher stock in the learning potential of less structured, more playful activities. Though not specific to the exhibits in children's museums, these findings suggest that parents may not perceive children's museums to be learning venues, given that unstructured and exploratory behaviors are central to what takes place in these venues.

In line with this idea, a study at the Children's Museum in Pittsburgh (Swartz & Crowley, 2004) found that to a large extent, parents were not taking advantage of the educational opportunities available to them at the museum. Sixteen percent of parents saw museums as places where their children could play and have fun, but did not attempt to foster any learning opportunities beyond that; 21% of parents allowed their children to explore exhibits independently, and felt they learned better that way. Twenty-six percent of parents did recognize learning opportunities for their children, but rather than engaging in the contents of the exhibits would instead ask children to identify colors, numbers, and letters on the exhibits. These findings provide corroborating evidence that parents are unaware of the full potential of museum exhibits as well as the best ways to help their children find that potential.

This paper explores parents' and experts' views on the value of the learning opportunities in the exhibits in children's museums. Our studies used children's museum visitors as participants and museum exhibits as a forum on parents' appreciation of the informal education that occurs there. Specifically, we investigated parents' awareness of the educational value of the exhibits that they were visiting. That is, we examined parents' perceptions of the potential of exhibits to increase their children's academic and non-academic learning. Study 1 surveyed both parents and experts to see whether there was agreement between these two groups on the educational value of two museum exhibits. We were particularly interested in whether they viewed the exhibits to have more value for academic areas (literacy, science, history, and math) or nonacademic areas (such as creativity, physical activity, and social development). Based on previous research (Fisher et al., 2008), we hypothesized that parents might see less educational value than the experts in both academic and nonacademic areas compared to the experts.

1. Study 1

To understand how parents and experts on early childhood development and education viewed two exhibits in a children's museum, participants were asked to rate the educational value in two exhibits at the Port Discovery Children's Museum in Baltimore, *Tiny's Diner* and *Adventure Expeditions*. These exhibits were selected because of their wide appeal to museum visitors and because they focus on different areas of knowledge. The *Tiny's Diner* exhibit is for younger children and focuses on math, language, and emergent literacy while *Adventure Expeditions* is designed for children who can already read and focuses on ancient history.

1.1. Method

1.1.1. Participants

Parents were asked to participate in our survey as they entered the museum exhibit if they had children between the ages of 2 and 10. Seventy-five parents participated (*Adventure Expeditions* $n = 38$; *Tiny's Diner* $n = 37$; response rate was not collected). Parents were volitional visitors when the survey was conducted, and had not been recruited to visit specifically for the purpose of this study. Approximately 7% of the parents did not fill out the demographic portion of the survey. Of those that did, the sample of parents identified as 82.9% Caucasian, 12.9% African-American, 1.4% Hispanic, and 2.9% mixed; and had an average of 2.58 children ($\sigma = 3.62$).

Experts in the field of child development were chosen by museum staff and recruited to participate in the study. Expert evaluators were comprised of individuals in the community connected with the field of education or those with training in child growth and development. This group was contacted via email by the museum staff and invited to visit the museum, and fill out a brief survey. The experts were not told about the purpose of the study. Forty-three experts participated (39 experts rated both exhibits, four experts rated *Adventure Expeditions* only, one rated *Tiny's Diner* only; response rate was not collected). Approximately 16% of experts did not fill out the demographic portion of the survey. Of those that did, the sample of experts identified as 63.3% Caucasian, 26.7% African-American, 3.3% Hispanic, and 6.7% mixed.

1.1.2. Exhibits

Adventure Expeditions (an Egyptian exhibit) encouraged personal/social development, mathematical/scientific thinking, and social studies concepts. It was designed to appeal to children aged 7–10. This exhibit, described as a mental and physical obstacle course (Port Discovery, 2012) emphasized history and literacy in the form of hieroglyphics and science, as it discussed the process of embalming and the life cycle. After deciphering and decoding hieroglyphics, children could combine this with other solved clues to find a pharaoh's "lost tomb." The other exhibit, *Tiny's Diner*, was a 50's style diner, geared toward younger children (aged 2–6), who had the opportunity to pretend that they were wait staff, cooks, receptionists, or customers. Children could practice their number and literacy skills, as the diner had menus and a cash register. It also invited physical activity as children moved through it to accomplish their make-believe tasks (e.g. "cooking" and serving food, ringing up orders on the cash register) and invited cooperative play with other children and creativity in the scenarios children created.

1.1.3. Survey and procedure

As parents entered one of the two exhibits, a staff member asked the parents if they would participate in a short survey about the educational value of that particular exhibit. If parents agreed, the staff member informed them that he/she would be waiting for them near the exit of that exhibit. Upon exiting the exhibit, children were offered the opportunity to participate in another activity while parents took a moment to fill out the survey. Parents completed the questionnaire for only one of the exhibits. Experts were invited by the museum staff to come for a visit. All but three experts rated both exhibits; experts were given both questionnaires upon arriving at the museum and turned it in at the museum education department upon leaving. Experts and parents

were told that the intended use of the survey was to see if the museum could increase the educational value of its exhibits.

The first part of the survey consisted of demographic questions regarding background of each family, including the ages of children and how many times they had previously visited the museum. The rest of the questionnaire contained a total of eight questions asking both parents and experts to rate various aspects of the exhibit they saw. Ratings were given on a 7-point Likert scale, with "1" meaning no educational value in a particular area and "7" indicating that the exhibit had many opportunities for learning in that area. Four questions focused on academic areas of learning (literacy, math, science, and history), and the other four addressed non-academic areas of learning (people's feelings, cooperative play, creativity, and physical activity). The areas of learning were labeled as such to be explicit about what each referred to. Parents and experts were also asked to explain briefly why they gave a particular rating for each area. These explanations also ensured that both parents and experts understood what was encompassed in each of these areas of learning.

1.2. Results

Parents who visited the *Adventure Expeditions* exhibit had significantly older children than parents who visited the *Tiny's Diner* exhibit ($t(68) = 2.18$, $p < .05$, Cohen's $d = 0.52$; *Adventure Expeditions*: $M = 5.02$, $SD = 2.69$; *Tiny's Diner* exhibit: $M = 3.76$, $SD = 2.15$). These data suggest that parents were taking children to age-appropriate exhibits. Demographic variables were not related to exhibit ratings. Table 1 presents the mean ratings in Studies 1 and 2.

1.2.1. Did parents and experts' views differ on the educational value of the exhibits?

The ratings were broken down into two categories: academic areas and nonacademic areas. The academic category included the areas of math, science, history, and language; and the nonacademic category included playing, people, creativity, and physical. A repeated-measures ANOVA with rating category as a within-subjects factor and rater (parent vs. expert) and exhibit (*Adventure Expeditions* vs. *Tiny's Diner*) as between-subjects factors revealed a main effect of rater. On overall ratings (average rating across all questions), experts rated the exhibits as more educational ($M = 5.22$), than parents did ($M = 4.79$), $F(1,153) = 8.63$, $p = .004$, *partial eta squared* (effect size) $= 0.053$. The number of times people had previously visited the museum had no effect on ratings $F(1,153) = 0.018$, $p = .893$.

1.2.2. Did the ratings for the academic and nonacademic areas differ?

A main effect of rating category emerged, with nonacademic areas ($M = 5.33$) being rated higher than academic areas ($M = 4.70$) on average, $F(1,153) = 72.50$, $p < .001$, *partial eta squared* $= 0.322$. There was also a significant interaction between rating category and rater, $F(1,153) = 37.82$, $p < .001$, *partial eta squared* $= 0.198$: parents ($M = 5.36$) and experts ($M = 5.30$) rated the non-academic areas similarly, but experts ($M = 5.14$) rated the academic areas higher than did parents ($M = 4.22$).

Table 1
Mean ratings and standard deviations pre- and post-signage by rater, exhibit, and content area.

Rating area	Exhibit	Rater	Pre-signage		Post-signage	
			M	*SD*	*M*	*SD*
Academic areas	*Adventure Expedition*	Parent	5.08	1.04	5.28	0.95
		Expert	5.79	0.86	5.72	0.65
	Tiny's Diner	Parent	3.34	1.14	4.46	1.10
		Expert	4.45	1.16	4.13	1.17
Nonacademic areas	*Adventure Expedition*	Parent	4.91	1.32	5.34	1.16
		Expert	4.89	0.97	5.23	0.79
	Tiny's Diner	Parent	5.83	0.84	6.14	0.57
		Expert	5.74	0.92	5.70	0.96

1.2.3. Were there differences between the exhibits?

Differences between the two exhibits were also found, suggesting that educational value may be more apparent in some exhibits than in others. Both parents and experts rated the *Adventure Expedition* exhibit ($M = 5.18$) significantly higher than the *Tiny's Diner* exhibit ($M = 4.84$), as indicated by a main effect of exhibit, $F(1,153) = 5.18$, $p = .024$, *partial eta squared* $= 0.031$. The *Adventure Expeditions* exhibit received higher ratings ($M = 5.45$) than the *Tiny's Diner* exhibit ($M = 3.92$) in academic areas; while the *Tiny's Diner* exhibit received higher ratings ($M = 5.78$) than the *Adventure Expeditions* exhibit ($M = 4.90$) in non-academic areas, $F(1,153) = 234.57$, $p < .001$, *partial eta squared* $= 0.605$. This suggests that both parent and experts saw more non-academic learning potential in the exhibit aimed at younger children (*Tiny's Diner* exhibit) and more academic learning potential in the exhibit geared for older children (*Adventure Expeditions* exhibit).

1.3. Discussion

The purpose of this study was to explore how parents and child development experts evaluated the educational value of exhibits in children's museums. As predicted, we found that parents and experts differed in their educational evaluations of the selected exhibits: parents saw less potential for learning in the exhibits than experts did, particularly in the academic areas. While parents and experts seemed to agree on the potential non-academic benefits of the museum exhibits for children's learning, experts saw more potential for academic learning compared to parents.

It remains to be seen, however, whether parents could perhaps be assisted in viewing these exhibits through experts' lens. Are there measures to take for children's museums to heighten the educational value of these exhibits? Prior research has found that simple interventions, such as encouraging people to focus on particular aspects of an exhibit, can have a substantial impact on people's behavior while visiting that exhibit. For example, orienting students to specific features of an exhibit before a museum field trip was effective in increasing what the students learned on the trip (Anderson & Lucas, 1997). In addition, disclosing to visitors that they will be asked questions at the end of an exhibit increased the amount of time spent in that exhibit (Serrell, 2000). Visitors' motivations, ranging from education to entertainment, also have a significant impact on their learning while at a museum: Those with an educational motivation learned significantly more than those visiting purely for entertainment purposes; however, those seeking entertainment were more enthusiastic about the subjects of the exhibits after leaving (Falk, Moussouri, & Coulson, 1998).

Given these empirical findings, there is reason to believe that orienting parents toward both the academic *and* non-academic learning potential in these museum exhibits prior to their exploration of them may change their beliefs in the inherent value of the exhibits for their children's learning. Study 2 attempted to do just that with a modest but potentially powerful intervention: It introduced signage at the museum that indicated the learning value of each exhibit along the dimensions examined in Study 1.

2. Study 2

Study 2 explored the key question of whether the introduction of signage indicating the learning potential of exhibits would help parents to see more of the inherent educational value in these museum exhibits.

2.1. Method

2.1.1. Participants

Participants were asked at the end of the survey whether they had noticed the signage in the exhibits; only those who reported having noticed the signage were included in analysis. Sixty-one parents participated and read the signs (*Adventure Expeditions* $n = 40$, *Tiny's Diner*

$n = 21$). Approximately 8% of the parents did not fill out the demographic portion of the survey. Of those that did, the sample of parents identified as 67.9% Caucasian, 23.2% African-American, 1.8% Asian, 5.4% mixed, and 1.8% other; and had an average of 1.97 children ($SD = 0.91$). Fifty parents were excluded because they reported not noticing the sign. Sixty-three experts on child development participated and read the signs. Approximately 16% of the experts did not fill out the demographic portion of the survey. Of those that did, the sample of experts identified as 63.6% Caucasian, 24.2% African-American, 3% Asian, and 6.1% other. One expert was excluded because he/she reported not noticing the sign.

2.1.2. Materials

The only change introduced in Study 2, was a sign placed next to the entrance of each target exhibit that highlighted inherent learning areas in these exhibits. Signs were designed as something that could be viewed very quickly, since parents in this setting were often with multiple children whom they had to keep an eye on. Learning areas relevant to the exhibit were labeled, along with pictorial representations, or icons, of that learning area. The same learning areas as assessed in Study 1 were aligned with the domains of learning in Maryland, as outlined by the Maryland Model for School Readiness (Maryland State Department of Education, 2009).

Each exhibit was assessed for its potential learning value in eight learning areas (language and reading, math, people's feelings, history, science, cooperative play, children's creativity, and physical activity) by the authors and members of the museum staff. A 7-point scale was used, and ratings for each learning area were averaged across the group. The sign presented relevant learning areas, with an assigned number of light-bulbs (out of 7), based on the average rating, to indicate how helpful the exhibit could be in each learning area (see Fig. 1). The signage at each exhibit outlined the particular way in which each exhibit earns its ratings. The sign contained no additional information.

The signage was displayed to help visitors see the value of certain areas in each exhibit. For example, the *Tiny's Diner* exhibit received a rating of 5 for mathematics (because toddlers could measure ingredients to bake a cake), and a 5 in science (since children could watch water and oil mix together). These markings were designed to offer parents a new lens with which to consider potential learning opportunities not otherwise readily apparent to them.

Exhibits were identical to those used in Study 1. The survey was also identical to the survey in Study 1, with the exception that at the end of the survey, parents and experts were asked if they read the signs.

2.1.3. Procedure

Procedure was identical to that of Study 1. As a manipulation check, parents and experts were asked at the end of the survey whether they had noticed the signage in the exhibits.

2.2. Results

2.2.1. Did the signage have an impact on ratings?

We first analyzed ratings from those who reported having noticed the signage. A repeated-measures ANOVA, with rating category as a within-subjects factor and phase (pre-/post-signage), rater (parent vs. expert), and exhibit (*Tiny's Diner* or *Adventure Expeditions*) as between-subjects factors, was conducted on the ratings. We found an overall main effect of signage ($F(1, 273) = 5.19$, $p = .024$, *partial eta squared* $= 0.019$); those who saw the exhibits with signage rated them significantly higher overall ($M = 5.25$, $SD = 0.08$) than those who saw the exhibits before the signage was posted ($M = 5.00$, $SD = 0.07$).

Several interesting significant interactions also emerged; see Table 1 for all means. There was a significant interaction between phase and rater whereby the signage had a more substantial impact on parents than on experts ($F(1,273) = 6.26$, $p = .013$, *partial eta squared* $= 0.022$). Further, we found a phase × rating category × rater interaction ($F(1,273) = 7.79$, $p = .006$, *partial eta squared* $= 0.028$): the magnitude of the differential effect on parents and experts was particularly pronounced for the academic ratings (see Fig. 2). While parents and experts had already looked relatively similar on their non-academic ratings pre-signage, they differed significantly on their academic ratings; where the signage had the most substantial impact was on increasing the parents' academic ratings such that they looked much more similar to the experts. There was also a phase × rating category × exhibit interaction ($F(1,273) = 6.44$, $p = .012$, *partial eta squared* $= 0.023$): the signage had the most substantial impact on the academic ratings of the *Tiny's Diner* exhibit but on the non-academic ratings of the *Adventure Expeditions*.

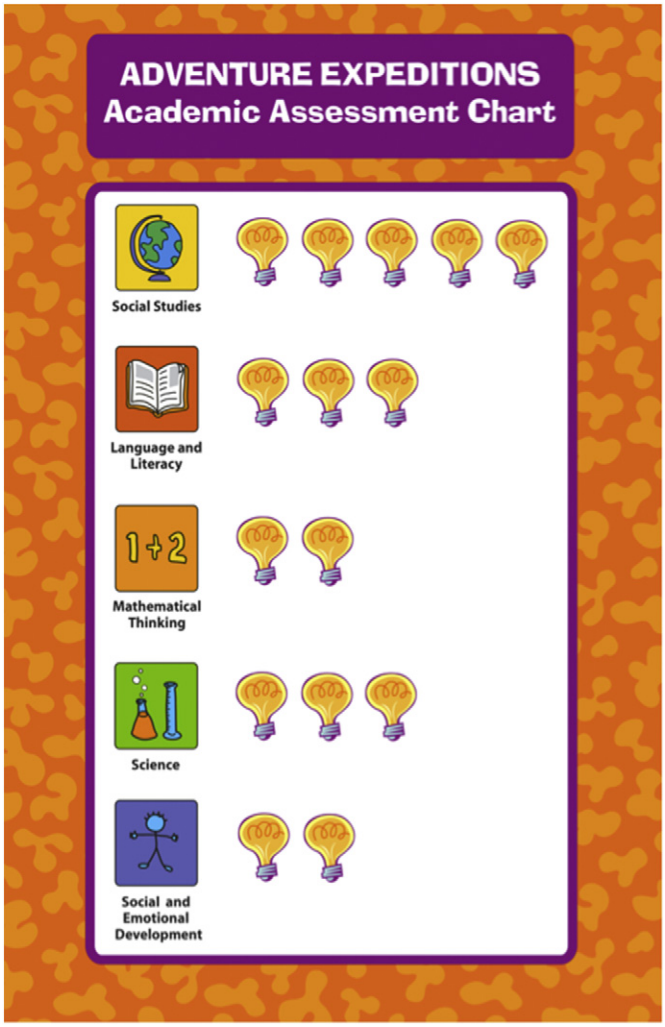

Fig. 1. Example of sign displayed in *Adventure Expeditions* exhibit.

Finally, we compared parents and experts who noticed the signs with those who did not (not included in the above analyses). Parents who reported reading the signs were compared with parents who reported not noticing the signs. Parents who read the signs had significantly higher ratings ($M = 5.30$, $SD = 0.86$) than parents who did not ($M = 4.80$, $SD = 0.86$) ($t(109) = 3.06$, $p = .003$, Cohen's $d = 0.58$). We note that experts were more likely to notice the signs compared with parents ($\chi^2(1) = 37.17$, $p < .001$).

2.3. Discussion

The purpose of Study 2 was to determine whether guiding signage could allow parents to see the inherent educational value in academic

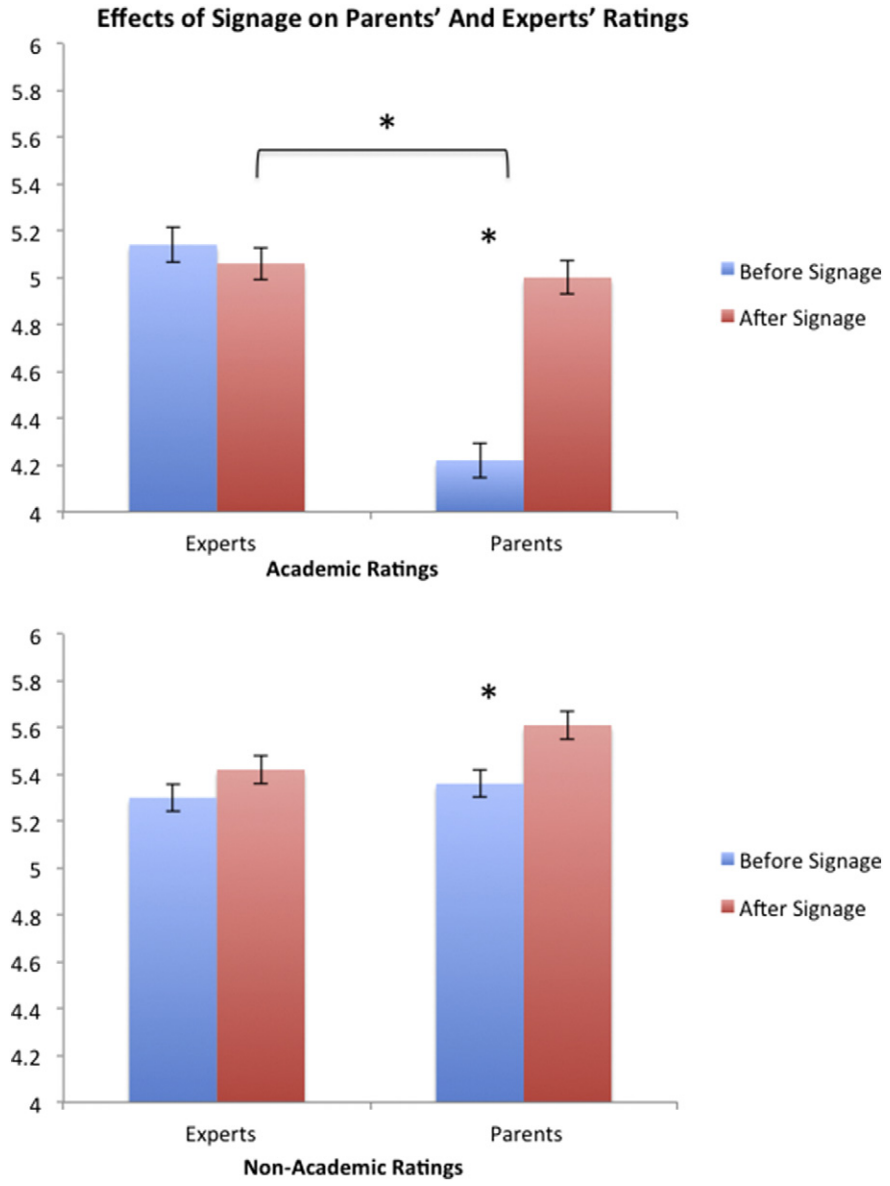

Fig. 2. Mean academic and non-academic ratings by parents and experts before and after signage.

areas in the informal learning setting of museum exhibits. We found that signs did in fact increase awareness of the learning opportunities in these exhibits. In particular, providing information on the specific ways in which an exhibit might provide learning opportunities in language, history, science, or math led parents to give higher academic ratings to exhibits where those opportunities had previously been less readily apparent to them.

Importantly, parents and experts were asked if they read the signs *after* rating the exhibits on learning opportunities. This suggests that the higher ratings for parents who were provided with a sign, compared to those parents who were not, were not due to a priming effect (e.g., asking about the signs caused higher ratings). Rather, our findings suggest that the information contained within the signs is what led to the parents' higher ratings. That parents who reported not noticing the signs had significantly lower ratings, similar to parents' ratings in Study 1, compared with parents who reported reading the signs, whose ratings were similar to experts in both studies, strengthens this claim.

As experts have long known, children's museums provide learning opportunities in multiple areas. However, this study suggests that although parents recognize the value of exhibits in non-academic skills, they are less aware of the informal learning opportunities for academic areas that museums afford. The successful intervention of the signage system suggests that additional information may help parents to better appreciate the educational value in children's museums that child development experts already understand. Thus, children's museums not only hold the potential to provide a playful and yet meaningful context for learning, but also have the capacity to guide parents to take full advantage of the exhibits and better engage children in playful learning.

3. General discussion

The purpose of these experiments was to see if parents' beliefs about the value of exhibits in children's museums might be brought more in line with experts' views of their value for children's learning. Too often parents may not appreciate how their children are engaged in meaningful learning outside of school, in venues like children's museums. Yet given that children spend only 20% of their time in school (Hofferth & Sandberg, 2001), it is crucial for parents to appreciate the learning opportunities their children encounter in the home, on daily errands, in children's museums and zoos, and in other places where families routinely go.

Study 1 asked whether parents and experts see the educational value in exhibits in children's museums in the same way. Prior to including signage to indicate that the exhibits might bear on children's academic learning, the first study sought to uncover whether raters in both categories perceived educational value in exhibits. Our data indicate that, without guidance, parents and child development experts differ substantially on their views of what children can learn from various museum exhibits. While both experts and parents saw similar opportunities for non-academic learning, experts saw more academic learning potential than parents.

Study 2 shows that after signage was introduced to indicate the educational value in the exhibits, another group of parents who were comparable to the parents in Study 1 rated the exhibits as having higher educational value in both academic and non-academic areas than did the parents in Study 1. When signs indicated that the exhibit could teach children about math, for example, parents rated the exhibit higher for potential mathematical learning opportunities. Since children's out-of-school activities and learning environments are strongly linked to children's classroom motivation and success (Crowley & Galco, 2001), it is crucial that parents have accurate views of what is educational and what is a worthwhile learning experience for their children. The use of a signage intervention as attempted in Study 2 provides a model for those struggling to bridge the gap between the societal emphasis on academic achievement and empirical data suggesting that playful environments like children's museums can afford meaningful learning opportunities to children (Hirsh-Pasek, Golinkoff, Berk, & Singer, 2009). As schools increase the structure children encounter, places like children's museums continue to allow children to explore ad lib and learn that which intrigues them.

It is important to note that our studies focused on two specific exhibits at the Baltimore Port Discovery Children's Museum, *Adventure Expeditions* and *Tiny's Diner*. Given that we found differences even between these two exhibits, it remains to be seen whether we would find the same results if we had selected different exhibits or a different museum for our intervention. It is likely the case that some museum exhibits – perhaps those geared toward older children – have more readily apparent academic learning potential than others do. It is particularly important to guide parents to learning opportunities for their children when they are less apparent, as was the case with using math to ring up orders at the cash register for very young children in the *Tiny's Diner* exhibit.

Future research should examine how to improve parent-child interactions in informal museum settings for parents who are aware and unaware of potential learning opportunities. Parents who are aware of the potential for learning are much more likely to engage in problem solving in a way that enhances children's learning when the parent is comfortable and familiar with the subject matter (Gleason & Schauble, 1999). However, when parents are unfamiliar with the subject matter, they tend to take the lead on problem solving, while allowing the children to do the physical tasks and manual operation of equipment. In contexts such as these, children achieve fewer gains in understanding, and parents have missed a chance to provide children with a key opportunity to collaboratively interpret evidence (Gleason & Schauble, 1999).

The current study used signs to provide information about relevant general learning areas. However, the *type* of information presented in signs may influence parent-child interactions – especially for parents who might be unable to translate these general learning areas into concrete activities specific to the exhibit. For example, while the sign may say the exhibit has strong potential for mathematical learning, it may not be clear to the parent what part of the exhibit is related to this learning area. Specific signage that instructs parents on *how* to use parts of the exhibit to enhance learning in particular areas may lead parents to rate these exhibits as having higher academic learning potential. Given that about 45% of the parents reported not noticing the sign in the current study, more attention should be given to the visibility of the signs when designing the signage in future. For example, the signage may be made larger in size and placed at more conspicuous locations at the exhibit. Or perhaps the signage could flash occasionally to increase parents' attention to it. Visitors may also be reminded of such signs through brochures or text printed on tickets.

More research is also needed to fully understand the long-range impact of the present intervention and interventions similar to this one. After being directed to non-obvious learning areas with our signage, will parents seek out these sorts of learning areas in other exhibits, at other museums, or in other aspects of their daily lives? How does this kind of intervention impact children? When parents are more aware of the potential learning opportunities in a particular experience, will they behave differently, and will there be a measurable improvement in their children's learning? Prior empirical research (e.g., Anderson & Lucas, 1997; Benjamin et al., 2010; Knutson & Crowley, 2005; Swartz & Crowley, 2004) suggests that simple interventions or small behavioral changes on the part of parents can have a substantial impact on children.

If this is indeed the case, an effort should be made to make simple changes, such as increasing museum signage, to enhance informal learning opportunities for children. For example, when parents are directed toward important information about a museum exhibit (through pictures of relevant objects and elaborative questions), they are more likely to engage their children in more elaborative talk and joint nonverbal activities, as well as transfer information across exhibits and to the home (Jant, Haden, Uttal, & Babcock, 2014). Further, such changes can take place in a range of informal settings. For example, signage placed in supermarkets regarding food in low socio-economic status neighborhoods increases the amount of conversation parents have with their children about relevant types of foods compared to when there are no signs in place (Ridge, Weisberg, Ilgaz, Hirsh-Pasek, & Golinkoff, 2015).

As we launch national efforts to improve students' achievement in math and science, the area of *informal* science and math education becomes increasingly important. In informal education settings such as a museum, children can learn scientific and mathematic concepts through active exploration, observation, discovery, inquiry, and experimentation. An important contributor to STEM (science, technology, engineering, and mathematics) success is curiosity (Jirout & Klahr, 2012), which can be heightened or dampened depending upon the nature of children's experiences. Parents and teachers play an important role in facilitating the development of curiosity, and learning in informal settings is largely driven by curiosity and motivation for discovery. Our findings clearly demonstrate that parents need help in appreciating the value of everyday, informal learning opportunities – especially as interest in children's academic content knowledge increases. Museums and other sites where informal learning occurs can take the lead in helping parents use everyday experiences as a time for exploring, asking questions, and encouraging their children to engage with new material.

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