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Intergenerational learning at a nature center: families using prior experiences and participation frameworks to understand raptors

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Using a sociocultural framework to approach intergenerational learning, this inquiry examines learning processes used by families during visits to one nature center. Data were collected from videotaped observations of families participating in an environmental education program and a follow-up task to draw the habitat of raptors. Based on a thematic analysis, researchers developed two themes about the learning processes at play in the nature center, related to the use of prior knowledge. First, families’ prior knowledge used at the nature center came from informal education activities: (a) observation in the outdoors and spaces designed to represent an aspect of nature, (b) media (including books and Internet), and (c) experiences at informal education institutions. Second, when sharing prior knowledge, participation frameworks were created through the conversation that leveled the hierarchy between parent and child allowing for negotiation and collaborative idea formation. In the nature center, families valued social harmony by positioning their children as capable contributors of environmental knowledge. Suggestions to researchers taking a sociocultural approach are given, including the potential of ‘participation frameworks’ as an analytical tool to study learning interactions and as a potential tool for environmental educators to encourage families to create roles and structures for successful learning outcomes in nature centers.

Keywords: learning; family; informal education; environmental education; qualitative; intergenerational learning

Using sociocultural theory to understand family interactions at a nature center, this analysis examines intergenerational learning processes related to the role of prior knowledge in family conversations. The goal of this study is to understand what cultural resources and social processes families used to make meaning out of novel information related to raptors observed while visiting a nature center.

Theoretical perspectives on family learning in nature centers

Sociocultural perspectives assert that learning is mediated by interactions with people and cultural tools like material and conceptual artifacts (Vygotsky 1978). As learners come to know about their natural world, they rely on sense-making interactions within their local context. Learning is not an ‘in the head’ only phenomenon,

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but rather, it is a phenomenon spread across the person in interaction in his or her environment (Ivarsson, Schoultz, and Saljo 2002; Pea 1993; Rogoff 2003).

An important aspect of learning in informal environmental education programs is the role of families’ social interactions. Studying social interactions in environmental education is important, given current research agendas that examine learning as an active meaning making process rather than as a passive knowledge transmission (Ballantyne and Packer 2005). According to Matusov’s (1996) perspective on joint activity, groups of people coordinate contributions from members as they develop understandings (and misunderstandings). Learning as participating in joint activities presumes that ‘knowing’ in environmental learning is dialogical and distributed between the people and their environment (Lundholm and Plummer 2010). The sociocultural perspective on group learning contrasts from a cognitive approach on group learning in regard to which learning outcome is assessed. In a cognitive approach, one examines individuals’ outcomes that result from a group experience (Akerkman et al. 2007). In the sociocultural approach, we examine how groups of people, families in particular, participate in environmental programs with the learning outcome of ‘joint activity’ (Wertsch, Minick, and Arns 1984).

Our theoretical framework highlights three aspects of sociocultural learning theory related to social cognition: (a) intergenerational learning supporting families in environmental programs, (b) prior experiences as learning resources and as entry points for new families’ learning activities, and (c) participation structures for organizing families’ learning activities.

**Family learning in environmental education programs**

Our focus is on families’ social interactions as related to the development of learning theory within informal environmental education (EE) experiences (Dillon 2003; Lundholm and Plummer 2010; Rickinson 2001; Rickinson, Lundholm, and Hopwood 2009). Environmental education research has a relatively small number of studies that focus on families learning in informal settings (Duvall and Zint 2007); however, there is growing research interest in intergenerational learning (Ballantyne, Fien, and Packer 2001). Intergenerational learning involves the mutual bridging of meanings (Rogoff 2003) where family members work together to negotiate a common understanding. In our study, we defined families as parents and children or custodial grandparents with grandchildren.

Most studies of intergenerational EE learning focus on learners’ cognitive and emotional outcomes, or on attitudinal and behavioral changes (Rickinson, Lundholm, and Hopwood 2009). Research on the affective aspects of learning has examined the relationship between parent and child environmental attitudes (e.g. Leppänen et al. 2012). Such EE intergenerational studies have shown that youth share environmental knowledge from school-sponsored field trips or in classroom experiences with their parents after the fact (Duvall and Zint 2007). Environmental education programs in schools, especially those tied to youth’s interests, can increase at home parent–child discussions about nature-related topics (Ballantyne, Connell, and Fien 1998). Some research (Ballantyne, Connell, and Fien 1998; Duvall and Zint 2007; Uzzell 1999) posits that increasing children’s positive attitudes toward environmental issues will also increase their parents’ positive attitudes toward environmental issues.
Our view on family social cognition examines parents’ and children’s interactions as part of group learning. The focus on families’ social cognition in nature centers is warranted because intergenerational groups are the most common social group within informal sites (Bell et al. 2009; Smithsonian Institution 2004), including nature centers and parks (Falk, Heimlich, and Foutz 2009; Forist 2003). Because of this high pattern of use, additional research is needed to enrich learning theories with findings from families learning in outdoor environmental education programs to add to the existing findings about families learning in indoor museums (e.g. Ash 2003; Palmquist and Crowley 2007).

Prior experiences as learning resources and as entry points for family activities

Alexander, Schallert, and Reynolds (2009) assert that applying prior knowledge to new situations is an important learning process. In science learning, integrating new and old knowledge (Linn 2006) is a process that supports the development of new concepts, ideas, and ways of thinking. For example, prior knowledge has been shown to help families learn in science museums (Allen 2002; Ash 2003; Ellenbogen 2002; Zimmerman, Reeve, and Bell 2010), as they connect previously shared experiences to exhibit content and thus make their learning more relevant (Rennie and Johnston 2004). Ballantyne, Packer, and Sutherland (2011) take another perspective; they examined the connection of prior knowledge and memories from a wildlife tourism venue to visitors’ increased environmental stewardship. While the role of existing knowledge mediating new information as part of individual meaning making has been well established in formal (Glaser 1984; Linn 2006; Schauble 1990) and out-of-school settings (Ballantyne, Packer, and Beckmann 1998; Falk and Adelman 2003; Falk and Dierking 2000), more recently, researchers have engaged in nuanced studies of informal learning processes in social groups. These current perspectives include fine-grained analyses of the talk and actions within specific learning environments. For example, Kisiel et al. (2012) analyzed families’ learning interactions at aquatic touch tanks and found a common pattern in families’ reasoning: families often first applied prior knowledge about a topic before making an assertion or asking a question about an animal. We build from these fine-grained analyses to examine the use of prior knowledge within a nature center to document, categorize, and find patterns in the sources and uses of prior knowledge.

Finally, our perspectives on prior knowledge build from Matusov (1996) who wrote that groups of learners engaging in joint activity must create a common entry point. In intergenerational learning, we examined the ways in which prior experiences have an expanded importance of helping families to establish common ground for thinking together in conversations about nature and their local environment.

Participation structures organize family learning activities

When studying social cognition, researchers explore how individuals’ contributions are coordinated by a group to advance collective thinking (Akkerman et al. 2007; Rogoff 2003), including the coordination of a group’s agreements and disagreements (Matusov 1996). Groups, in this sense, are defined as bands of learners, and they may include co-workers, peers engaged in play or hobby activities, students in schools, and families in informal settings.
Participation is a term in environmental education with many divergent meanings (Reid and Nikel 2008); given our sociocultural framework, we build from a ‘situative’ approach to participation (Greeno 2006; Reid and Nikel 2008) where people engage together in tasks with shared social practices. When engaged in shared social practices, groups structure their activities to organize involvement, including opportunities to contribute in the shared activity. This unpremeditated, tacit microsocial structure for organizing involvement and contribution has been called a ‘participation framework’ (Goodwin 1990). Goodwin’s conception of a participation framework includes an examination of the group members’ talk to uncover the implicit ways that a group organizes roles, stances, positions, and responsibilities.

Groups’ participation frameworks are related to education in the way that they influence learning outcomes and experiences. Goodwin (1990) examined the participation frameworks in the everyday activities of children in their neighborhoods. She found that through conversation, youth create participation structures that are both inclusive and exclusionary, as well as participation structures that position the speaker and listeners in a social hierarchy. Additionally, Goodwin (2007) documented a case study of one family that created a participation framework, which supported imaginative play, sharing of animal information, and games during their walk together before dinner. O’Connor and Michaels (1993) used similar methods to analyze how the role of ‘re-voicer’ within a participation framework can support or inhibit school-based learning. In sum, participation frameworks have microstructures created implicitly through discourse to organize activities – participation frameworks can support learners or can exclude learners (Goodwin 1990, 2007).

Our work brings the concept of participation frameworks to studies of family learning in environmental education through our examination of how families coordinate their activities through talk to position each other as capable (or incapable) learners. We posit that understanding participation frameworks can assist environmental educators and researchers, as demonstrated by a study of students visiting a nature center (Anderson, Thomas, and Nashon 2009), which found that social status and social processes negatively impacted group work and cognition. In this way, our examination of participation frameworks allows for a critical examination of the assumptions for family members’ social participation in outdoor education programs that influence social cognition.

Research questions

While most EE intergenerational studies show the influence of children on parents and the knowledge gains of youth, these studies do not examine intergenerational learning processes (Rickinson 2001; Rickinson, Lundholm, and Hopwood 2009). This study examined two intergenerational learning processes by which families negotiated meanings related to ecology in a nature center. In our research, we analyzed how family members coordinated their thinking and positioned each other to be valid contributors of ecological information during family conversations, highlighting the role of prior knowledge and of participation frameworks:

• How do families use prior experiences as learning resources as they participate together in learning about birds of prey (BoP) at a nature center?
When discussing BoP and what these birds need to survive, how do families structure their contributions and negotiated ways of knowing in order to allow children to contribute to the conversation?

To answer these research questions, we examined nine families learning together in an informal environmental setting.

**Methodology**

To understand EE learning processes, we created a collective case study (Stake 1995) of families engaged in joint activity at a nature center. The overall approach was an interpretive study (Glesne 2011) driven by sociocultural theory – with research questions, data collection, and analysis guided by our theoretical framework. The methodology is congruent with the sociocultural theoretical perspective where learning is both a process and product (Alexander, Schallert, and Reynolds 2009). Our approach studied learning processes in social conversations, which is in keeping with informal education research (e.g. Leinhardt, Crowley, and Knutson 2002) that examines discourse for evidence of learning.

**The setting**

The nature center, Shaver’s Creek Environmental Center (SCEC), is an outreach and research facility of a large university in the mid-Atlantic region of the USA. SCEC abuts 28 km² (7000 acres) of natural spaces. It is a designed learning space that receives thousands of visitors annually. Features of SCEC include an indoor exhibit room with live animals and environmentally themed displays, outdoor displays with nonreleasable BoP, and a short wheelchair-accessible nature walk with a small number of informational signs. Additionally, hiking trails spread into state and university-owned forestlands. From late spring through mid-fall (April to November), SCEC hosts public and university events, including classes, festivals, native plant sales, and weekend public programs featuring SCEC’s raptors (also referred to as BoP).

The data collection centered on this latter program called ‘Meet the Birds of Prey Show’. Raptors are meat-eating birds with talons for grasping prey and sharp beaks for tearing their food, such as owls, eagles, falcons, and hawks. The raptors associated with this nature center were injured in their natural environments and cannot be released. These BoP programs feature a naturalist presenting information and answering questions while holding a live raptor. The goal of the BoP show is to provide nature center visitors with a close-up experience that includes viewing a living animal in order to increase people’s knowledge, curiosity, and positive experience of their local ecology, given the importance of understanding their local communities (e.g. Ballantyne, Fien, and Packer 2001; Stewart 2006).

**Participants**

Researchers video-recorded 20 BoP shows held on weekends at SCEC, in the course of one year (spring through fall). At the end of each show, researchers asked attendees to fill out a one-page survey. About 203 people (adults and children) filled out surveys after these 20 BoP shows. All 203 survey respondents were asked to participate in an interview task with their families; nine families and one solo visitor volunteered.

The primary interview participants consisted of nine families, totaling 23 individuals who volunteered, representing 11% of the total survey pool. For the
purposes of our study, families were defined as intergenerational groups; eight were parent–child groupings and one group was a grandmother/grandson pair. Given that our aim was to understand visitors who were normal users of nature centers, we did not purposefully recruit specific age groups or types of family. Consequently, children ranged from elementary to middle school aged. The family structures differed, too: grandmother/ grandchild, mother/ children, father/ child, and mother/ father/ children. Relatedly, we did not strategically sample for race, ethnicity, or social class; our nine volunteer families represented (a) primarily European American and secondarily Chinese American backgrounds and (b) various social classes as parents held jobs in the farming/ manual labor sector, service/ retail industry, local levels of government, and white collar professions. Given the nature center’s location in the midst of forestlands, all families in the study were from rural communities or small towns (areas of under 50,000 people) according to their self-disclosed postal codes (also called post codes or zip codes).

**Drawing task**

Based on recommendations of the importance of conversation as a meaning-making tool (Leinhardt, Crowley, and Knutson 2002), we developed a drawing task that encouraged participant families to talk together about the raptors that they encountered during a SCEC BoP show. Our task encouraged the articulation of ideas through the creation of an artifact – an image of a bird of prey and its habitat. The use of drawings to understand people’s perspectives about science is well established through the draw-a-scientist test (e.g. Finson 2002). Researchers have adapted this protocol to environmental education with the draw-an-environment test (Moseley, Desjean-Perrotta, and Utley 2010; Shepardson et al. 2007). We adapted the drawing task to add a social element. Duvall and Zint (2007) suggest that environmental interventions should allow for parents and children to redefine roles, so that parents are not always disseminating information to their children. With this in mind, we requested that families work on the drawing task as a collaborative learning group. Groups were provided with the following prompt:

Pick one bird of prey. Work as a team to draw a picture of where this bird of prey lives. You can draw the best you can – your team can use labels or words if you need to. Include in your drawing the things that it needs to survive and things that it may encounter each day and night.

The task was open-ended because we intended for different ways of knowing to be shared between family members. From an educational perspective, allowing children space within the conversation to contribute as a mutual partner is important; the finding suggests that children may have more recent information about environmental issues than their parents (Zimmerman, McClain, and Crowl, 2013; Ballantyne, Fien, and Packer 2001; Duvall and Zint 2007; Uzzell 1999).

**Data collection**

We collected the following data:

- Video-recorded observations of family interactions during SCEC BoP shows and immediately after shows during a group drawing task.
• Open-ended family interviews with nine families who volunteered for the study.
• Artifact analyses of science drawings.
• A short survey to understand the demographic backgrounds of SCEC visitors and study participants.

To prepare the data for analysis, video recordings were transcribed. To represent the talk as spoken by the visitors, the research team included sentence fragments and any partial words in the transcripts. Relevant nonverbal information was marked within double parentheses.

**Data analysis**
Task and interview transcripts were analyzed using a thematic approach derived from ethnographic research (Spradley 1979). We identified episodes of action as indicated by theoretical perspectives from prior work on intergenerational learning, including the mutual bridging of meanings (Rogoff 2003) and perspectives on how groups gain intersubjectivity (Matusov 1996): by creating a common entry point, engaging in joint activity, and finishing the activity with a new outcome. Next, the research team iteratively read the coded records while considering the following three areas:

1. How families started the task together and how, or if, entry was allowed for all group members.
2. How families structured their contributions and negotiated ways of knowing and which contributions were valued in the task.
3. Techniques used by families for consensus building, disagreement, and co-construction of meaning.

Finally, as themes were developed, we looked for examples and counter examples (Erickson 1986) throughout the data set. The interpretive focus allowed for a stronger realization of our theoretical framework because we examined, line by line, families’ learning interactions.

Once the data were coded, family case studies were strategically sampled from three families because these families employed participation structures that were particularly helpful in engaging all family members as intellectual contributors.

**Strengths and weaknesses of this methodological approach**
Our choice of collective case study had trade-offs. Case studies using thematic approaches are common in environmental education (e.g. Briseño-Garzón, Anderson, and Anderson 2007; Vergou 2010) because on one hand, they afford an in-depth focus on learners or a learning phenomenon. In our case study, we conducted a microanalysis of nine families’ interactions (23 people), to examine their learning processes related to prior environmental knowledge. Given the multiple forms of data collected in the study, a strength of our approach is that the research team also saw evidence that the parents’ descriptions of the children’s expertise represented the children’ actual skills. In many instances, children in the study pointed to and correctly identified an animal species (i.e. downy woodpecker, chipmunk,
black-capped chickadee) that scampered or flew by the nature center during our research time.

On the other hand, our case study approach did not allow us to draw overall conclusions about families in nature centers, nor could we generalize to families in other educational contexts. Our study included analyzing family interactions where families were knowingly videotaped, as per institutional review board requirements for conducting an ethical study. We kept with modern ethical perspectives on videotaped observations (Derry, Pea, et al. 2010). While families were aware of the cameras, we observed families engaged in interactions that we also often observed with other nonresearch participant nature center attendees, alongside the learning moments reported here. For example, children asked for snacks during the tasks, a few expressed the desire to go home, and in one family, the children started an argument over crayons—and the parents responded in kind. Consequently, while there is an effect on family behavior at play due to being videotaped in studies such as ours, given the research team’s goal to study participation at a public nature center, we posit that this videotaping effect on family behavior is similar to the effect on human behavior of being in the public eye. We do not presume that the observed social learning processes in the public nature center are congruent to these families’ learning processes in their private moments in homes or other educational settings. In fact, empirical evidence suggests that learners act differently in distinct public educational environments (Bell et al. 2013; Fleer and Hedegaard 2010), even without a distinction between performance in private home and public settings (cf. Goffman’s concepts of self-related to identity performance 1959). Given this limitation, we extend our findings only to theory related to families’ learning moments in public outdoor learning settings. While there are limits to our findings, this approach does, however, permit us to make suggestions for future EE research, especially with regard to the utility of our analytical constructs. We can also develop directly testable suggestions to practice that could be vetted through additional evaluation or research.

Data and findings: learning processes used by families

The following analysis highlights the processes that organized the use of prior knowledge and social interactions. Based on our thematic analysis of the video records, we developed two findings about intergenerational learning processes as they occurred in an informal environmental education setting:

1. Prior knowledge of shared experiences was important for making sense of information related to raptors; these experiences came primarily from family experiences in the outdoors, media, and experiences at informal education venues.

2. Many families created participation frameworks to organize their activities. Some frameworks aimed to solve family disagreements and some were created so that all family members’ prior knowledge and contributions were valued. When families created a space to level the hierarchy between elder and child, they negotiated ideas and participated in collaborative idea formation.
Using prior knowledge to make sense of new phenomena

In the nature center, when discussing BoP, families referred to prior knowledge, prior shared family experiences, and the recent information from the BoP show. Families used their prior experiences as learning resources during conversations from three primary sources: (1) experiences outdoors; (2) media such as books, the Internet, and games; and (3) prior experiences at informal education venues – all of which are from informal learning settings.

Family experiences outdoors

Across the data set, the parent (or grandparent) and children discussed shared family experiences in a variety of outdoor settings. Families learned about nature by observing animals in forestlands, in settings designed to represent an aspect of nature, or in situations where families’ interactions with an animal was encouraged or fostered (such as a birdfeeder or birdbath). For example, families discussed learning about animals from birds that frequented the bird feeders or from noticing wildlife in outdoor areas near their yards. In some cases, these observations were unplanned, as these two families recounted:

Barbara (mom): We saw one in our backyard, the red-tailed hawk, huh?

Lydia (age 10): Yeah. It was on the fence.

Evan explained to the researcher why he and his grandmother drew a red-tailed hawk:

Evan (age 8): Because I have them living on my farm and they’re the only real raptors I get to see … I got to see a wild one.

For these families, their backyards and spaces surrounding their homes were places of previous environmental learning. Interest in the raptor they selected to draw was often based on prior experiences related to that bird. For Evan’s family, observing animals occurred by looking out their home’s windows as well as on family outdoor trips. Evan’s grandmother, Lois, reported Evan’s proficiency with observing animals:

Lois: … we have bird feeders outside our windows and he runs and gets the, uh, nature guides when he sees birds and he has become very good at identifying them.

Evan: There’s a downy! (pointing to a wild downy woodpecker on one of the trees at SCEC)

Lois: We do that as a family. ((pause)) We go to look for wildflowers, although deer have eaten most of the wildflowers in our area, but there are still some.

For Lois and Evan, purposeful family efforts supported learning about plants and animals. In addition, they recounted serendipitous learning moments when animals appeared before their window due to their families’ placement of a birdfeeder with the goal to foster a human–animal interaction. The grandmother/grandson pair intentionally sought out resources that supported turning these planned, unplanned,
and encouraged encounters with local flora and fauna into meaningful learning experiences.

The participant families had numerous outdoor experiences within their local environment prior to their visit to the nature center, and these experiences increased their interests to learn more. At multiple times, during the tasks and interviews, families spoke of curiosity toward what they saw in everyday, outdoor settings. These first-hand outdoor observations were experiences that drove families to organize their resources (i.e. time, money, and community networks) in order to support further investigations within settings designed to represent nature or to foster a human–animal interaction (i.e. the birdfeeder), and through media sources. New learning experiences were thus developed from these original interests in outdoor environments, as has been shown in field trip-based curiosities and interests for schoolchildren (Griffin 1998).

**Media: books, the Internet, games, and the like**

Sources of environmental knowledge came not only from outdoor experiences but also from print and online media. The following two exchanges between a father and son during their interview with the researcher exemplify this finding:

Peter (father):… How many books do you have at home about animals?

Ryan: Ohh. At least ten thousand!

Peter: He also learns a lot about it from, uh, Zoo Tycoon™ (points at son).

Ryan: ((nods)) Mm hmm.

Peter: ((explaining Zoo Tycoon)) He has a little computer game where you build the zoo and you have to know a little bit about the animals and what they’re gonna eat.

Peter provided resources needed to advance his son’s interests in learning about nature – including travel, books, and videogames. As a result, his family visited zoos, read books together, and played games in support of Ryan’s animal interests.

Not every family had their own collections of environmentally oriented learning resources at home. However, these families still expanded their environmental knowledge based on children’s interests with free community resources:

Lois (grandmother): Well, we have gone to the library, we get nature books out.

Given the accessibility of library resources, Lois was able to provide supporting information to her grandson that could be incorporated when on nature walks, when looking out their window, and in other family investigations. Other families discussed movies, television, and documentaries that they utilized as free learning resources.

When it came to learning about topics that interested them, like animals, families gained access to resources to expand their ways of knowing about the environment. More specifically, having access to media-related resources was deemed important for the families to understand nature – a finding that has been observed with adult visitors to other environmental learning settings (Ballantyne, Packer, and Falk 2011).
Prior experiences with informal education institutions

Previous research has documented the important role that informal learning institutions have in people’s lives (Bell et al. 2009; Falk 2005; Falk and Dierking 2000), and our research found that these experiences with informal institutions provide a wide range of knowledge that our research participants leveraged in future learning experiences. For example, Peter and Ryan explained to the researcher that they have had previous informal learning experiences relevant to animals:

Peter: How many zoos have you been to in your life?

Ryan: Mmm … ((counting on fingers)) Denver, Pittsburgh, Philly, eh … I can’t count that many.

Peter prompts Ryan to explain how he learned about animals by sharing their family’s previous trips to zoos. Although it is unclear whether Ryan’s interest in animals encouraged these trips or whether the trips to zoos sparked his interests, Ryan’s continued curiosity about animals encouraged his family to seek out additional informal sites during their leisure time.

In our study, families’ prior experiences in informal institutions provided ways of knowing about their local environment. Most families referenced their prior experiences at SCEC as a source of knowledge about raptors during the drawing activity, but also shared experiences from other, previously visited informal spaces as resources for the learning activity.

Prior experience as a common ground within a family’s conversation

When drawing a raptor and its habitat at SCEC, prior knowledge was more than just spoken aloud. In our data set, it was common to observe one family member evoke a memory reminding another family member about a previously shared experience. In the following instance, a father prompted his son to offer an idea about what prey animal to draw. After discussing what barn owls might eat, a father reminded his son of the information they recently learned at the BoP show in order to establish common ground about an owl’s diet:

Bob (father): What do you think an owl would eat? ((pause)) Remember holding that little pack [a tray with an owl pellet dissection] you walked around with?

Michael (son): What pack?

Bob: That – that he [interpreter] had in that bin? Remember, there was uh, a vole, a mouse, um, that stuff. That stuff that owls eat. We want to draw what he eats.

Using the recent BoP show experience as a reminder, Bob prompted Michael to remember that he had seen an owl pellet displayed in a pack and to think about what it contained (i.e., rodent bones). After this exchange with his father, Michael drew a rodent (Figure 1) in their picture. This shared experience from the BoP show provided the means to start a discussion that owls ate rodents, which subsequently influenced their family’s drawing.

In the cases where one family member (most often a parent) reminded one another of a shared experience, prior knowledge moved from just an individual
phenomenon to a social phenomenon. Creating common ground by sharing memories of previously shared visits to informal education institutions (including an earlier trip to SCEC) helped the families work together to represent the raptor, its food, and the objects nearby for shelter and perching.

Discussion: using prior knowledge and shared experiences

This analysis contributed two findings related to prior knowledge. First, informal settings are important learning spaces for families to gain prior knowledge that they use in future conversations at nature centers to make sense of wildlife. In indoor museums, visitors have used prior experiences to make sense of new science-related ideas (Ash 2003; Ellenbogen 2002; Zimmerman, Reeve, and Bell 2008, 2010). In this outdoor nature center, SCEC, prior experiences were used to support family’s learning processes, as well. The families in this study identified a constellation of resources (e.g. zoos, books, computer games) that they used to engage with the raptor drawing. For example, time spent together in the outdoors, in designed spaces, in the families’ backyards, and on shared family trips were important learning resources. This research about the sources of prior knowledge used when making sense of BoP is important in light of prior research findings by Falk,
Storksdieck, and Dierking (2007) that found adults (from densely urban area of Los Angeles, CA, USA) self-reported that their science knowledge came mostly from out-of-school experiences. Our work with rural and small town families found through family discussions in situ that adults and children relied on informal institutions and everyday interactions to support their environmental knowledge. The finding that families used out-of-school knowledge in consequential ways during discussions of environmental topics informs learning theories related to the cumulative effects of multiple out-of-school experiences coming together to support the development of in-depth ecological knowledge. In addition, the families not only developed new ecological knowledge, but this was active knowledge that they applied to new situations, rather than inert information (Brown, Collins, and Duguid 1989). Adults and children used their environmental information to make sense of new phenomena, transferring their knowledge (Bransford, Brown, and Cocking 1999) to the raptor discussions.

Second, the act of reminding one another of activities the family had previously experienced emerged as a social learning tool. This finding demonstrates that some families used shared experiences to create a common ground (Matusov 1996), thereby allowing family members to participate in the conversation and task at hand. In our study, successful families used prior knowledge as an entry point to start a discussion, such as the case of Bob and Michael discussing the fact that owls eat rodents. Prior knowledge has previously been conceived of as a tool for individual meaning making (e.g. Glaser 1984); but here, participating families used prior knowledge in social cognition where a shared memory created a shared space of thinking and doing at the nature center. Given the recent work by Kisiel et al. (2012) showing prior knowledge being shared before questions or statements about aquatic wildlife onsite in a touch tank, our work adds another dimension to the understanding of families talk: these families used prior knowledge at a nature center to establish a common ground so that the whole family could successfully talk about animals and their natural history.

Creating participation frameworks where children’s contributions were valued

Given our interest in supporting learners in informal environmental education settings, we examined the social structure used by families when sharing prior knowledge. We specifically highlight the participation frameworks created through talk that allowed children and adults to participate in the learning conversation, thus supporting the families’ learning in the nature center. From the examination of all the participation frameworks in the nine families’ talk, three themes related to the microstructures of activity emerged that supported social learning related to environmental education:

- Parents managing disagreements.
- Families negotiating ideas.
- Collaborative idea formation by parents and children together.

The first theme, parents managing disagreements, was present within multiple families in our study. The other two themes, families negotiating ideas and collaborative idea formation by parents and children together, were not representative of the full data set, but we share these as exemplars that represent successful learning
processes used in the nature center. With additional research, we see these negotiation and collaborative idea structures as potential strategies for advancing environmental education practice.

**Parents managing family disagreements**

Matusov (1996) argues that in the study of group interactions, too much research focus has been placed on agreements, rather than disagreements – yet through examining both agreements and disagreements, a researcher develops a more accurate account of how people participate in joint activity. A variety of participation frameworks were found in our study where families took on roles and positioned each other as capable contributors, yet not every role or microstructure supported the family group’s cognition relating to raptors. Some were related to managing disagreements between family members. For example, some siblings disagreed with each other about the types of trees found in the raptors’ habitat. Consider the incident with Lucas and his older sister, Madeline, where the parents, Diana and Owen, stepped in to over-ride Madeline’s insistence that Lucas’ ideas should not be included in the family’s drawing:

Lucas: … I wanna draw the apples ((pause)) on the tree.

Madeline: Lucas, there are no apples on the tree!

Diana: Okay.

Owen: He can do an apple tree. Yeah.

Owen and Diana maintained harmony in their family by telling Madeline that her younger brother can draw apples on the tree, not based on scientific accuracy or information presented at the public show, but based on fairness to include all family members in the task. In the dialog before and after this incident, the disagreement between Lucas and Madeline was who could add to the drawing, not what should be added to the drawing. The parents settled their children’s dispute to be inclusive and find a space for both children to contribute.

In some cases, parents avoided sibling disagreements by relenting their insistence on scientific accuracy. For example, after a lengthy discussion over what animals a barn owl would eat, one father, Bob, eventually concedes to his son’s adamant decision not to draw a mouse because his sister had drawn one on her own raptor illustration. Bob prompted Michael to name what a barn owl eats, given that it hunts at night:

Michael: ((points crayon at Bob)) Squirrel!

Bob: Wellllll, maybe not at night. What else is at night?

Michael: Mmm, bats? … Mosquitoes?

Bob: What do you think an owl would eat? ((pause)) Mouse? Wanna draw a mouse?

Michael: ((points to sister and mother)) They drew a mouse.
Bob: So? We can draw one, too, right?

Michael: I’ll just draw aaahhhh ((pause)) a squirrel.

Bob: ((pause)) Okay, draw a squirrel … you got gray?

Michael: No. ((Bob throws Michael a gray crayon.))

Even though Bob attempted to guide his son’s thinking in terms of a barn owl’s diet and their nocturnal hunting patterns, he eventually relented to his son’s position that owls eat squirrels and his wish to add a squirrel to the drawing. Although Bob questioned the validity of adding squirrel (a diurnal animal) into their nocturnal illustration, he eventually relinquished the scientific accuracy of their drawing in order to maintain the social harmony between them by letting his son draw a different animal from his sister. He gave Michael a crayon so that he could include a squirrel on the drawing canvas.

In both of these examples, the disagreement and positioning was related to sibling disagreements, rather than about disagreements to the ecological accuracy of the idea. In the first case, the parents used their authority to allow equal access to the drawing and in the second case, a father, Bob, conceded ecologically accuracy so that his son could draw a different species from what his sister drew on her picture. While Bob attempted to redirect his son to scientifically accurate information about an owl’s diet, he eventually forfeited this effort. Given that these exchanges were occurring within the context of a family, we posit that the social context (Falk and Dierking 2000) is equally important to the parents, as is the scientific accuracy. The families have a history together and a future together, so the parents in our study managed disagreements in this public nature center setting with more in mind than the ecology of raptors.

Families negotiating ideas

In our study, we also found that within every family, children negotiated for the inclusion of their scientific ideas in the drawing about raptors. This strategy was most successful when the children offered a rationale along with the provided idea. In these cases, children asserted evidence that their knowledge should be included in their families’ drawing. We provide two examples of children negotiating ideas when prompted by a parent. The first example is of a parent asking about the child’s intention for drawing a favorite animal, and the second example is a parent asking permission to add a tree to the shared drawing.

In the first example of negotiating ideas, a mother and daughter worked on their drawing of a red-tailed hawk:

Diana: You gonna do your bunny?

Madeline: No bunny.

Diana: Hmm? ((looks at Madeline))

Madeline: ((shakes head ‘no’))
Diana: No bunny?

Madeline: No, they [red-tailed hawks] never went for the bunny ... I’m going to do lots of mice.

In the family’s drawing, Madeline drew mice as prey animals for the red-tailed hawk (shown in Figure 2). When Diana suggested to Madeline that she draw a rabbit (or a ‘bunny’), Madeline asserted ‘No bunny,’ to which the mother offered a surprised facial expression and then double-checked that Madeline’s intention was to not draw a bunny as part of what a red-tail hawk needed to survive. Madeline next offered an explanation: she believed that red-tailed hawks preferred mice. Here, the mother provided space for Madeline’s ideas that red-tailed hawks eat mice, while not correcting Madeline’s idea that these hawks also eat rabbits. In this way, Madeline influenced the drawing based on what she believed about red-tailed hawks. It is important to note that in this negotiating moment, the mother Diana did let go of her own correct idea that rabbits are common prey for the red-tailed hawk.

In the second example of negotiation, a ‘checking in structure’ was used in the participation framework before another family member added his or her idea. In the following instance, a father and son have drawn a screech owl and its habitat. Peter asked his son, Ryan, about what the owl needed:

Peter: Is there anything else we need?
Ryan: Ummm. Water, the mouse, no, no.

Peter: I'm going to draw a pine tree over here, maybe? ((Reaches to draw on the paper.)) Can I draw a pine tree?

Ryan: Nooo ((elongates)). They [the interpreters] never said they [screech owls] needed pine trees.

The father, Peter, started this exchange by asking his son what to include in their owl habitat. Ryan listed the things that they had already drawn, and then, he focused on

Figure 3. Ryan does not allow his father Peter to include a pine tree in their family’s drawings because he learned the screech owl prefers deciduous trees at SCEC.
the idea that screech owls live in deciduous forests, as evidenced in an earlier conversation. Because of this belief, Ryan rejected his father’s attempt to draw an evergreen pine tree in the drawing (Figure 3). In the end, the father did not draw a pine tree on the paper and yielded to his son’s ideas, rather than imposing his own ideas and observations that deciduous forests can also have evergreen trees in the case of mixed hardwood forests, as the SCEC nature center is located within. This specific participation structure valued the social interaction with Ryan, and as a result, the father did not attempt to override his son’s idea; only deciduous trees were represented.

In both of these cases of negotiation, the parents position the children as capable contributors through double-checking intentions and asking consent before moving on. The parents here adopted a role that focused on creating a space for their child’s contribution – even as the children were very literally focused on what information that the interpreters had shared about raptors during the BoP show (and missing out on rabbits and evergreen trees that were accurate, but not mentioned during the presentation). In other participation, frameworks that have been studied with adult–child interactions, the adult (i.e. the teacher) took on a role of evaluator (Cazden 1988) or of re-voicer (O’Connor and Michaels 1996). In our cases at SCEC, parents took on a role of facilitator that emphasized social harmony. The importance of enabling a positive contribution for youth within these two families learning in the nature center reinforces the importance of understanding the emotional and social aspects of out-of-school learning (Bell et al. 2009; Falk, Heimlich, and Foutz 2009), alongside the scientific and ecological accuracy.

**Collaborative idea formation by parents and children together**

In addition to negotiating ideas, families participated in ‘collaborative idea formation’. In collaborative idea formation, a new idea results from an integration of thoughts offered by family members. In these cases, multiple persons contributed to an idea so that it was built together; they did not simply adopt an idea offered by one family member. Two examples of this technique used within a participation framework follow from Madeline’s and Ryan’s families.

During the interview, Madeline and her father explained their drawing to the researcher. As they spoke, both added pieces to the explanation about the relationship of corn to mice and mice to red-tailed hawks (Figure 2):

Madeline: Well, the mice, the mice, live in the field to eat the corn.

Researcher: Okay.

Owen: So that’s why the bird hangs out at the field.

Madeline: To eat the mice.

During this exchange, Owen and Madeline built upon each other’s turn of conversation, by finishing a sentence and completing the idea. Their collaborative contributions created a shared explanation of what a raptor needs to survive – mice – and why raptors were located near cornfields. The idea did not belong to Madeline or Owen (or the mother or brother), but to everyone. This participation structure, therefore,
positioned Madeline and her father as partners in the intellectual work of developing an explanation of the mice and the red-tailed hawk’s behaviors.

In a second example, Peter and Ryan continue to work on their drawing and together, they co-construct the idea that mice are present in deciduous forests and should be included in their drawing (Figure 3).

Peter: I think she [presenter] said deciduous forest, right? Sort of like what we’re in now.

Ryan: ((looking around)) This is a good place to hunt for mice if you can see good.

Peter: So, um. That’s right. They said, if they [researchers] say to draw what they [screech owls] would need to survive …

Ryan: Mice!

Peter: Let’s draw!

When Peter said they were located within a deciduous forest, this echoed Ryan’s comments from eight minutes earlier that there were no pine trees in the screech owl’s habitat. Ryan then introduced the idea that raptors would thrive in the current surrounding if they can ‘see good’. Peter acknowledged this comment then subsequently suggested that they begin the drawing task, which included the idea that mice were needed by screech owls in order to survive.

In both examples of collaborative idea formation, family members added to each other’s sentences, building a collective process for expressing knowledge about raptors. The participation framework that the families created allowed for collaborative idea building, which supported family members in working together as social learning partners. Across multiple cultures, different models of parenting exist with vital roles for parents and children implicitly constituted through everyday interactions (Rogoff 2003). Here, these two SCEC visiting families showed a tacit model of parenting that supported their children as equal contributors and partners during the drawing task. The children responded in kind showing that the role created for them as a developing expert (Crowley and Jacobs 2002) was one that they felt comfortable taking on in the nature center context.

**Discussion: participation frameworks inclusive of children’s contributions**

Families create participation frameworks (Goodwin 2007) in order to support intergenerational interactions in informal educational settings. Through the examples from three families, we show how exemplar participation frameworks created by talk supported a mutual bridging of meanings (Rogoff 2003). In some cases, the participation frameworks supported learning about ecology. In some cases, the participation frameworks were used to deal with disagreements that had to do more with the families’ harmony, than with the ecological or scientific content. Overall, we found that in the public nature center setting, participant families acted in a way that valued social harmony as much as scientific accuracy. In fact, parents of siblings settled some sibling–sibling disagreements based on maintaining family harmony, rather than on maintaining scientific accuracy.
Similarly, this work showed that family groups could create participation frameworks that organized their social interactions and empowered all family members, including the youth, as valid contributors of environmental knowledge. This finding is relevant specifically for environmental education in that prior research (Ballantyne, Fien, and Packer 2001; Duvall and Zint 2007; Uzzell 1999) suggests that children have more information about environmental issues than their parents. By allowing the children space to bring their ideas into the conversation, these three families at SCEC created structures that tackle ‘hegemonic’ or dominant views (Reid and Nikel 2008) of the primacy of adult-driven ‘learning agendas’ (Anderson, Piscitelli, and Everett 2008) and adult-directed interactions. Here, participation frameworks flattened intergenerational microstructures during discussions of raptors, so that the elders’ ideas did not overshadow the ideas of children, even while the parent or grandparent in our study still retained control of the visit (such as the ability to end the trip).

In addition, our examinations of participation frameworks allow the research team to elucidate the tacit views of parenting within public informal settings held by the adults – one that emphasized family harmony. Given the multiple views of parenting in various cultural arrangements (Rogoff 2003), parents within our study ceded some control of the conversation to their child and relinquished, in some cases, their initial insistence on fully ecological accuracy. Many of the participation frameworks that emerged in our study provided the children with the freedom to direct their activity (Chawla 2001) and the ideas behind what they drew. While not every participation structure supported family learning, when it did in our study, the family members had the opportunity to share, explain, and defend their understandings within a collaborative intergenerational space.

In public outdoor, environmental education settings, research needs to account for the variety of familial roles and microstructures for facilitation in order to illuminate the nature of parent–children interactions related to teaching and learning in informal education settings (Gleason and Schauble 2000). We argue that analyzing families’ discourse to discern the created participation framework can aid researchers in understanding the nature of parental facilitation within family interactions.

**Implications to learning research in environmental education**

Building from sociocultural perspectives, we examined the role of prior knowledge in family conversations and how it was used within learning conversations at one nature center, SCEC. The notion of learning as an active process, where learners make connections between prior knowledge and new content, is recognized in the educational research literature (Alexander, Schallert, and Reynolds 2009; Bransford, Brown, and Cocking 1999; Bruner 1996). However, the processes by which family members enact their prior experiences in the context of environmental education program settings as shared social cognition had not been elucidated. Our study demonstrated the importance of prior knowledge among intergenerational groups, the processes by which families used prior knowledge, and how families supported each other to recall prior knowledge. Families sourced their ecological knowledge from multiple social settings: home, media, and experiences in informal education pursuits. By understanding when nature center visitors leverage different types of knowledge in meaning-making conversations, educators and curriculum developers can build prompts and questions into programs that attempt to elicit prior knowledge and experiences.
Goodwin (2007) has shown that participation frameworks created by youth build social organizations within their contexts of play and activity. Employing participation frameworks as an analytical construct within our informal learning theory expanded what we knew of the families’ group cognition by providing insights into the processes families use to organize their talk as they learn together. We noted in our findings that social processes were at play, which allowed children equal footing to negotiate ideas about natural history with adults and therefore permitted families to collaboratively structure ideas about nature. Parents and grandparents sought out resources in order to provide their family access to information in their daily lives, such as library books, nature books, trips to environmental learning settings, and media. Yet, while the elders in our study took to arranging visits to outdoor learning centers and to find learning resources to support environmental education, at SCEC, the parents and grandparents were not always the intellectual leaders in the conversations. In some cases, children were enabled to share significant knowledge to the conversations about raptors during the nature center visits.

Given the interest in EE about the nature of participation (Reid and Nikel 2008), the participation framework concept can provide researchers with an analytical tool to examine joint participation in future studies to better understand the roles and positions available for learners. Additionally, a future line of work can examine environmental educators suggesting that families engage in discursive patterns to create participation frameworks that provide learners access to the meaning-making conversations as valid contributors of knowledge related to environmental topics. Our study suggests further inquiry into participation structures that support engaging discussions may be fruitful to supporting parent–child interactions related to environmental learning.

Through this case study approach, we hope that our work can advance the environmental education field’s discussion about incorporating learning theory to better understand how people learn about the environment and its various processes (Dillon 2003; Lundholm and Plummer 2010; Rickinson 2001; Rickinson, Lundholm, and Hopwood 2009). The examples presented in this article demonstrate how sociocultural conceptions of participation and social structure can provide insights into the learning processes used by families – the most common social learning group to visit informal environmental education settings – when they engage in leisure experiences at a nature center.

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