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Culture, Learning, and Development and the Natural World: The Influences of Situative Perspectives

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The study of human learning and development from situative or sociocultural perspectives has had significant impacts on a wide range of scholarship largely driven by the theoretical and methodological focus on understanding the role of *activity systems* in cognition and development. This article first explores how situative perspectives have advanced fundamental knowledge about how culture and race impact learning and development and works to demonstrate how these understandings have enabled new insights into folk-biological cognition. Traditional cognitive, cross-cultural, and situative perspectives with respect to folkbiology are compared and contrasted to demonstrate how situative perspectives enabled more complete understandings of the complexities of biological cognition. These complexities are conceptualized as the conceptual and epistemological ecologies of activity systems. Implications for education are considered.

The study of human learning and development from situative or sociocultural perspectives has had significant impacts on a wide range of scholarship. The expansion of knowledge has been largely driven by the theoretical and methodological focus on understanding the role of *activity systems* in cognition and development, as opposed to focusing on individuals in decontextualized contexts or on mind alone (e.g., Greeno, 1997, 1998; Greeno, Collins, & Resnick, 1996). Activity systems are constituted of subjects in specific contexts; are object oriented, meaning they have an objective or purpose; have discernable configurations or participation structures; employ artifacts, tools, and tool mediation; typically have rules or governing principles that shape interaction; and have some division of roles (e.g., Engeström, 2001). More simply, to explain why and how people think and act in the world the way they do, scholars employing situative perspectives often study and characterize how people in places interact with each other toward goals often utilizing materials to mediate and support their interactions and goals. Situative perspectives have been fruitfully taken up across a broad range of phenomena (e.g., from memory and emotion to decision making and language production to the study of domains) and

have expanded our foundational knowledge of human learning, as well as led to important practice-based innovations in learning environments.

Differences between traditional cognitive perspectives and situative perspectives are often crystallized by an interest in understanding individuals with a focus on internal mental processes in contrast to a focus on individuals in interaction and sense-making in localized activity. Although there are a multitude of influences giving rise to this turn in the field, it has been heavily influenced by neo-Vygotskian scholars, taking up Vygotsky's ideas about the acquisition of higher psychological processes occurring in interaction with others in the life of one's cultural community (e.g., Brown, Collins, & Duguid, 1989; Cole, 1995, 1998; Gonzalez & Amanti, 2005; Goodenow, 1992; Greeno et al., 1996; Gutiérrez & Rogoff, 2003; Lave, Murtaugh, & de la Rocha, 1984; Lee, 2003; Rogoff & Chavajay, 1995; Vygotsky, 1978; Wertsch, 1993). The distinction crystallized when "situative scholars" called into question the adequacy of accounts of individual internal mental processes separated from the activity systems in which things occurred (e.g., Hutchins, 1995). There remains some disagreement about whether research should be seeking to characterize human universals or the diversity of human sense-making (ojalehto & Medin, 2015); however, it is increasingly accepted that what people think and how people think are interdependent and sculpted by the daily

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activities, discursive practices, participation structures, and interactional processes in activity that shape development over the life course (e.g., Greeno, 2011). These dimensions are typically not the dimensions of focus in traditional cognitive research engaged to explain the how, why, and what of human thought.

In this article I focus on the ways in which situative perspectives have expanded the study of human cognition and development specifically with respect to the natural world (often called biological or folkbiological cognition) and explore emerging trends and implications for educational practice. My focus on folkbiology is intertwined with the critical contributions situative perspectives, also called sociocultural perspectives, have made to understanding and studying culture and race. To begin I review the theoretical and methodological advances sociocultural perspectives have made with respect to culture and learning; these are then taken up in subsequent sections focused on folkbiology. Beginning with this is necessary because the situative perspectives I take up in folkbiology are driven by the conceptual progress made in understanding race and culture more broadly.

After this broad review, I then explore how traditional cognitive perspectives and situative perspectives have both diverged from and complemented one another through two groups of studies focused on specific aspects of biological cognition (anthropocentrism and core biological concepts). Through these examples I demonstrate how the situative perspective makes visible dynamics in cognition simply not detectable without the focus on interaction in activity. I then explore a third group of studies conducted from both cognitive and situative perspectives that propose a focus on *conceptual and epistemic ecologies* as a generative direction for future research. Conceptual and epistemic ecologies generally consist of both what and how people think, what is “knowing” and the implications for being and doing in the context of dynamic activity and interaction in cultural practices. From this third group of studies, I argue that the study of biological cognition has been largely driven by Western conceptions of the natural world as opposed to characterizing the conceptual and epistemic ecologies of individuals and communities on their own terms. I suggest that a shift away from intended or unintended privileging of Western perspectives and framings opens up opportunities for significant advances in the field, for example, by expanding our understanding of the possible range of human knowledge organization and reasoning patterns. To begin to explore these opportunities, I focus on a series of studies that attempt to understand how *relational epistemologies* influence knowledge and reasoning, as well as activity configuration about the natural world. I end by considering the implications for educational practice, specifically

teaching and learning focused on the natural world typically located in science classrooms.

SITUATIVE PERSPECTIVES: ADVANCING CONSTRUCTIONS OF CULTURE AND LEARNING

Situative perspectives have advanced understandings of culture and learning both conceptually and methodologically. For example, a key contribution of situative perspectives with respect to culture and race has been the compelling and empirically supported argument for the need to move away from “box models” approaches to culture and race that assign people to discrete categories of culture, race, and ethnicity, among others (Gutiérrez & Rogoff, 2003; Lee, 2003), to a view of culture as dynamic repertoires of practices (Nasir, Rosebery, Warren, & Lee, 2006). From a sociocultural perspective, culture, learning, and development are seen as dynamic, contested, and variably distributed and transformed within and across groups and involve a reciprocal and evolving relationship between individuals’ goals, perspectives, values, and their environment (Cole, 1998; Rogoff, 2002; Hirschfeld, 2002; Lave, 1988; Lave & Wenger, 1991; Nasir & Hand, 2006; Nasir, Rosebery, Warren, & Lee, 2006; Rogoff, 2003). Culture, in this sense, is both historically constituted and dynamically changing through participation in social practices and making sense of life. More simply put, all people explore, narrate, and build knowledge about their worlds, but they do so in varied ways that are dynamically linked to particular contexts. It is important to note that these practices also reflect epistemic and ontological orientations; thus, particular forms of knowing and being in the world are cultivated in activity (e.g., Bang, Warren, Rosebery, & Medin, 2013; Bell, Lewenstein, Shouse, & Feder, 2009; Rogoff & Lave, 1984). In short, culture is brought to life in the unfolding social practices of activity systems, not through assigned stable categorical memberships that are often reflective of dated biological determinism. This complex dynamism of both individuals and variations across communities has rarely been measured, sometimes ignored or even denied, and perhaps more important this occurs without sufficient empirical evidence to support such conclusions. There are also important implications for the ways in which these forms of research may be contributing to problematic and stereotyped notions of race and culture of people and communities.

Race and Culture in Everyday Understandings and Research

Although the critique of the tendency to assign individuals to discrete membership categories of culture and race reflect the sociohistorical evolution of the United States, it is also a widely engaged social organizing practice

globally. Until very recently in the United States, viewing distinct human races as natural (biological real) was considered straightforwardly factual. This largely commonsensical understanding was (and largely still is) mobilized in the design and claims of large bodies of research (e.g., AAA Executive Board, 1998). A significant part of this early research focused on establishing a biological basis for White supremacy, for example, through constructions of intelligence (see Nisbett et al., 2012). However, over the past century, scholarship across disciplines has demonstrated that clear, biologically based categorical distinctions of peoples are not possible in meaningful ways. Increasingly scholars and the general public views race as a social construct that carries socially real consequences (e.g., Lopez, 2000). Thus race, with respect to cognition and development, reflects how people are positioned through processes and practices of racialization in a wide range of social and institutional practices (Nasir, 2011).

However, the recognition of race and culture as social constructs alone is not sufficient in developing robust understandings of human cognition. Sociocultural critiques of “box model” approaches argue that categorical assignments tend to perpetuate problematic and essentialized constructs of peoples. Indeed racial labels often serve as simplified mediators that flatten and narrow the complexity and dynamics shaping peoples’ lives. Therefore, reconceptualizing culture and race from situative perspectives, one that views race and culture as constructed in dynamic activity, carries significant methodological implications. A situative perspective requires relentless critical awareness of the normative assumptions embedded in what is considered “known” about human cognition, as well as how our study designs continue to build on these assumptions. For example, the majority of research subjects are reflective of the racial and economic demographics of psychologists in analogous contexts (schools and labs in and around major research universities) and are often reported as if they are universally relevant. This narrow sampling has constructed a psychology that Heinrich, Heine, and Norenzayan (2010) contended is based on “WEIRD” (western, educated, industrialized, rich, and democratic) people, not a field of study that knows and has studied the diversity of human communities.

Although this tendency is pervasive, there have been some cross-cultural studies that have worked to study the psychology of peoples and communities outside of the mostly White middle-class communities in and around universities. However, many of these studies tend to be focused on minoritized people in WEIRD societies. Until recently, these cross-cultural studies represented a kind of shifting ground between distilling universal processes of human mind (e.g., Cole & Scribner, 1974) and developing sensibilities around diversity. In this broader body of work, there has been a tendency

to characterize differences in the cognitive and developmental pathways of nondominant children, families, and communities through deficit discourses and a reification of Whiteness, or predominantly White U.S. middle-class norms, that are positioned as human universals (Callanan & Waxman, 2013). Perhaps the quintessential example in cognitive science (as well as other fields) are conclusions from cross-cultural studies in which culture is operationalized methodologically or analytically as a racial category ascription (e.g., African American children think X, Native American children think Y). Further, claims about the racial group are frequently compared to a “normative” or control group, wherein the control group is underspecified in equivalent characteristics or is explicitly White. These forms of results often reflect implicit and ongoing assumptions of normativity defined by the White middle class, and they position Western norms and values as natural and right. The detailed difference of descriptions of participants and forms of claims made in research carries cumulative weight for trends and understandings. For example, national policy and program efforts, such as early childhood, are often constructed based on the current state of knowledge with little acknowledgment of the deep gaps in knowledge.

It is important to note that not all cross-cultural work presumes the control group paradigm that perpetuates normativity but rather utilizes such designs to unearth differences across historically defined culturally communities to more fully account for the possible scope of human variation and has and can be incredibly productive in advancing the field of psychology. For example, Barbara Rogoff, with various colleagues, has conducted research focused on children’s attention and participation in work across Indigenous heritage communities in rural and cosmopolitan Mexico and White middle-class communities in the United States (e.g., Alcalá, Rogoff, Mejía-Arauz, Coppens, & Dexter, 2014; Rogoff, 2012, 2014; Rogoff, Paradise, Arauz, Correa-Chávez, & Angelillo, 2003). Often this research suggests that results may have implications for communities that have similar experiences, but these similarities cannot be presumed. What Rogoff and colleagues’ work does do, among other cross-cultural research that works from analogous stances, is to broaden the theoretical territories and understandings of the ways in which specific contexts and activity shape cultural variation of human psychology.

Increasingly there is recognition in psychology that characterizations of people reflected and derived from research have political and experienced consequences for those labeled in scholarship (Kapp, Gillespie-Lynch, Sherman, & Hutman, 2013; Norbury & Sparks, 2013). It will be important for the field to continue to excavate how views of culture and race, whether articulated in discourses of difference or deficit (see Callanan & Waxman, 2013), have largely been derived in geosocial contexts that have

particular racialized histories (i.e., the United States) and may or may not be valid constructs cross-nationally (Medin & Atran, 2004). Indeed some scholars have suggested that a failure to excavate these historicized dynamics from scholarship may prevent the advancement of fundamental knowledge of human cognition (Gutiérrez & Rogoff, 2003; Lee, 2008). Scholars engaged from sociocultural perspectives argue that a key object of study to advance our foundational knowledge should be focused on the constellations, or ecologies, of sense-making practices and processes of interaction that people participate in, particularly in everyday contexts, and the meanings, ideas, problem solving, and forms of social life that emerge in these contexts and across development (e.g., Goodwin, 2013; Nasir, Rosebery, Warren, & Lee, 2006; Vossoughi & Gutiérrez, 2014). This stands in sharp contrast to research that uses the box model approach of categorical membership. To concretize these insights, in the next section I explore how situative perspectives emerged and have contributed to our understandings of human cognition and development about the natural world. Further, I work to uncover some of the ways in which underexamined assumptions reflective of Western perspectives are embedded in the study of biological cognition.

CONSTRUCTING KNOWLEDGE ABOUT THE NATURAL WORLD

Cognitive scientists have long been interested in understanding fundamental concepts related to biological knowledge, also called folkbiology, or knowledge about the natural world. However, there has been significant debate about its ontology, development, and relationships to language, experience, context, and more recently culture. The shifts in formal understandings of culture as made up of constellations of practice, and the complexities of practice as described in the previous section have been a key development in studying folkbiology and the emergent reconceptualizations of knowledge about the natural world. Generally speaking, the study of folkbiological knowledge has suffered from the same methodological problems and narrow samples of human communities discussed in the previous section.

Indeed much of what we know about biological cognition is based on children from middle-class, urban populations typically from WEIRD societies, although not exclusively (e.g., Carey, 1985; Chavajay & Rogoff, 1999, 2002; Coley, 2012; Correa-Chávez, Rogoff & Mejía Arauz, 2005; Gelman & Wellman, 1991; Hatano & Inagaki, 1999; Hirschfeld, 1995; Keil, 1989, 2007; Rogoff, Najafi, & Mejía-Arauz, 2014). Further, developmental trajectories of biological cognition have been conceptualized through a lens of Western epistemic traditions, norms, problems, and more specifically

understandings of the domain of biology (Medin, Waxman, Woodring, & Washinawatok, 2010; ojalahto & Medin, 2015). In this article I explore how traditional cognitive, cross-cultural, and situative perspectives have contributed to our understandings of folkbiology specifically focusing on anthropocentrism, core biological concepts, and orientations to the natural world and their relations to social practices.

Study Group 1: Biological Cognition: Anthropocentrism

A foundational debate in the field of folkbiology has revolved around the ontological status of biological knowledge. Is biology a core domain of human knowledge? In other words, are humans biologically predisposed to make sense of the natural world (e.g., Atran, Medin, & Ross, 2005; Hirschfeld & Gelman, 1995)? Or is the development of biological knowledge a developmental accomplishment and biology a derivative domain emerging from another domain (Carey, 1985)? Although these questions have led to impressive contributions to knowledge of human cognition, both initially located inquiry and findings within cognitivist views—or in the minds of individuals—and paid little serious consideration to context and produced universalist claims derived from narrow populations. Over time, scholars have expanded the approaches to these questions to explore cross-cultural variation and situative perspectives. I trace examples of this trajectory and explore how situative perspectives have expanded knowledge about folkbiology.

Cognitive perspectives on biological cognition: Anthropocentrism. Several veins of research have investigated the proposition that knowledge of the natural world is biologically based and driven by perceptual systems that require minimal experience or triggering conditions—or what can be referred to as core domain of human mind. For example, the biophilia hypothesis proposed by Wilson (1984) claims there is a biologically based, innate need for humans to affiliate with other life and lifelike processes. Stephen Kellert has extensively investigated the biophilia hypothesis and developed nine fundamental dimensions of human beings valuing and affiliating with the natural world (e.g., Kellert, 2002; Kellert & Wilson, 1995). He asserted that these aspects are biologically and evolutionarily based in various ways and are at the core of human learning and behavior with respect to the natural world. Although this body of work has been critiqued in important ways, scholars have proposed what Kahn (1997) called a structural-developmental account of biophilia, meaning an explanation for the development of biophilia that changes organizing structure over time. Kahn's work represents an important investigation of the biophilia hypothesis while opening the space for a developmental account, as well as a

cross-cultural view. However, he and colleagues largely focused on dynamics of anthropocentrism (or as they call it, homocentric terms) and seemed to find relative uniformity cross-culturally. I return to this further along.

In contrast to viewing biology as a core domain, some scholars have argued that biology is a derivative domain. Carey (1985), for example, argued that naïve biology grows out of naïve psychology. In a series of studies, Carey mounted a two-part argument for this claim. First, she argued that although humans may not be prototypical within a biological domain, they are the premier psychological being. She then worked to demonstrate that children's biological reasoning is organized around humans as the prototype, reasoning that if this is the case, it would support the idea that children's biological reasoning is derived from naïve psychology and thus anthropocentrism. As evidence of this argument, Carey reported dramatic developmental changes in inductive reasoning in which children showed strong asymmetries in inductive projections to and from humans. For example, when children were asked to answer inductive questions using pictures as tools, children's inferences from human to dog were stronger than from dog to human (Carey, 1985). These studies demonstrated the ways in which the category of humans functioned to expand or constrain inductive reasoning. Further she reported that older children and adults did not demonstrate these same patterns of asymmetries, and so concluded that anthropocentrism was a developmental stage. Carey's provocative claims stimulated a great deal of research both supportive of and critical of her work.

Cross-cultural perspectives on biological cognition: Anthropocentrism. A remarkable line of work by Hatano and Inagaki proposed that young children begin with a distinctively biological framework theory reflective of their cultural community (Hatano & Inagaki 2000; Inagaki & Hatano 2002). Most significantly they argued and provided convincing supporting evidence that experience mattered in reasoning about the natural world (Inagaki, 1990; Inagaki & Hatano, 2002). In these studies they found that the reasoning of Japanese children living in urban environments with minimal experience with a diversity of biological kinds converged with Carey's findings with respect to anthropocentric reasoning. However, they also found that children who raised goldfish showed a different reasoning pattern—these children reasoned from both the human and goldfish base (thus not manifesting the asymmetrical pattern of reasoning), a pattern similar to the older populations in Carey's studies. The Hatano and Inagaki studies suggested that familiarity or experience with goldfish reorganized children's thinking, thus opening questions about context and forms of expertise.

Stimulated by these questions and ongoing debates, other scholars set out to study the role of culture and expertise in peoples' understanding of biology (Atran & Medin, 2008).

A team of scholars (e.g., Medin, Waxman, Woodring, & Washinawatok, 2010; Waxman, Medin, & Ross 2007) replicated the core (but not exact) design of Carey's studies, but varied the location of study participation to serve as proxies for experiences (urban and rural) and cultural communities (Native Americans and European Americans) in the same proximal locations. These studies replicated Carey's (1985) findings of human-centered reasoning in 4- to 5-year-old urban children but found that neither rural European American children nor rural Native American children demonstrated Carey's markers of anthropocentrism.

These findings seemed to support the experience argument that Hatano and Inagaki presented, but had little bearing on the influence of culture. Interested in understanding the centrality of culture and experience in reasoning about the natural world, Herrmann, Waxman, and Medin (2010) hypothesized that anthropocentrism is a learned cultural model and thus if they studied children at younger ages than previously studied (3 year olds), the asymmetrical pattern might not be there. This study marks a methodological innovation in inductive reasoning, because it gathered comprehensible data for children 1 to 2 years younger than previously collected in research. The researchers used two puppets, which essentially acted out the inductive reasoning task typically done with older children. First, they introduced one biological entity (either a human or a dog), and then researchers characterized the human or dog with a novel biological property. Next, the researchers asked whether this novel property was present in other objects (including humans, nonhuman animals, plants, and artifacts), and each of the puppets took a position. Children were asked to say which puppet they agreed with. Indeed they found that 3-year-old urban children, who have had less exposure to and engagement with anthropocentric models than their 5-year-old counterparts, did not yet favor humans over non-human animals in their reasoning. These scholars concluded that the universalist claims about anthropocentric biological cognition was not a developmental universal but rather a learned cultural model of urban American children reflective of context and participation/exposure to their communities' orientations to the natural world.

Although remarkable work on all fronts, variability in both the goldfish and puppet studies was linearly conceptualized, thus preserving developmental stages and positioning experience and cultural group membership as a mediator of biological cognition rather than the context or activity system in which reasoning unfolds. An implication of these designs presumes that there is stable or persistent mental representations of biological knowledge beyond the experimental context—in short, there was little consideration of how reasoning about the natural world may vary for the same individuals depending upon the interaction and activity in which sense making was occurring. The next section explores studies that aimed to study reasoning about the natural world in everyday contexts during unfolding activity.

An example of situative perspectives on biological cognition: Anthropocentrism. In a recent study (Bang & Marin, 2015) we examined the forms of meaning making about the biological world that urban dwelling Native American families (a caregiver and child) constructed in the context of a walk in a forest. The children were between the ages of 4 and 8. Each walk lasted from 30 min to 1 hr. The families recorded themselves using small wearable cameras (see <http://www.vio-pov.com>). In the first series of studies conducted by Marin, three Native American families were asked to go on multiple (between four and six) walks, and she focused on coordination of attention and mobility (see Marin, 2013).

In our joint work we were interested in studying unfolding interaction but from expanded epistemic and ontological understandings of the natural world. Namely, we recognized that most studies operationalized normative Western assumptions about the natural world. We were interested in understanding how Indigenous conceptions of the natural world were shaping interaction. Our analytical work, relevant for this section of the article, focused especially on ascriptions of agency and intentionality by more than just human actors (I return to issues of epistemology later). We reasoned that the notion that humans are the only agentic actors in the natural world, a view commonsensically held in Western perspectives of the natural world (see Latour, 2012), is itself a kind of anthropocentrism and a learned cultural model, as opposed to a universal truth. We hypothesized that Western perspectives of the natural world tend to structure human asymmetries, similar to the kind Carey found about reasoning about the behaviors of biological kinds, with respect to agency and intentionality of non-human biological entities. Our intent in this study was not to debate the truth claims of a particular knowledge system but rather, utilizing the lessons learned about race and culture from situative perspectives, to characterize cross-cultural differences in reasoning on their own terms rather than in comparison to what is considered accurate in Western normative model. In short, whether entities other than humans are agentic and act with conscious intentionality is not the point of our inquiry—peoples' beliefs about such matters and its impacts on sense making is. An important and distinct overall finding in our study with respect to anthropocentrism and the cross-cultural studies previously discussed (enabled by situative perspectives) was the rapid shifts between cultural models and orientations to the natural world that unfolded in activity even within the same individuals.

I highlight this research to demonstrate that studying interactions in activity made visible the multiplicity of orientations to the natural world, carrying implications for how we might understand peoples' conceptual and epistemic ecologies. In the example shared here, two different orientations were present. One orientation showed the presence of typically Western anthropocentrism (if part of

anthropocentrism presumes that only humans are agentic communicators) and a second orientation that reflected an expanded notion of agency and communication, specifically named part of Anishinabe orientation to the natural world by the participants. The following excerpt is from one forest walk that involved a mom, Jackie, and her two sons, Jeremy (6.5 years old) and Samuel (4 years old). Immediately before this excerpt the family had found a dead tree and Samuel was enamored with it. He began to step toward the tree, and Jeremy warned him against it because he saw glowing eyes. After several exchanges the boys decided to investigate the dead tree. In the following exchange, Bang and Marin (2015) focused on Jackie's initial reaction that seems to reject Samuel's assumption that he could communicate with the animal in the tree (line 4). This assumption we concluded is most closely aligned with a Western perspective. This is followed by a rapid reorientation to Samuel's assumption (line 8–10) that supports his attempt to communicate across species—a notably different proposition!

1. Jeremy: We should first check with the stick. Something came out, maybe.
2. Don't get to, that close
3. Samuel: Hello? Hello?
4. Jackie: When you say that, do you think something's going to answer
5. you? ((laughter))
6. Jeremy: Nothing's in there, guess I was wrong. Maybe, it just a illusion,
7. that I was seeing.
8. Jackie: Some people say that like animals, they a, they'll understand, like
9. um, if you speak in Anishinabe, so maybe you should be saying
10. "boozhoo"
11. Jeremy: Boozhoo?
12. Jackie: Mm hm

Although there are many interesting things to note in this interaction (for more elaborate analysis, see Bang & Marin, 2015), for present purposes it is important to recognize that neither the cognitive perspective nor the cross-cultural perspective alone would likely have sufficiently accounted for the kind of biological sense making occurring here. This is partly because both perspectives tend to operationalize variable box models that manifest an assumption that individuals have singular models or concepts about the biological world and thus would have glossed the richness and complexity occurring in this short interaction. Although it is possible we could have found an overall propensity for one or the other model of more-than-human agency in reasoning by these participants using other methods, this study opened more complex and nuanced understandings of anthropocentrism and cross-cultural models of the natural

world. These findings have relevance not only for foundational understanding of human cognition and development but also for how these understandings dynamically shift—or not—over time and place. In the next section I continue to explore these issues in the context of studies of core biological concepts.

Study Group 2: Biological Cognition: Core Concepts

In response to Carey's and others' influential findings, some scholars have taken up the study of core biological concepts as a way to deepen understandings of folkbiology. These researchers sought to discover what foundational concepts about the natural world people had across development. Concepts of interest ranged from what kinds of basic ideas children and adults held about what is an animal or what is alive and what growth means (e.g., see Hickling & Gelman, 1995; Hirschfeld & Gelman, 1994). Some of these studies aimed to further specify the developmental trajectory of concept development and were agnostic with respect to the ontological debate (whether biological knowledge was foundational or a derivative domain). Still others pursued alternative theoretical orientations to the ontological debate utilizing cross-cultural studies. Studies that explored the influence of language and experience on biological knowledge and reasoning have been especially important with respect to core biological concepts and are reflective of the shifts associated with situative perspectives.

Significant research has demonstrated that language practices shape the formation of conceptual understandings of biology (e.g., Echols & Marti, 2004; Waxman & Booth, 2001; Waxman & Lidz, 2006). A line of cognitive research has produced substantial evidence supporting the claim that children understand the concept of ANIMAL early in development (e.g., Pascalis, de Haan, & Nelson, 2002; Johnson, Slaughter, & Carey, 1998) and that children are exposed to naming practices of biological entities that support the development of biological concepts (Gelman, 2003; Graham, Kilbreath, & Welder, 2004; Waxman & Markow, 1995). However, there is an important complicating factor in this line of research that points to the value of situative perspectives: The noun *animal* is polysemous, that is, the concept *animal* can have multiple meanings (Anggoro, Medin, & Waxman, 2010a). Medin, Lee, and Bang (2014), exploring this issue from a cross-cultural view, using language as a proxy, explained that for speakers of English, "*animal* can refer either to an inclusive concept, including all animate beings (as in "Animals have babies"), or it can refer to a more restricted concept that includes nonhuman animals but excludes humans (as in "Don't eat like an animal"). Ultimately in their discussion, they argue that although the polysemous use of *animal* is endemic in English-speaking communities, the context or activity in which *animal* is used shapes the intending meanings and may have cross-cultural variability even within English

speakers (Anggoro, Medin, & Waxman, 2010b). Although they may not have positioned the study as such, I suggest their findings and discussion are reflective of situative perspectives. Although there is certainly a wider range of research demonstrating the impacts of language on conceptual development than mentioned here, the work highlighted succinctly demonstrates how social practices in activity (of which language is a part) shape the meaning of core biological concepts and the conceptual development of children.

Utilizing situative perspectives, I conducted a study designed to contribute to understanding the conceptual and epistemic ecologies of peoples' understanding of the natural world. Similar to the studies that worked to expand our understandings of agency and intentionality of biological identities beyond humans, this study aimed to excavate privileged Western perspectives with respect to core concepts. I investigated the core biological concepts of ALIVE with urban and rural Native American middle school students (Bang, 2009). Further, I was interested in exploring how activity shapes meaning, as well as how participation and interaction with different cultural communities might consciously shift meanings of core biological concepts. I hypothesized that Native children knew both typically Western scientific meanings of ALIVE and concepts of ALIVE that reflected their Native communities in which rocks, water, and other kinds identified by Western science as "natural inanimates" are alive. Students were given a set of 16 cards with pictures of animals, plants, artifacts, and "natural kinds"¹ (sun, water, rocks, sky/clouds). Students were asked to group the cards into piles according to two prompts. One prompt asked students to group the cards according to whether an elder would say they were alive. The other prompt asked students to group the cards according to whether a science teacher would say they are alive. Prompts were counterbalanced. The prompts were intended to prime a school-based context and a home or cultural community context. Results indicated that youth perceived there to be different meanings of ALIVE for each context/person reflected in the prompt. The key distinction was youths' perceptions that elders from their own communities thought the sun, water, rocks and sky were alive and that science teachers did not. The language studies focused on ANIMAL and the cross-cultural ALIVE study demonstrates that context shapes meanings of biological concepts and that individuals can readily hold a multiplicity of meanings about the biological world as opposed to singular stable understandings—a further example of the power of situative perspectives.

However, there are some critical shortcomings of this research with respect to studying human understandings of the natural world beyond Western normative constructs.

¹Note that the use of natural kinds reflects a privileging of Western biology.

Whereas the ALIVE study demonstrated cross-cultural variation in meanings of alive, its design and findings left intact unexamined western taxonomic notions of “living” and “nonliving.” In short, the design of the study tells us little about how variations in meanings of “alive” affect reasoning about the natural world. I take this up in the next section.

TOWARD A DIVERSITY OF HUMAN UNDERSTANDINGS OF THE NATURAL WORLD

In a recent review of culture and concepts, akin to the Heinrich et al. (2010) WEIRD study, ojalehto and Medin (2015) argued that psychological research and theory has largely been conducted with Western samples and reflects Western norms and problems (see also Medin, Waxman, Woodring, & Washinawatok, 2010). In this section of the article I focus on two extensions to these points. First, I suggest that a diversity of perspectives, meaning a diversity of orientations and ways of knowing, or epistemologies, may formulate new or revised starting points for theory and methods (Medin & Bang, 2014). Second, I argue that taken-for-granted domain divisions may be more reflective of researchers’ worldviews or specific cultural communities’ knowledge organization than of universals (Bang, 2009; ojalehto & Medin, 2015). ojalehto and Medin specifically explored the ideas of folk ecology and folk sociology as alternative domains of focus (as distinct from folkbiology and folk psychology) and linked these differences to potential differences in epistemological orientations, specifically relational epistemologies (see Bang, 2009). The explicit pointing to relational epistemologies is critical and underscores the power of situative perspectives because they are suggesting that knowledge making—even for expert researchers—is situative. That is, knowledge making is shaped by activity systems, the kinds of interactions that occur and meanings that are made.

Toward Situated Perspectives of Epistemology

Much of the educational and psychological literature on epistemology has focused on explicit and stable personal epistemology (e.g., Carey & Smith, 1993; Kitchener & King, 1981; Kuhn, Amsel, & O’Loughlin, 1988; Perry, 1970) and has tended to study broad, usually domain-general epistemological development (e.g., Hofer & Pintrich, 1997; Schommer & Walker, 1995). However, some researchers have challenged these ideas by demonstrating the inconsistencies of students’ personal epistemologies across domains (Hofer, 2000). For example, this work suggests that it is reasonable to expect that students’ epistemological beliefs for the domain of biology might be different from the domain of math or art (Hofer, 2000; Stodolsky, Salk, & Glaessner 1991). Other work has shown that individuals’ epistemological beliefs are not necessarily

consistent across contexts in a given domain (Leach, Millar, Ryder, & Séré, 2000; Louca, Elby, Hammer, & Kagey, 2004; Sandoval & Morrison, 2003; Songer & Linn, 1991). For example, like the ALIVE study, individuals may align with a particular epistemological belief about biology while they are in the classroom or at the doctor’s office but may articulate an entirely different epistemological belief in the context of family or work.

A situative perspective on epistemology is one way to synthesize these findings. If we are to meaningfully understand student epistemologies and their development, we must study them in socially situated practices (Roth & Roychoudhury, 1994). In my own work I have explicitly sought to understand the interplay between epistemology and conceptual understanding in the context of activity systems. In this work epistemology is not seen as in an abstract philosophical sense but rather conceived as being embedded, carried, and brought to life in peoples’ socially situated everyday practices. In this sense peoples’ epistemologies are often implicitly reflected in their words, actions, and interactions with others in specific times and places (Bang, 2009). Indeed, Goodwin (2013) explores the ways in which ensembles of practice shape epistemic activities. He suggests that

distributions of knowledge are not only built into the basic structure of many forms of human action, but change in ways that are consequential as action unfolds (Goodwin, 1979, 1980; Heritgage, 2012). Forms of knowing within the organization of human action are thus organized as a dynamic ecology. (p. 19)

Goodwin argues that a central aim of cultures and distinctive ways of knowing is apprenticing new participants to become competent and consequential actors into dynamic cultural ecologies. More specifically, I suggest that what counts as consequential action (mental or physical action) is critically shaped by local conceptual and epistemic ecologies—that is both the what and how of thought in the context of dynamic activity. Of importance, as scholars increasingly take up the study of assemblages and unfoldings of activity we must simultaneously recognize the ways in which Western norms quietly and not so quietly shape the work—both theoretically and methodologically. As a field, and situative perspectives can help us, we need to work toward new theoretical positions and research designs that can adequately understand and characterize the conceptual and epistemic ecologies of individuals and communities as they are, not through an imposed Western lens. In my own efforts and partnerships with colleagues toward more expansive views of learning and development, we have utilized the notion of relational epistemologies and their impact on knowledge, reasoning, and activity in and about the natural world.

Relational Epistemologies

Relational epistemologies with respect to the natural world constitute a paradigm shift of sorts from viewing the natural world as natural resource ripe for human-entitled resource extraction to (a) an explicit attention to and valuing of the interdependencies among the natural world, that is, all things are connected (e.g., Cajete, 1999; Deloria, 1999; Kawagley, 1995); (b) frameworks for reasoning and problem solving in terms of ecological, reciprocal, and correlational relations; (c) a focus on whole organisms and systems at the macroscopic level of human perception (also a signature of complex-systems theory; Pierotti, 2011, pp. 72–73); and (d) seeing nonhumans as agentic and having personhood (e.g., Cajete, 1999; Kawagley, 1995). In the domain of biology more specifically, it has meant the conceptualization of the relationships between humans, other organisms, and the environment (and all the complexities of each). Historically, there have been sharp divides between natural and cultural worlds, what some scholars have called the nature–culture boundary (e.g., Latour, 2012). Indeed, relations, or perhaps perceived nonrelations, between the natural world and cultural worlds arguably ground much of human activity and figure centrally in core ontological and epistemological frameworks across social and scientific domains (e.g., cultural anthropology, philosophy of science, indigenous ecology, and critical epistemology; Bang et al., 2013). In my work I am interested in how the situated nature of activity shapes the conceptual and epistemological ecologies of meaning-making (Goodwin, 2013), specifically around nature and culture—or what I call nature–culture relations.

Constructing Nature–Culture Relations and Models of the Natural World

Not only have nature–culture relations varied across disciplines, but different cultural communities have also developed different ideas, practices, and characterizations of nature–culture relations that reflect and influence understandings and models of the natural world. For children, figuring out the multiplicity of relations between humans and nonhuman animals depends largely on the kinds of relations their own community entertains with the nonhuman world (Medin, ojalehto, Marin, & Bang, 2013; ojalehto, Waxman, & Medin, 2013). Situative approaches have begun to explore how young children are educated into different sets of relations with the natural world through the values and activities of their communities and what forms children are exposed to and included in (e.g., Bang, Medin, & Atran, 2007; Rogoff, 2014).

Nature–Culture Relations in Practices: An Example

To begin to explore the ways in which activity systems are dynamically shaping nature–culture relations and

meaning making about the biological world, I, with Douglas Medin, studied descriptions and frequencies of 30 outdoor practices through surveys, clinical and narrative interviews, and observations with 65 individuals from three cultural communities—rural Native American (specifically Menominee), rural European American, and Urban Native American—across three age cohorts (child, adult, and elder). The study focused on understanding the perceived variation in activity systems and their correlations with knowledge and reasoning about the natural world in participant descriptions. In short, these methodologies helped us work toward engaging situative, cross-cultural, and more traditional cognitive perspectives.

We were particularly interested in studying the role and position of the natural world and the orientation and engagement with nonhuman living things in everyday practices. Like the forest walk study, we hypothesized that there would be patterned differences in conceptions of other-than-human agency and intentionality that would have predictable manifestations in the shape of their activity in nature. More specifically, we hypothesized that peoples who reflected conceptions of agency that applied to more than human entities in the natural world would be more likely to engage in practices/activity systems that foregrounded nature and have more than humans as central actors in activity. Conversely, we predicted that people who did not hold this view of agency would background nature and be less likely to have more than humans as central actors in activities. We conducted both quantitative and qualitative analyses on the survey and interview data. We did not expect these findings to hold for all peoples, because they were reported by historically defined cultural communities. Further, as I demonstrate, there is important variability both within and across communities.

Findings supported these hypotheses (see Bang, 2009; Bang, Medin, & Atran 2007). Native parents and children reported engaging significantly more frequently in outdoor practices that foregrounded nature (e.g., berry picking, forest walks), whereas European Americans engaged significantly more in practices that backgrounded nature (e.g., snowmobiling, playing sports). More specifically, backgrounded practices used nature as a backdrop, and no nonhuman had a primary interactive role in the practice. Foregrounded practices were dependent on some entity in the natural world (e.g., fish in the practice of fishing), and it was a primary contributor or actor in the practice. There were no significant differences in the types of practice urban and rural Native people engaged in. There were some differences in the frequency of engagement between rural and urban-dwelling people, though not across all practices. A second round of analysis focused on both the activity structure and the conceptual ecology of biological knowledge reflected in the narratives of specific practices. This analysis was intended to understand how attending to the

range of configurations of the same practice might affect the conceptual and epistemic ecologies reported. Specifically I focused on attentional habits and the range of content participants described and enacted in the interviews and think alouds (Bang, 2009). To illustrate this variability I focus on one practice.

The Case of the Practice of Fishing

During clinical interviews in the study just presented, all 65 participants were specifically asked about the practice of fishing. This was done to ensure that we had at least one practice described by all participants. The descriptions of fishing were analyzed to characterize the conceptual and epistemological ecologies reflected by participants. Although we employed grounded techniques for some of the analysis, there were important a priori dimensions that focused on discerning the activity structure (e.g., fishing locations, tools used—fly, rod, spear, net), the biological content (kinds, behaviors, and relations), and epistemic orientations. Four forms of relations between biological kinds emerged as robust themes: ecological, functional, causal, and human-nature relations. The epistemic analysis was focused on understanding the ways in which ecological and relational constructions occurred with a specific focus on humans and nature.

The study found significant differences in activity structures and the conceptual and epistemological ecologies participants reflected. As an example there was a correlation between the location and related structure of the practice (e.g., the shore of a river or in a boat on a lake) and the scope of biological knowledge and forms mentioned in the fishing narratives (e.g., participants who fished on the shore of a river mentioned more animals and plants; Bang, 2009). However, the grounded analysis was very important because the nature of activity structure described by participants, especially Native participants, was importantly nuanced. In the following excerpt, a Menominee adult participant, Chris, explained that when and how one fishes “depends upon how you look at it.”

It depends on how you look at it. If you want to preserve them, like the trout, they spawn at a certain time of the year, and that's when you don't want to fish, because you're just gonna deplete the population, but if you want to catch fish, you gotta know, like fly fishing, you gotta know when the hatch is on, what fly to use, when you can use worms, when's the best time for a spinner, stuff like that.

In this short statement, Chris demonstrated the intertwining of activity structure (seasonal timing) and the tools used (fly fishing or hook and worm) with biological knowledge and was framed by human-nature relations (“if you want to preserve them”). This points to an important finding across these interviews with respect to ecological and relational epistemological orientations. Native

participants consistently enacted narrative forms in which biological entities (as well as water) were in relations and systematically connected. Non-Native people predominantly attended to single dimensions in their narratives; for example, they would focus on one type of fish and what bait worked to catch it. However, there was an important exception that emerged. We found that when the activity structures of the European American participant most closely aligned with the activity structure of Native people, the cross-cultural difference in the scope of biological knowledge communicated was no longer significant—in short, European Americans who fished on the river shore attended to a wider variety of biological kinds than did their counterparts who fished from a boat on a lake. However some of the epistemic differences across cultural community remained, especially with respect to human-nature relations (Bang, 2009). For example, a Native person from Chicago, Sarah, explained that she learned important things while she was fishing as a child:

We couldn't throw nothing like that [garbage, coffee, etc.] in the water. We learned that there's life in the water. You can't dirty the water because they live there. And that we depend on the water to drink. And the earth needs the water to drink also . . . so when you go fishing, when you're near the water, you have to be really respectful.

In this brief utterance Sarah has articulated a set of interrelations between water, broadly what lives in the water, fish, peoples, and the earth that frame the activity of fishing. In this expression she, similar to interviewees across cultural communities, attended to how the fisherperson's presence or actions affected or could affect fish—a focus on causal relationships between humans and nonhumans. In short, the participation in fishing facilitated specific human-nature relations and what can be called possible human identities with respect to the natural world. To return to previous ideas about anthropocentrism, we found important distinctions in these human-nature relations also reflected in the previous utterance. Although Sarah narrates human-nature relations, she explicitly positions humans in respectful deference to water and other forms of life. She focused on not hurting the life that lives in the water first and then why it is important for people (we drink the water). Across the broad range of practices studied, Native participants' descriptions consistently intertwined meanings, identity, and specific forms of nature-culture relations that were facilitated or shaped in and by the focal activity.

These findings suggested that understanding the role of activity as a variety of grain sizes is critical to understanding the possible scope of biological knowledge, practices of knowledge construction, and meaning making, as well as the ways in which identities are intertwined with knowledge and knowing. Although there is still work to be done, these findings underscore how the situated nature of activity

shapes the conceptual and epistemological ecologies of meaning making (Goodwin, 2013).

IMPLICATIONS FOR SCIENCE LEARNING

There are important differences in the scope, organization, and nature of biological knowledge across cultural communities, and these are important in relation to forms of biological knowledge in school science. The ascription of agency to nonhumans is a form of discourse that is largely outside the bounds of allowable sense making in science learning (Bang et al., 2013). However, that does not change the reality that at least for those who ascribe agency to entities other than humans, school practices as they predominantly exist now will routinely demand epistemic navigation, that is, students will have to understand that their teachers expect them to think and engage by different criteria than their families and communities. Understanding the ways in which children navigate across these different epistemological expectations is increasingly helping to construct better learning environments that support their navigation and utilize the resources constructed in community contexts to enhance students' school learning (see Bell et al., 2009).

Although these sorts of ideas around agency of entities other-than-humans are routinely dismissed in schooling contexts, many practicing expert scientists talk about biological entities or natural kinds in agentic ways. In *A Feeling for the Organism* (Keller, 1984), about the life and work of geneticist and Nobel Prize winner Barbara McClintock, we learn that her ability to do her work stemmed from her forms of relations: "Over and over again, she tells us one must have the time to look, the patience to 'hear what the material has to say to you,' the openness to 'let it come to you.' Above all, one must have a 'feeling for the organism'" (p. 206). "You need to have a feeling for every individual plant. No two plants are exactly alike. They're all different, and as a consequence you have to know that difference," she explains. "I start with the seedling, and I don't want to leave it. So I know every plant in the field. I know them intimately, and I find great pleasure to know them" (p. 271).

The point here is not necessarily that expert scientists think of plants as having consciousness (although recent discoveries demonstrate that plants do have selective communicative functions beyond what people imagined even a decade ago; see Kim, LeBlanc, Wafula, & Westwood, 2014; Kim & Westwood, 2015) but rather that the way that they engage with, talk about, and do good science rests on nature-culture relations that have more imaginative agentic qualities than is often taken seriously in school settings (e.g., Warren & Rosebery, 2011). The kinds of imaginative shifts under way in the physical sciences further point to

the necessity of rethinking the bounds of study in human learning.

Learning scientists are increasingly accepting that even as expertise develops, intuitive notions, or knowledge developed in our everyday lives, about the way the world works do not seem to disappear (Sherin, 2006). Rather, intuitive notions become critical aspects of sophisticated problem solving and serve as a kind of heuristic for students to move from and between standard academic explanations and multiplicities of discourses, at minimum including home and professional or work-related discourses. However, it is not always explicit in this work that "intuitive notions" are ideas that are formed in specific contexts, or are situated understandings, and that they continue to shape new situated meanings. Opening learning environments to the epistemic heterogeneity of learners and nurturing the intellectual resources that develop in children's everyday lives may be generative and motivating in ways that most school environments have yet even to imagine, especially for children from nondominant communities who engage in nature relations beyond those traditionally included in Western normative forms (e.g., Bang et al., 2013; Warren & Rosebery, 2011).

The next-generation science standards have done important work in making human-nature relations explicit, for example, through core disciplinary ideas like humans and biodiversity in the life sciences or human impacts on earth systems in earth and space science. However, in a cursory review, the forms of these relations tend to privilege Western normative constructs of human-nature relations broadly. As socioecological impacts and resultant challenges continue to mount, or have already transformed whole societies like Tuvalu or the homelands of Native Alaskans living in the Arctic (see Krupnic & Jolly, 2002; Wildcat, 2013), understanding anthropogenic impacts on earth systems is critical. However, these same socio- and technoscientific challenges of our time also call for cultivating thinking and practice beyond anthropocentric activity and understanding (McLean, 2009) in order to reimagine and understand possible nature-culture relations toward socially and sustainably just futures. Ironically these massive issues are increasingly manifesting in locally specific-situated-ways bringing new challenges to science, policy making, community development, and community infrastructure, among other dimensions. The resiliency and innovations that are demanded of us require far better understandings of the situated and cultural nature of activity.

In this article I have argued that situative perspectives have enabled significant advances in understanding culture, learning, and development broadly by focusing on the ways in which people in all communities explore, narrate, and build knowledge about their worlds. They do so not solely in their minds but also in varied ways that are dynamically and inextricably connected to particular contexts and

interactions. Of importance, I have not argued that traditional cognitive perspectives or cross-cultural perspective are unimportant; rather, I have argued they are incomplete and can, without critical awareness, replicate ideational artifacts that perpetuate inaccurate and problematic ways of thinking about culture and race. The foundational insights into human learning emergent from situative perspectives have allowed for more sophisticated and nuanced engagement with specific domains of interest, and in this case the natural world or folkbiology. Further, I have suggested that situative perspectives enabled more complete understandings of the complexities of biological cognition by demonstrating how variation in knowing across cultural communities, as well as across contexts for the same individuals, are a routine aspect of knowing. I highlight how the scope of knowledge is sculpted by the activity structures in which people engage, as well as the relationships and perspectives about actors in those activity systems. I have suggested that these dimensions constitute the conceptual and epistemological ecologies of activity systems. The variability of knowing about the natural world made visible through situative perspectives raises questions and intriguing possibilities about how the study of conceptual and epistemic ecologies of activity systems may be critical in expanding our knowledge and developing educational practices for the 21st century and beyond.

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