

“If you don’t want to leave him out, go ahead”:

Constructing belonging of non-native animals during Native American  
parent-child dyad play with a diorama

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**Abstract**

“If you don’t want to leave him out, go ahead”:  
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This study examined open-ended play of urban Native American parent-child dyads with a forest diorama that included plastic representations of both trees and animals. Previous research demonstrated that Native four-year-old children engaged in habitat based ecological play with native animals on a forest diorama (Washinawatok et al., in press). The present study asks whether Native parent-child dyads continue to engage in habitat based play with non-native animals. This study found that parent-child dyads continued to engage land-based play and that belonging between animal and place on the diorama was a prominent play theme that led to emotional tension and unique problem solving strategies, including making specific relationships with land that were not habitat based. Drawing upon sociocultural research on play and research on situated cognition, this study extends current conceptualization of science learning in early childhood to include affective imagination as a core component of sense-making.

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# 1. INTRODUCTION

Young children are naturally inquisitive and constantly engaged in making sense of the world around them (NRC Report 2012; Inagaki & Hatano, 2006; Metz 1995), yet despite this innate curiosity and rich sense making, young children, particularly young children of color, are often positioned as being lagging in understanding or producing scientific thought and engaging in scientific practices (Eberbach & Crowley, 2009; Metz, 1995). This is in part because conceptualizing how and what young children know about the natural world has emphasized universal norms (Carey, 1985), rather than culturally variable sense-making repertoires (Medin, 2015; Medin & Bang, 2014; Ojalehto & Medin, 2015). Research on children's cognition often takes place in laboratories utilizing material resources and participatory structures familiar to middle-class, European American children from industrial and democratic societies in order to make individual, universal, and stable claims about human development and knowledge organization (Henrich, Heine, & Norenzayan, 2010). These norms routinely shape learning environments for young children. Consequently, young children of color whose ways of knowing and engaging may be distinct are seen from deficit perspectives and placed in what Bang, Warren, Rosebery, and Medin (2012) refer to as "untenable epistemological positions that work against engagement in meaningful science learning" (pg. 302).

While the National Research Council (2007; 2012) recognizes that young children have complex understandings and practices prior to entering formal school, science for early childhood is still constrained by a narrow view of what children are capable of knowing (Fleer, 2009). Trait-based categorization of biological entities (animals, plants,

etc.), shapes, and colors remains a core component of scientific curricula for young children (e.g. Roth, Goulart, & Plakitsi, 2013), rather than, for example, curricula aiming to engage children in complex systems or ecological concepts and practices of which they are fully capable (NRC 2007). By having such low expectations for children as they enter school science, these expectations may persist and consequently we run the risk of limiting our collective ability to innovate to face such monumental scientific concerns as climate change, decreasing ecological diversity, and water shortages (Carter, 2007).

The purpose of this study is to build upon existing research in the domains of sociocultural play and folk biology to better understand how learning and play develop during unfolding activity. The present analysis utilizes a subset of data collected from a study that examines how nature-culture relations are constructed in structured and unstructured parent-child settings. The goal of the study was to investigate cross-cultural differences in children's biological cognition by focusing on family's interactions with a 3-dimensional diorama designed to elicit spontaneous expressions - in actions or in words -- about living things in an open-ended play context (Washinawatok et al., in press). Previous analyses have been conducted with solo children (Washinawatok et al., in press) and parent-child dyads (Bang, Pugh & Medin, submitted). Contrary to popular belief, Washinawatok, et al. (in press) found that Native children, both urban and rural, spoke more than non-Native children during the play task, suggesting that children talk more when presented with materials and content that are culturally (via stories, books, songs, etc.) and experientially (i.e. being in the forest) familiar. They also found that Native children engaged in more realistic play with the diorama than imaginary play. Native children were more likely to engage in taking animal perspectives, rather than

personifying the animals. Finally, Native children engaged in ecological play, meaning that they attended to the relationship between animal and habitat during play in addition to a complex web of animal-animal relationships. Washinawatok, et al. (in press) specifically examined two native animals present in the study (eagle and turtle) and found that Native children were significantly more likely to enact habitat relations (tree and pond, respectively) with these animals. This research deepens our understanding of how children are constructing place-based relationships as a part of folk biological thought during play.

Extending these findings, the present analysis interrogates whether and how urban Native parents and children conceive relationship to place when animals do not belong in the habitat during diorama play. In other words, if children are enacting realistic ecological relationships, then we should expect that the cow, gorilla, and zebra that were present alongside animals native to a North American forest should pose a dilemma for Native families. Specifically, this study takes up the concept of “belonging to place” as an integral component of ecological reasoning and potentially an avenue for expanding current conceptions of science learning in early childhood.

This study is structured in the following way: First, I present my theoretical framework that consists of two strands of research on play and biological cognition, focusing on sociocultural and situative perspectives on learning. This is followed by my research questions and analytic framework. I then present statistical findings and a discursive analysis as two complementary methods of understanding the data. Lastly, I offer a discussion on these findings as well as the limitations and implications for research and practice.

## 2. THEORETICAL FRAMEWORK

This study emerges from two promising lines of research in play and folk-biology that are informed by sociocultural and situative perspectives. Sociocultural theories of play ask us to attend to the dynamic relationship between children as they play with each other, adults, and/or play materials in unfolding activity (Fleer, 2014). Research in folk-biology conducted from situative and cross-cultural perspectives interrogates the long-held assumptions about children's biological cognition (Bang, 2015). I will briefly expand on each of these lines of research and attend to the openings for new inquiry that the present manuscript takes up.

### 2.1 STRAND ONE: PLAY AND LEARNING

The first strand of research focuses on the intertwining of play and cognitive development in early childhood to support learning broadly, and science learning specifically. This growing literature focuses on the dynamic ways that early childhood learning environments can use play activities, toys, and teacher scaffolding during play to facilitate young children's comprehension of scientific content and practices (Andersson & Gullberg, 2014; Fleer, 2009; Metz, 1995, 1997; Peterson & French, 2008; Robbins, 2005; Roychoudhury, 2014; Unsworth et al., 2012). In particular, science in early childhood builds from children's natural curiosity and experiential learning practices to focus on the physical (e.g. Gopnik & Walker, 2013) and natural world (e.g. Inagaki & Hatano, 2006).

The literature on play theory is extensive and spans many disciplines; therefore,

for the purpose of this paper I focus specifically on theories of play from developmental psychology (for a review of play theory from multiple disciplines, see Sutton-Smith, 2009). Within developmental psychology, the field has been split into constructivist, sociocultural, and ethological<sup>1</sup> camps that work to understand how play is linked to cognitive, social, and physical development of children. Particularly in the realm of imaginary play (also known as dramatic play, pretend play, role play, and symbolic play), constructivist and sociocultural theories of the form and function of play have sharply divided research and practice. This divide is often attributed to two historical figures, Piaget and Vygotsky (Diachenko, 2011)

Contemporaries, Piaget and Vygotsky developed robust theories of child development centering on play as a mechanism of cognitive and social development and both advocated for the increased devotion to play in children's lives (e.g. Piaget, 1962; Vygotsky, 1996). While both theorists outline an age-determined trajectory of development that links play to increasingly complex forms of social relations and higher-order cognitive processing, Piaget is associated with the decontextualized and individualized understanding of play and development and Vygotsky with the interaction between children and their social worlds in the process of development (Diachenko, 2011).

### 2.1.1 *Sociocultural Theories of Play and Learning*

Much of the research that guides practice in early childhood learning

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<sup>1</sup> The latter body of research focuses on the evolutionary development of play in humans and animals and will not be discussed in detail here (e.g. Pellegrini & Smith, 1998; Pellis & Pellis, 2007)

environments in contemporary Western society is driven by a narrow understanding of play and development of Piagetian persuasion that attempts to provide an account of what children can and should know about the natural world at a given age (Yelland, 2011; Metz, 1997). Promising sociocultural<sup>2</sup> research on play and learning; however, attempts to contextualize learning and play to develop a more robust theory of *how* children come to make meaning during the act of play, rather than focusing on *what* they know (e.g. Fler & Pramling, 2015).

Sociocultural theories of play and learning focus on the ways in which children engage with peers, adults, and play materials to construct meaning from any play activity, whether science related or not. In particular, these theories attend to the ways in which the imaginary and real worlds of children are dialectically informed and shape any activity under study (e.g. Fler, 2008; Robbins, 2005). This paper specifically explores two theoretical domains: affective imagination and conceptual reasoning during play to support science learning.

### 2.1.2 *Affective Imagination in Science Learning*

Unlike constructivist approaches to play and learning, sociocultural theorists pay close attention to the affective nature of play as children narrate and work through emotional tension during unfolding activity (Fler, 2013). Fler (2013, 2014) and Zaporozhets (2002) use the term “flicker” to describe the ongoing emotional tension between real and imagined worlds during play. For example, Fler (2013) noted that

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<sup>2</sup> While many of the play theorists of interest refer to themselves as cultural-historical researchers, following Vygotsky; I choose to apply the term “sociocultural” here to designate a broader theoretical trend to view culture as socially mediated rather than a static, inherited trait (Wertsch, del Rio, & Alvarez, 1995).

children enacted fear during a role-playing of the fairy tale, *Goldilocks and the Three Bears*, and that this emotional blurring of real (the sensation of fear) and the imaginary (acting out a story) motivated the children to problem solve (making a sign to indicate a safe zone during play). Furthermore, Fler found that flickering between imaginary and real worlds and subsequent emotional tension could be used to scaffold scientific learning in an early childhood setting. As exemplified with the *Goldilocks* case above, Fler (2013) argues that “a *scientific narrative gives purpose and develops a motive* for engagement in thinking and acting scientifically” (pg. 2090, emphasis Fler). In other words, utilizing a familiar cultural device can support children’s collective problem solving and offer a different method for acting out scientific explanations too difficult to articulate verbally (Fler, 2013).

Substantial research supports the theory that children are able to reason conceptually during play because play does not rely on the same verbal fluency as traditional assessments (Andersson & Gullberg, 2012; Fler, 2009; Ochs, Taylor, Rudolph, & Smith, 1992). Rather, children are able to reason about conceptual phenomena without pressure of right/wrong answers (Gopnik & Walker, 2013). A foundational component of early childhood science, according to Gopnik and Walker (2013) is the ability to reason counterfactually, or imagine possible worlds to solve scientific problems. Knowledgeable adults are critical in helping to shape budding conceptual ideas by contextualizing children’s reasoning within a broader system of knowledge (Fler, 2009).

Extending this research, we could ask how a forest diorama acts as a familiar cultural device for Native parent-child dyads as they engage in open-ended play. Further,

we could ask how parent-child dyads flicker between real and imaginary worlds and what emotional tensions emerge from this flickering. We can then draw inferences about how conceptual development of natural phenomena is occurring during this type of play. This line of inquiry is promising because it utilizes a cultural device that may be more familiar and in alignment to Native families' epistemologies than *Goldilocks and The Three Bears*. Thus, this analysis offers a new vantage point from which to understand the culturally dynamic ways conceptual development unfolds. In the next section, I review a second line of research that details cross-cultural differences in children's biological thought and underscores the impetus for examining Native parent-child dyads during open-ended play with a culturally familiar device.

## 2.2 STRAND TWO: CHILDREN'S BIOLOGICAL THOUGHT

The second strand of research examines how a sociocultural lens on biological cognition expands theoretical and methodological scholarship on the subject. Bang (2015) provides a succinct discussion on sociocultural learning about the natural world and offers promising avenues for studying cultural differences in biological thought. As noted previously, constructivist theories of learning and development focus on decontextualized, individualized, and stable knowledge (e.g. Greeno 1997; Greeno et al., 1998). Sociocultural perspectives, on the other hand, intently examine how people within a historical, material, and social context interact during unfolding activity to explain how learning happens (e.g. Bang, 2015). The current analysis is specifically concerned with sociocultural perspectives on biological cognition and the culturally mediated way that thinking and learning unfolds.

Within in the realm of folkbiology, or the development of knowledge of the natural world, great strides in theory and methodology have been made to suggest that taxonomical organization is not developmentally universal as previously argued (e.g. Carey, 1985). Rather, what is worthy of attention and how it is organized (i.e. epistemology), is culturally mediated through direct experience and cultural artifacts and devices (e.g. stories, books, toys, etc.). Broadly, folkbiology has contributed to our understanding of variability in knowledge organization and sense-making repertoires across cultures. These differences are surfaced by attending on cross-cultural differences in: 1) experience/exposure to epistemic orientations that lead to difference in knowledge organization and reasoning patterns (Herrmann, Waxman, & Medin, 2010; Inagaki & Hatano, 2002; Medin & Bang, 2014); 2) context (Waxman, Herrmann, Woodring, & Medin 2014); 3) nature-culture representations in artifacts (Dehghani, Bang, Medin, Marin, Leddon, Waxman, 2013); and 4) interaction during unfolding activity (Bang & Marin, 2015; Marin, 2013).

For example, studies focusing on Native and non-Native children's reasoning about the natural world found that non-Native children's knowledge organization patterns mirrored traditional cognitive development findings (such as trait-based categorization and human essentialism), while Native children, engaged in relational epistemic organization (e.g. Herrmann, Waxman, & Medin, 2010). In other words, Native children attended to the complex web of relations between natural entities (animals, plants, rocks, weather, etc.) rather than the discrete categorization of those entities. Importantly, both animal-to-animal (Bang, Pugh, & Medin, in press), and animal-to-place (Washinawatok et al., in press) reasoning has been documented.

This finding is unsurprising given that relationship to place<sup>3</sup> is a core component of Native epistemology (Cajete, 2000). Research on relational epistemology (Cajete; 2000; Deloria 1999; Kawagley 1996; Periotti, 2010), drawing from scholarship on Indigenous Knowledge systems (Battiste, 2002; Berkes, 1999; Cajete 2000), argues that Native communities reason about the natural world from an interrelatedness where humans are a part of the natural world rather than apart from it. Meaning that knowledge is derived from *and accountable to* the natural (non-human) and social (human) ecologies in which young children live and interact. For example, findings from Washinawatok et al. (in press) suggest Native children reason from the perspective of animals rather than impose human desires and actions. How then do Native families make sense of non-native animals in a forest when the relationship to place is disrupted? This general question is the substance of my analysis, which is further detailed in the second half of this paper.

### 3. RESEARCH QUESTION

By bringing the theoretical components of play and place together, there is an opportunity to examine an often-overlooked component of science education: the affective and culturally mediated nature of learning. While I dig into this more in the implications section, it is important to frame the data as embedded within a knowledge system that values place-based knowledge and that learning during play hinges on emotional tensions. As I looked at the data, it was with these two theoretical dimensions

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<sup>3</sup> I use the term “place” in this manuscript to designate both attention to and relationship with land, but also to the social and historical contexts of a place. The term “place” is bounded enough to convey a particular location, socioecology, and history, yet abstract enough to refer to different scales (e.g. a geographical region, a habitat, the grassy area on the diorama).

in play. Thus, making relationships between non-native animals and land is framed as *belonging to a place*, reflecting the epistemological orientation to place-based meaning making and the emotional nature of playing. This analysis asks *how Native parents and children construct relationships to land when playing with non-native species*, given that habitat relationships are not in alignment.

## 4. METHODS

### 4.1 PARTICIPANTS

The present study uses data collected as part of a larger inquiry into nature-culture relations in three Midwest communities: rural Native ( $n = 19$ ), urban Native ( $n = 21$ ), and urban non-Native ( $n = 21$ ). For the purpose of this paper, only data from the urban Native sample is presented and analyzed.

Twenty-one Urban Native American children ( $M = 4.31$  years, range 3.2-5.2) and their parents, guardians, or other family member were recruited from various activities at the American Indian Center of Chicago (AIC) and from family and friends in research assistant and AIC staff social circles. Three families participated in their homes and the remainder engaged with the diorama in a quiet place in the AIC building. There was one triad (parent and two children) participating in the task jointly.

## 4.2 MATERIALS & PROCEDURE

### 4.2.1 *Diorama Materials*

The open diorama represented a North American forest. The diorama was 30 x 46 cm and mounted on a thick piece of polystyrene foam. A textured green mat was overlaid the polystyrene to simulate a grass. Trees, bushes, logs, rocks, and a pond were attached around the edges of the diorama with enough space to allow movement of animals during play. The trees were plastic models 10 cm to 12.7 cm tall. The logs were made from real sticks and bushes from real moss. Accompanying the diorama were animals native to a North American forest and non-Native animals as well as additional trees, logs, and rocks for dyads to add to the diorama wherever they wished (see Table 4.1)

Table 4.1.  
*List of Diorama Parts*

| Diorama Elements    |                     | Animals |            |
|---------------------|---------------------|---------|------------|
| Fixed               | Moveable            | Native  | non-Native |
| Deciduous trees (3) | Deciduous trees (2) | Eagle   | Zebra      |
| Evergreen trees (3) | Evergreen trees (2) | Bear    | Gorilla    |
| Bushes              | Logs                | Stag    | Cow        |
| Pond                | Rocks               | Turtle  |            |
| Logs                |                     |         |            |
| Rocks               |                     |         |            |

#### 4.2.2 *A note on developing these materials*

This study was a part of a larger program of research. As part of a commitment to community-based research that aims to disrupt normative power dynamics between researcher and researched (Bang et al. 2010; Bang & Vossoughi, in press; Smith, 1999), community members from the Menominee tribe in Wisconsin and the American Indian Center in Chicago were engaged during every step of the design process. This process meant that foundational assumptions about research were often questioned and reconceptualized - even at the level of tasks and materials used in studies.

For example, while developing this play task, at one research meeting with Menominee colleagues, the university partners brought some plastic animals and suggested presenting children with pairs of these toy animals to probe for their spontaneous descriptions of ecological relations. Menominee research assistants objected to this task, pointing out that this would be very unnatural for a Menominee child because there was no “context” provided for the animal pairs. After an extended discussion, one Menominee research assistant volunteered to construct a diorama (made with realistic models of trees, shrubs, water, and grass, as well as several pieces of “real” wood and rock) to be used as a context for the task with toy animals. The diorama used in the study is based on that original design.

#### 4.2.3 *Procedure*

Parent-child dyads were given the diorama on a low table at height for children to play while seated or standing; all moveable pieces were given in a separate ziploc bag or set next to the diorama on the table. They were instructed to “Play with it however you

like; there's no right or wrong way." The research assistant informed the dyads that the task would last approximately 15-20 minutes, or until the dyads were done playing. If they finished early or had questions, the assistant would be waiting in a separate room. After 20 minutes, the research assistant returned and asked the dyads if they had fun and to describe what they did during the play task. All sessions were video taped.

### 4.3 ANALYTIC FRAMEWORK

#### 4.3.1 *Criteria for Coding*

This analysis looked solely at parent/child talk with non-native animals. Excerpts of play-talk with individual or clusters of non-native animals were pulled from the transcripts to create a data corpus (see Table 4.2 for criteria for excerpts). A total of 234 excerpts were selected across 21 transcripts ( $M = 11.143$ ,  $SD = 5.053$ ). Four transcripts were considered for exclusion because they were considered outliers with either too few number of excerpts ( $n \leq 5$ ) or too many excerpts ( $n \geq 16$ ) ( $M = 11.44$ ;  $SD = 3.88$ ). An ANOVA between the data set with the full 21 transcripts and the data set with 17 transcripts demonstrated no statistical difference between the data sets,  $F(1, 36) = 0.003$ ,  $MSE = 0.07$ ,  $p > 0.95$ , so the four transcripts were kept.

Table 4.2

*Examples of Excerpts of Non-Native (N.N.) Animals for Coding*

| Single N.N. Animal  | List Multiple N.N. Animals                           | N.N. Animals Play Together                               |
|---|--|--|
|   | CHILD: A bird, a turtle, a bear,<br>a moose, a deer. | CHILD: He's behind you.<br>[moving zebra around gorilla] |
| PARENT: Well, where does a<br>gorilla go? Where should I put<br>him? Hiding? Hiding in the<br>tree?                         | PARENT: A deer?<br>CHILD: A cow.<br>PARENT: A cow?   | CHILD: "Found you." [Zebra<br>finds gorilla]             |
| CHILD: Gorillas climb up the<br>trees.  | CHILD: And a gorilla, and a<br>zebra.                | PARENT: He found him?<br>CHILD: Yeah.                    |
| PARENT: Oh, they do? Okay.<br>Something like this, right.<br>Should I put him right there?<br>CHILD: Yeah.<br>PARENT: Okay. |  |  |

4.3.2 *Overview of Coding Scheme*

A grounded coding scheme was developed to analyze the data. To develop this coding scheme all 234 excerpts were reviewed. This was followed by a series of analytical memoing reflecting on the data. These memos attended to patterns of verbal play with non-native animals' relationships with the diorama and talk between parents and children. After several rounds of memoing, a grounded coding scheme of 25 codes was generated around themes of making relationship to place and parent-child talk that attempts to provide empirical evidence for whether and how dyads engage in a relational epistemic practices. Within these 25 codes there were several domains including: 1) play type (place relationship or not); 2) forest concept; and 3) specific forms of relations. The second and third domains only applied to those excerpts that received a place relationship code. Each are described in detail (see Appendix A for full coding scheme).

### 4.3.3 *Play Type Codes*

Each excerpt was first coded for whether the play-talk was about recognizing an animal-to-place relationship (*Place-based*) or not (*Non Place-based*). Place-based play included talk about non-native animals belonging to a place on the diorama or in a forest (e.g. “gorillas live in a forest”). Non place-based play included all other forms of play-talk with non-native animals including fantastical play (e.g. “bear fights gorilla”) or naming species (e.g. “What is this?” “It’s a zebra”). Because these codes were mutually exclusive, an excerpt was coded for Place-based even if it contained non-place-based talk in addition to place-based. The place-based code has two subcodes: forest concept and specific relationship, which are described in greater detail below.

### 4.3.4 *Place-based Reasoning*

*Forest Concept and Specific Relationship:* Two grounded subcodes, forest concept and specific relationship were generated to track reasoning about non-native animals on a forest diorama from the abstracted conceptual level (forest specific) and following the structure of local relationships. While biological categorization often falls along class of animal, in this instance categorical reasoning involves membership to a particular habitat. In other words, this analysis is predicated on the assumption that parents and children will engage in categorical reasoning such that they recognize the cow, zebra, and gorilla as not being members of the North American forest category. The forest concept code then tracks the number of times parents and children refer to the categorical membership of a non-native species in a forest. The forest concept code is

further broken down into a series of codes that details the dialogic nature of the play task in the next section.

Analogical reasoning, by contrast, constitutes reasoning about the structural relationship between entities within a known system and applying that information to a similar but unknown system (Goswami, 1992; Vosniadou, 1995). In this instance the unknown system also constitutes a hypothetical or play system in which parents and children selectively enact known relations to the available system. The specific relationship code then tracks the number of times parents and children engage in applying known animal-land relationships. Subcodes for the specific relationship code describe the structure of the relationship are detailed below.

#### *4.3.5 Characterizing Reasoning Patterns: Subcodes*

*Forest Concept Subcodes:* A sociocultural analysis requires that I attend to the dialectic nature of talk during the activity and local meaning-making, to that end I created subcodes for the forest concept code that track how the concept is initiated and how a parent or child responds (see Table 4.3). I generated two a priori codes for how the concept could be initiated: questioning or making a declarative statement. Because question asking is a familiar communicative strategy used to frame the boundary between real and imaginary during play, I hypothesize that parents and children will initiate the forest concept by question asking more often than making declarative statements.

If dyads are inferring a habitat-based relationship between animal and diorama, then we should expect to see an attempt to either remediate the relationship, shift the nature of the play from realistic to fantastic, and/or remove the animal from the diorama.

I generated six grounded codes for possible responses to the initiation of a forest concept that reflect these three orientations.

Table 4.3  
*Forest Concept Sub-Codes*

| Code            | Subcode                        | Definition   |
|-----------------|--------------------------------|--|
| Initiation Type | Initiate question              | A question is asked about whether the diorama is a forest or whether an animal belongs in a forest. This could include directly calling the diorama a forest or asking where an animal lives   |
|                 | Initiate declarative statement | A claim is made that the diorama is a forest and that an animal does or does not belong  |
| Response Type   | Response specific place        | The animal belongs to a certain location on the diorama (e.g. pond, tree, grass, etc.)   |
|                 | Response other habitat         | The animal belongs in another location (e.g. zoo, farm). They do not have to name a specific place, but could respond "no" when a parent asks "does the animal belong in the forest" because it implies that it belongs to a different place |
|                 | Response pretense              | The non-native species can belong on the forest diorama because they are playing or pretending   |
|                 | Response yes-belong            | Contends that the animal does belong in a forest   |
|                 | Response remove                | The animal is removed from the diorama   |
|                 | No response                    | No response is made  |

These codes were not mutually exclusive meaning that a parent or child could ask multiple questions, or make multiple declarative statements, or both, in a single excerpt. Revoicing of the same question or statement within a single turn was not counted more than once. While many children chose to respond by physically placing an animal on the diorama, this data was not analyzed. This is a limitation of the study and will be taken up in the discussion section. For example, Table 4.4 demonstrates how the codes were

applied to a transcript of Beth and Matthew. All names have been replaced with pseudonyms.

Table 4.4  
*Example Excerpt of Forest Concept Coding*

| Excerpt  | Code(s)   |
|--|---|
| Beth: “Okay, do all the animals live in the forest at the same time or just a few of them? Or just a couple of them?”                                    | Parent<br>Initiate Question                                     |
| Matthew: “Uh, this animal [ <i>cow</i> ] lives at the farm.”   | Child<br>Response other location                                |
| Beth: “He lives on a farm, right? Well, do they have a place in this forest? Should we put him in this forest then? [ <i>son nods agreement</i> ] Okay?” | Parent<br>Response other location<br>Response specific location |

*Specific Place Relation Subcodes:* In addition to examining how often the specific place code occurs, I looked at the type of relationship as explained by a parent or child. Three a priori codes were generated based on expected types of relationships given the features of the diorama: eating/drinking (e.g. grass/bushes, water) or behavior (e.g. climbing trees, running, hiding from prey etc.) Again, the action of placing an animal on the diorama was a prevalent theme; however, this analysis only looks at talk about placing animals. Table 4.6 represents an example excerpt that has been coded with specific place relation codes.

Table 4.5  
*Specific Place Relationship Codes*

| Code                        | Definition  |
|-----------------------------|---|
| Without explanation         | Talk about a non-native species belonging to a specific place on the diorama but doesn't not give a reasoning why they belong to that place   |
| Eating/drinking explanation | Talk about a non-native species belonging to a specific place on the diorama because it eats something from that place. This could also include a prompt in the form of a question from a parent to put an animal where it could eat/drink. |
| Animal behavior explanation | Talk about a non-native species belonging to a specific place on the diorama because of something it does in/on that place (e.g. climbs, swims, etc.)   |

Table 4.6  
*Example Excerpt of Specific Relation Coding*

| Excerpt   | Code(s)   |
|---|---|
| May: Oh, he's just eating his lunch?  | N/A   |
| Brandon: Mmmm hmmm [ <i>indicating yes</i> ], his grass. He's laying down and eating his grass. Laying down and eating his grass. | Child<br>Eating explanation<br>Behavior explanation |

## 5. FINDINGS

In this section I first provide a quantitative analysis of the data. Chi-Squares and Analyses of Variance were conducted to test for significance. Secondly, a discursive analysis examines the unique talk-styles between parents and children during play. Together these lines of analysis provide a robust account of how parent-child dyads played with the non-native animals on the diorama.

## 5.1 PLAY TYPE FINDINGS

The open ended nature of the diorama play task afforded many different types of play; two types were distinguished in the first round of coding: place-based versus non place-based. An ANOVA of play type revealed a statistical difference,  $F(1, 40) = 4.38$ ;  $MSE = 6.67$ ;  $p < .05$ . Native dyads engaged in more place-based play ( $M = 6.67$ ,  $SD = 3.98$ ) than they did non place-based play ( $M = 4.48$ ,  $SD = 2.68$ ) as evidenced by the overall number of number of excerpts (see Figure 5.1).

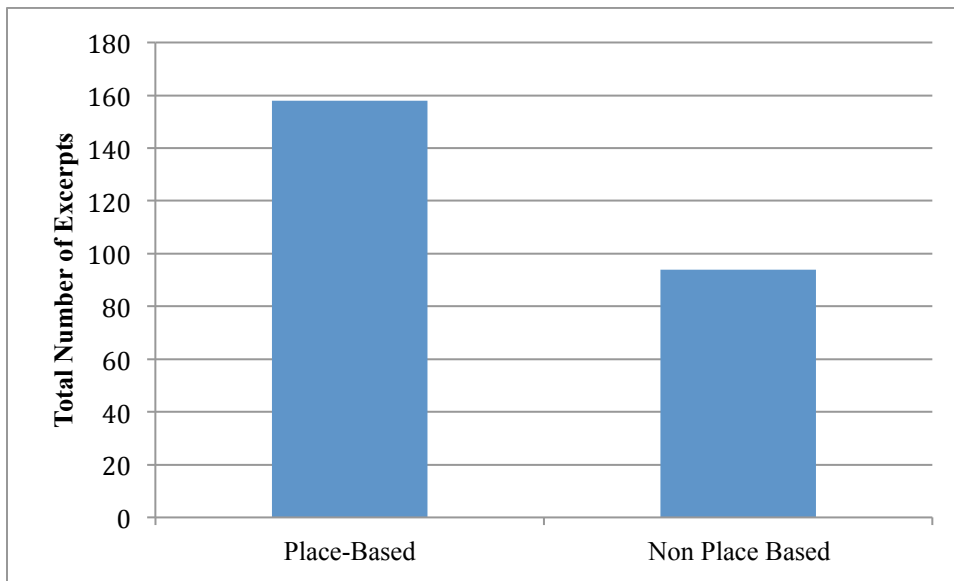


Figure 5.1  
*Number of Excerpts by Play Type*

## 5.2 PLACE-BASED REASONING TYPES FINDINGS

Within types of place-based play, a Chi-Square indicates no statistical difference between place-based reasoning at the transcript level,  $X^2 = 0.56$  meaning that Native dyads were as likely to reason about a forest concept as a specific relationship during the play task. An ANOVA for total number of excerpts, however, yields a statistical

difference for overall frequency of occurrence with Native dyads talking more about specific relationships per transcript ( $M = 4.67$ ,  $SD = 3.55$ ), than a forest concept ( $M = 1.91$ ,  $SD = 2.20$ ) (see Figure 5.2).

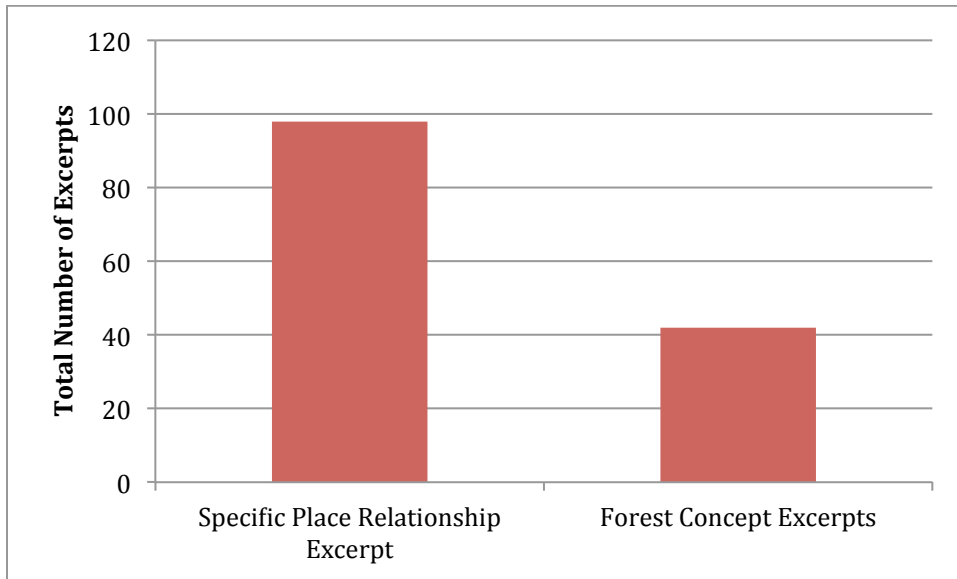


Figure 5.2.  
*Number of Excerpts by Place-based Reasoning Types*

### 5.2.1 *Forest Concept Subcode Findings*

*Initiation of the Forest Concept.* Dyads asked more questions about belonging ( $M = 1.81$ ,  $SD = 2.13$ ) than made declarative statements ( $M = 0.95$ ,  $SD = 1.36$ ); however, an ANOVA yielded no statistical difference (see Figure 5.3). Initiation included questions about whether a non-native animal belonged in a forest or declarative statements about what habitat an animal belonged to (i.e. in a forest or in another location the implication being that if an animal belongs in, say a dessert, it therefore does not belong in a forest).

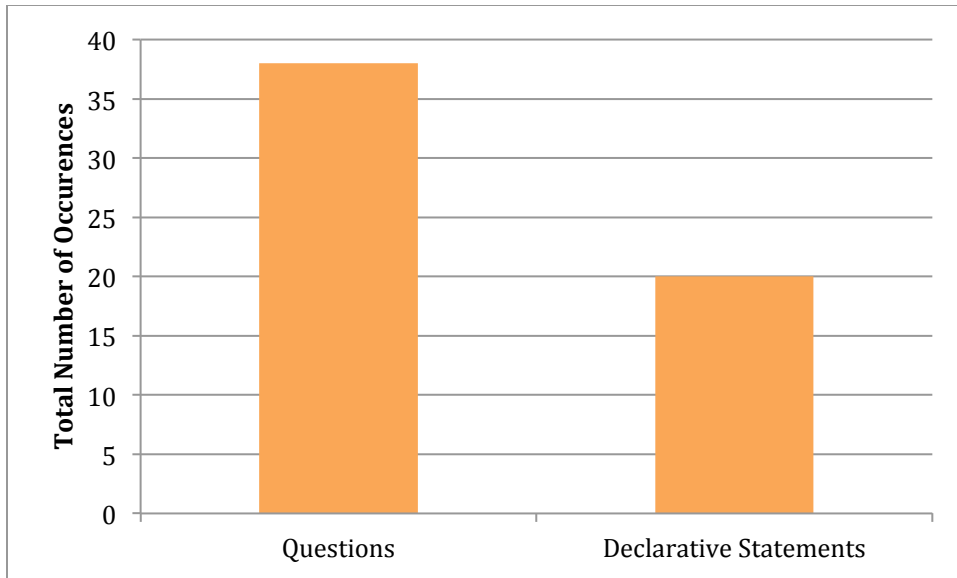


Figure 5.3  
*Number of Initiations by Type*

*Response Type of the Forest Concept:* There were six possible types of response to initiation. An ANOVA demonstrates a main effect of type of response,  $F(5, 120) = 2.89$ ,  $MSE = 3.21$ ,  $p = 0.017$  (see Figure 5.4) with dyads responding that animals belong to another location most often (see Table 5.1 for means and standard deviation).

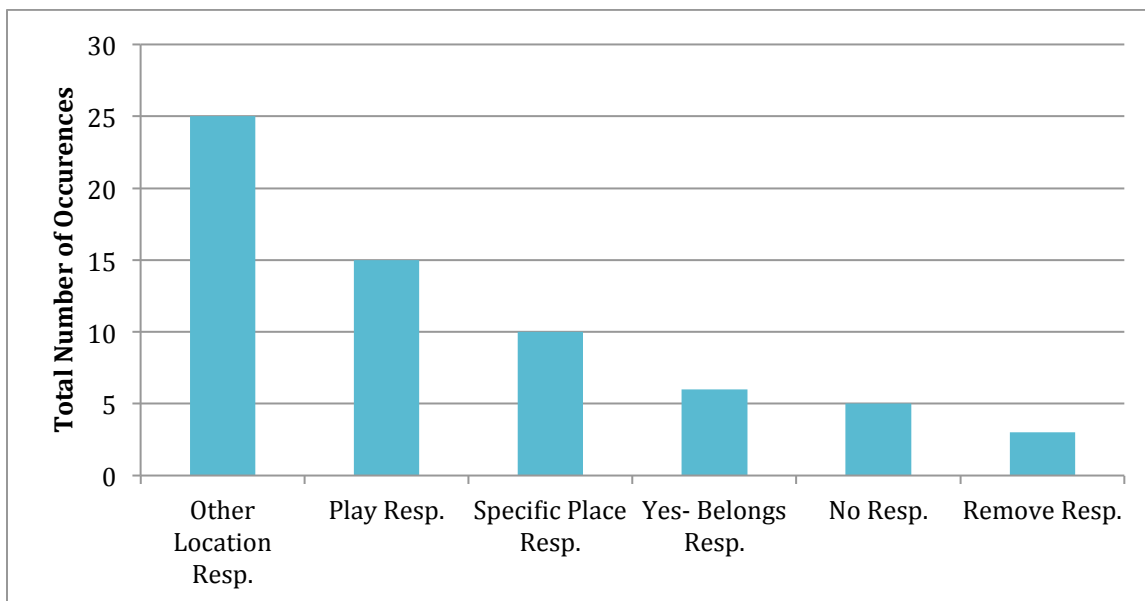


Figure 5.4  
*Total Frequency of Response Type*

Table 5.1  
*Response Type Means and Standard Deviation per Transcript*

| Code                 | Mean | Standard Deviation |
|----------------------|------|--------------------|
| Specific Place Resp. | 0.48 | 0.81               |
| Other Location Resp. | 1.19 | 1.83               |
| Play Resp.           | 0.71 | 1.38               |
| Yes- Belongs Resp.   | 0.29 | 0.56               |
| Remove Resp.         | 0.14 | 0.48               |
| No Response          | 0.24 | 0.44               |

### 5.2.2 Specific Place Relationship Subcode Findings

There were three subcodes for specific relationship. Dyads gave more behavior explanations for their reasoning ( $M = 1.95, SD = 2.11$ ), followed by no explanations ( $M = 1.71, SD = 1.74$ ), and then eating/drinking explanations ( $M = 1.48, SD = 2.02$ ); however, an ANOVA yielded no statistical difference  $F(2, 60) = 0.31, MSE = 1.19, p > .05$  (see Figure 5.5).

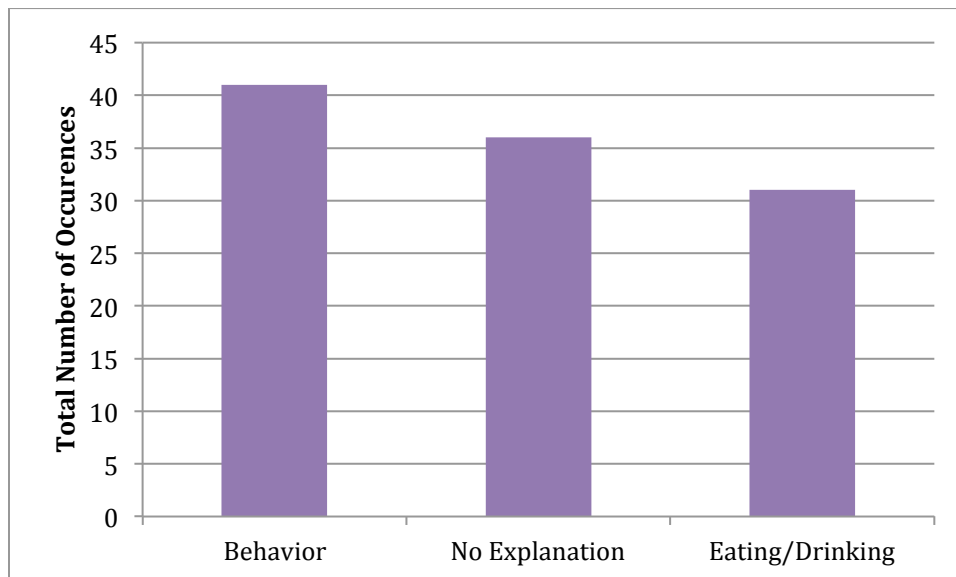


Figure 5.5  
*Total Frequency of Specific Place Relationship Explanations*

### 5.3 DISCURSIVE ANALYSIS

This discursive analysis attended to moments of what Fler (2013) and Zaporozhets (2002) call “flicker” or those instances where parents and children navigate real and imaginary worlds as they work through emotional tension. In this case, I attended to moments when parent and children felt tension between playing realistically and belonging to place. Findings from the discursive analysis demonstrates that Native parents engaged in an extended style of questioning and reasoning that scaffolded making relationships to place while recognizing the disjunct between non-native species in a forest diorama. This occurred over the course of the transcript weaving categorical and analogical reasoning together to scaffold a more complex understanding of a forest system. By utilizing question-asking, a communicative strategy often found in play scenes by participants to frame the boundary of real and imaginary play, parents surfaced children’s thinking and supported deeper conceptual awareness.

For example, consider the excerpt below. All names have been replaced with pseudonyms. See Appendix B for glossary of transcription symbols (Jefferson, 2004).

#### Excerpt 5.1

*Beth and Matthew* 00:04:40

- 1 Beth: Okay, do a:ll the animals live in the fo:rest at the <same time>? Or just two
- 2 of- just a couple of them?
- 3 (.)
- 4 Matthew: Uh::: (.) <this animal ((referring to the cow)) li:ves at the fa::*rm*>
- 5 Beth: >He lives on a fa:rm, right?< (.) Well does he have a pla:ce? in this forest?
- 6 (.) Should we put him in this forest then?
- 7 Matthew: Yeah!
- 8 Beth: °Okay° ((Matthew places on a grassy area of the forest))

We see that Beth asks a prompting question (line 1), asking Matthew to reason about a forest and the animals that make up this concept. Her follow up question on line 2 “Or just a couple of them?” implies that at least a couple of the animals do not live in a forest habitat, scaffolding Matthew to about which animals do not live in a forest. By framing her scaffolds as questions, Beth leaves room for Matthew’s thoughts and reasoning to surface. When Matthew finds an animal that does not live in the forest but rather on the farm, Beth revoices, confirming his answer (line 5). If this were a typical known-answer questioning or an Initiate-Respond-Evaluate (IRE) form of dialogue familiar in Western education settings (Cazden & Beck, 2003; Lemke, 1990; Mehan, 1979; Rogoff, 2003), we would expect the excerpt to end after the first sentence in line 4; however, we see that Beth then extends the conversation by asking whether there is a specific place on *this* forest for the cow. It is clear that Beth is asking Matthew to reason about a forest as a complex system where multiple animals make up a forest (“*just a couple of them?*”) that changes over time (“*at the same time?*”).

A second example further elaborates how affective imaginations shapes constructions of belonging to place. In the following two excerpts a father scaffolds his son towards making relationship with land at multiple levels (conceptual and specific). As Excerpt 5.2 begins, the dyad is setting up. Mikey has already put the eagle next to a coniferous tree and the bear in the center of the diorama in an open, grassy area. Noe is placing deciduous trees around the pond.

#### Excerpt 5.2

*Noe and Mikey 00:00:57 – 00:01:20*

- 1 Mikey: Go:rilla=
- 2 Noe: =Does a gorilla belong? in the forest with the? ((looks at animals on the
- 3 diorama)) with the eagles and the bears?
- 4 Mikey: >No<

- 5 Noe: =No (.) You jus wanna pre:tend? ((Mikey nods head)) (.) >Where does he  
 6 belong?< >Do you know?< (0.2) The gorilla? ((points to gorilla)  
 7 Mikey: <H::e be::longs> (0.2) in the zoo ↑  
 8 Noe: £In the zoo?

A minute later, Noe comes back to the gorilla belonging on the diorama:

### Excerpt 5.3

Noe and Mikey continued 00:02:19 – 00:02:30

- 9 Noe: >Are you g:onna put the gorilla in there? or no< ((Noe glances up from the  
 10 diorama to look at Mikey)) °Or leave him out↓° (.) I took him out justa-  
 11 justa ((shrugs head)) make some room. But go ah:ead >put him in wherever  
 12 you want<. If you °don't wanna leave him out, go ahead.

In this second excerpt the father, Noe, begins similarly to Excerpt 5.2 by questioning whether a gorilla belongs in the conceptual category of forest (line 2). Again, he recognizes that a forest is a complex system in lines 2-3 that contains multiple kinds of animals. It is also important for Noe that Mikey recognize that even if the gorilla does not belong in a forest it belongs somewhere as we see in line 9. Mikey's response that the gorilla belongs in a zoo mirrors a theme found in half of Native children's responses (7 out of 15 Child F.C. Other Resp.) and may reflect familiarity with visiting gorillas at the zoo or through depictions in storybooks. In Excerpt 5.3, Noe revisits the gorilla belonging on the diorama and makes it clear that Mikey has agency to reason about the gorilla's belonging and enact that belonging (where).

The diorama presents a situation in which parents and children are called upon to think simultaneously about a "real" forest and the imaginary play scene that is enacted during the task. In these two excerpts, we see evidence of what Flear (2013) calls *flickering* or the jumping between real and imaginary worlds that helps to promote conceptual development. Noe and Mikey flow between the real world of a forest concept

and the imaginary situation of the gorilla in the North American forest habitat. By lines 16-17 Noe is considering Mikey's emotional tension at leaving the gorilla off the diorama. While this may be seen as an emotional construct of belonging to a group, I suggest this is more than just emotional tension over the gorilla not being played with. In lines 19-20, Noe says "put him in wherever you want" suggesting that at least part of the construct at play here is belonging to place.

Further, Native parents scaffold children not only to consider whether an animal belongs to a place, but to also reason about the function of the relationship (eating/drinking or behavior) based on meeting the needs of the animal. For example, the excerpt of May (mother) and Brandon (son) below are one of seven dyads that do not bring up a forest concept in relation to non-native animals; instead they attend to the particular relationship that zebra has with grass.

Excerpt 5.4

*May and Brandon* 00:01:32 -

- 1 Brandon: Da deer goes in da fo:rest=
- 2 May: =Oh: the deer goes in the fo:rest?
- 3 Brandon: °With da ea:gle°
- 4 May: °Okay°
- 5 (.)
- 6 Brandon: And da ze:bra go he:re ((places zebra on a grassy area in the middle of the diorama))
- 7
- 8 May: Right. >What does the zebra eat?
- 9 Brandon: Uh< (.) trees?
- 10 May: A:nd?
- 11 (0.2) ((May swipes fingers across the grass))
- 12 Brandon: Gras:s. Trees and grass

Lines 1-3 demonstrate that Brandon is recognizing a complex web of relations connecting deer and eagle with the concept of a forest. In other words, the forest concept is the anchor for understanding the relationship between deer and eagle. Notably, in line 6

“forest” is not the anchor for understanding zebra’s relationship to place. While Brandon does not give an explanation of his reasoning, it is still worth noting that his placing of the zebra is realistically plausible for a non-native animal (e.g. he could have put the zebra in the tree). In line 8, May takes a cue from Brandon to make a specific relationship with place and offers a line of reasoning consistent with this frame asking him what zebra eats. She asks him to reason through his frame of belonging-- that an animal could belong to a non-native habitat provided with a near match of the correct food. This is a prevalent theme in the specific relationship excerpts, providing non-native animals with a realistic place to meet their needs of food, drink, or behavior when in a non-native habitat. Washinawatok et al. (in press) found that Native children engaged in perspective taking during playing with animals rather than imposing human actions on them. This analysis provides further evidence that Native families consider the needs and behaviors of animals as they enact play.

## 6. DISCUSSION

### 6.1 SUMMARY OF FINDINGS

This study asked whether and how parent-child dyads engaged in place-based play with non-native animals in a forest diorama. Within place-based play I was interested in whether dyads took up a conceptual frame for play revolving around non-native animals belonging in a forest or whether dyads made specific relationships between animals and land features of the diorama. The major finding of this analysis is that place-based play is a prominent form of play even when animals are non-native to habitat. Additionally, although many dyads engaged in a forest framing, almost all of the

dyads enacted play analogous to realistic animal-place relationships. In other words, dyads attended to micro relationships such as zebras eat grass and gorillas climb trees as a way to satisfy place-based logic.

A discursive analysis demonstrated that parents utilized an emergent pattern of scaffolding that wove together both a forest framing and enactment of specific relationships in order to support a broader concept of ecological relations that included land. Parents modeled toggling between reasoning at the macro (forest) and micro (specific relationships) levels of the system. The ability to toggle between levels of a complex system is considered an expert skill that is necessary for science learning, yet one that is often over looked in science education (Wilensky & Resnik, 1999). This study provides evidence of toggling between systems in the play of the family participants. While the sample was small ( $n = 21$ ) and the findings of this study must be considered with caution before generalizing to all Native families, this study provides evidence that young children can and do engage in complex systems reasoning at multiple levels with appropriate scaffolding.

Another contribution of this study is that affective imagination played a critical role when parents chose to toggle between systems. Fler argues that emotional tension during imaginative play prompts children to engage in problem solving in order to resolve the emotional tension. As evidenced in the excerpts provided in this study, there was emotional tension as to whether non-native animals should be played with on the diorama. This tension was often accompanied by shifts from the macro level of the system (habitat) to the micro. Toggling between levels of a system and flickering in imaginative play could be parallel or interacting cognitive processes.

## 6.2 IMPLICATIONS FOR FUTURE RESEARCH AND PRACTICE

This study provided evidence of culturally dynamic discursive practices and conceptual reasoning that supports complex systems thinking during imaginative play. Expanding this research, future work could untangle how toggling between levels of systems thinking and flickering in imaginative play are conceptually linked. A potentially fruitful analysis to do this work would look at embodied actions during imaginative play, particularly since young children's verbal skills undermine their intellectual abilities. Additionally, future work should characterize the discursive practices that families use to support complex reasoning. This analysis provides some evidence of families' talk, but developing a set of diverse practices would not only reveal culturally nuanced reasoning patterns, but also could be used to support teachers' in early learning settings.

Future research should continue to utilize culturally familiar devices and interaction styles in order to understand children's and families' sense-making about the natural world. Doing so allows children and families to bring their epistemic orientations to scientific endeavors and recognize their own contributions and disrupts a system of imposed deficit frames. Utilizing culturally appropriate research practices requires equitable community engagement in the research process (Bang & Shirin, 2016).

As research with communities becomes more equitable and representative of culturally variable practices and sense making, formal institutions of education should implement curricular materials and interaction styles that supports and deepens dynamic ways of knowing. Young children are capable of engaging in complex systems thinking from multiple levels of analysis. Imaginative play is a promising avenue to support and

deepen this complex thinking, but requires explicit attention to the affective nature of play and learning and to culturally nuanced epistemic practices.

## 7. CONCLUSION

Today, we face a myriad of social and natural challenges that require expansive forms of thinking and problem solving. If our communities are to flourish, we need equitable research practices that recognize and support individual and collective communities' right to self-determination in the face of these crises. Centering equity in our work as researchers, practitioners, and community members means cross-disciplinary collaborations and expansive forms of engagement in research, practice, and policy. This study provides one example of research-community collaboration that expands current conceptualizations of biological thought. It is my hope that this study provides promising pathways for future innovative and equity-centered research and practices.

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## APPENDIX A: CODING SCHEME

| Code Type             | Code                  | Subcode                        | Definition   |
|-----------------------|-----------------------|--------------------------------|--|
| Play Type             | Place-based           |                                | Play talk includes some mention of land features on the diorama (trees, pond, grass etc.) or of a forest   |
|                       | Not place-based       |                                | Play talk does not include mention of land features or a forest  |
| Place-based Reasoning | Forest Concept (F.C.) |                                | There is talk about a forest   |
|                       | F.C.                  | Initiate question              | A question is asked about whether the diorama is a forest or whether an animal belongs in a forest. This could include directly calling the diorama a forest or asking where an animal lives   |
|                       | F.C.                  | Initiate declarative statement | A claim is made that the diorama is a forest and that an animal does or does not belong  |
|                       | F.C.                  | Response specific place        | The animal belongs to a certain location on the diorama (e.g. pond, tree, grass, etc.)   |
|                       | F.C.                  | Response other habitat         | The animal belongs in another location (e.g. zoo, farm). They do not have to name a specific place, but could respond "no" when a parent asks "does the animal belong in the forest" because it implies that it belongs to a different place |
|                       | F.C.                  | Response pretense              | The non-native species can belong on the forest diorama because they are playing or pretending   |
|                       | F.C.                  | Response yes-belong            | Contends that the animal does belong in a forest   |
|                       | F.C.                  | Response remove                | The animal is removed from the diorama   |

|  |                             |   |
|--|-----------------------------|---|
| Specific<br>Place<br>Relationship (S.P.) |                             | There is some talk about an animal belonging to a specific place on the diorama (i.e. grass, trees, pond, etc.)   |
| S.P.                                     | Without explanation         | Talk about a non-native species belonging to a specific place on the diorama but doesn't not give a reasoning why they belong to that place   |
| S.P.                                     | Eating/drinking explanation | Talk about a non-native species belonging to a specific place on the diorama because it eats something from that place. This could also include a prompt in the form of a question from a parent to put an animal where it could eat/drink. |
| S.P.                                     | Animal behavior explanation | Talk about a non-native species belonging to a specific place on the diorama because of something it does in/on that place (e.g. climbs, swims, etc.)   |

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## APPENDIX B: GLOSSARY OF TRANSCRIPTION SYMBOLS (Jefferson, 2004)

|       |   |
|-------|---|
| =     | no break or gap   |
| (.)   | a tenth of a second pause                                       |
| (0.0) | a pause for specified number of seconds (in tenths of a second) |
| —     | stress  |
| ::    | prolonged sound   |
| :—    | intonation  |
| ↑↓    | shifts in pitch   |
| ◦◦    | softer utterance  |
| <     | hurried start   |
| <◇    | slower utterance  |
| ><    | faster utterance  |
| £     | suppressed laughter   |
| (( )) | transcribers description  |