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# Culture and Epistemologies: Putting Culture back into the Ecosystem

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Abstract. This chapter reviews a body of research on cultural differences in framework theories for engaging with nature, focusing primary on Indigenous American and European-American comparisons. Native-American samples reveal a pattern of converging observations that point to a relational epistemological orientation and a propensity for systems level thinking. In contrast, Non-Native samples show observations suggesting that humans are conceptualized as more psychologically distant from the rest of nature. Correlated with distance is a tendency for a taxonomic rather than an ecological orientation. We also suggest that the way that researchers think about and study culture may reflect their own cultural practices and we propose a more ecological analysis of culture itself.

Key Words: Folkbiology, Folkpsychology, Folkecology, Relational Epistemology, Native-American, Systems Level Thinking, Cultural Practices

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## I. INTRODUCTION

In any analysis of culture and cognition, one might expect an answer to the question, “What (or where) is culture?” This question dances between traditional disciplinary boundaries. Cognitive psychologists tend to think of culture as strictly in people’s heads and don’t usually pay much attention to the environment, artifacts, or even other people. Conversely many anthropologists appear to equate culture with everything *but* what is in the minds of individuals.

We hope to offer another perspective on the culture question. Our work has led us to navigate complex but consistent patterns of results by taking an “ecosystems approach,” one that focuses on systemic interactions between ideas, artifacts, and the social and ecological environments that comprise what we might call ‘cultural ecosystems.’ Critically, these cultural elements co-develop and may reinforce one another in ways that make it hard and perhaps even irrelevant to give explanatory priority to any single factor or dimension.

To begin, we tentatively define culture as the knowledge, values, beliefs, and practices among a group of people, usually living in geographical proximity, who share a history, a language, and cultural identification. Importantly, we view knowledge, values, and beliefs as causally-distributed patterns of mental representations, their public expressions, and the resultant behaviors in given ecological contexts. People's mental representations interact with other people's mental representations to the extent that those representations can be transmitted in public practices (language, dance, signs, artifacts, etc.). These public representations, in turn, are constrained by ecological features of the environments, as well as interactions between and among individuals (Atran and Medin, 2008). It is also important to emphasize that ideas, or mental representations of them, do not circulate in a vacuum--ideas are contextually-embedded. This context may include framework theories, notions about what is worthy of attention and in need of explanation, that are so basic and so much part of our backgrounds that we are normally unaware of them.

Studying ecosystems naturally places a scientific focus on systemic patterns and dynamics expressed in ecologies; it would be odd indeed to concentrate efforts on some "mainstream" species typifying that ecology. In our own research on culture we are almost never focused on what or how the average person of some cultural group thinks. Instead we are interested in within culture dynamics, whether or not they describe a consensus. Our aim is to identify different frameworks or ways of thinking that may be correlated with cultural memberships and contexts. Methodologically speaking, one way we have done this is to triangulate data across different types of studies (i.e., basic cognitive research, research of everyday practices and design-based research). On this view a given culture may provide more fertile ground for some sets of ideas than for other sets of ideas (and different cultures have different soil characteristics). For example, it may be important to understand anthropocentric frameworks and to ask when and why particular cultures utilize this framework, rather than identifying (and possibly essentializing) frameworks as characterizing particular cultures. In this sense, we are more concerned with what cultures a framework has than what framework(s) a culture has.

One reason to think carefully about culture is that definitions of culture affect how researchers go about studying phenomena. If the study of culture is conceptualized as identifying shared norms and values, it is natural to assume that individuals become part of a culture through a process of socialization, sometimes called enculturation. It also means that once you

have identified a consensus on these norms and values you don't need to keep asking about it, any more than if you ask five people what day it is and all five agree. Perhaps most seriously, minority voices are discarded as noise.

If instead culture is seen as dynamic, contested, and variably distributed within and across groups, it is natural to see cultural learning as involving a reciprocal relationship between individuals' goals, perspectives, abilities, and values, and their environment (Hirschfeld, 2002; Nasir et. al., 2006). On this view, socialization partially depends on agents or others who are caregivers as well as an individual's interpretation of and reaction to their environment. In addition, the task of a researcher goes beyond determining the consensus and may include tracking down within-culture sources and subclusters of variability in values, practices, and the like.

By suggesting that cultures are like ecosystems, we undermine the tendency to essentialize cultures and encourage attention to within-culture relationships. This analogy also encourages attention to system level dynamics rather than focusing on components in isolation. We have capitalized on the ecosystems approach in our research among Indigenous communities.

Overview. In this chapter, we review findings on several cognitive orientations that are major elements of what we see as a "relational epistemology." Again, the question is not what cultures have or how they are defined by a particular relational epistemology, but when, where, and why this framework is implicitly or explicitly expressed and by what cultures. We bring these elements together in broader cultural perspective in our conclusion.

The emerging picture on cultural differences in epistemological orientations is based on our research conducted in partnership with Indigenous communities in Chicago, Wisconsin and Panama. We will describe a wide range of converging observations involving four central markers of relational epistemologies: 1. perspective-taking, including taking the perspective of nonhuman entities, 2. sensitivity to ecological relations, 3. non-taxonomic conceptual organization, and 4. attention to context and relations linked to it. These markers support viewing nature as an interconnected system and interacting with it. We will also describe contrasting data from non-Indigenous samples that afford an alternative orientation for conceptualizing nature and the place of humans in it. As we will see, these also use these differences are extensive and have far reaching implications.

## II. STUDY SAMPLES AND METHODOLOGICAL ISSUES

### A. PARTNERSHIPS AND RESEARCH SITES

When considering research populations, it is common to say that one has to start somewhere, implying that a single locus is a logical necessity. One person can't be two places at once but a research team can. Further, by virtue of research partnerships and reflectively developing research tools and methods simultaneously in multiple contexts, one can go a long ways towards limiting the asymmetries that seem endemic to cultural research.

*1. Partnerships.*

Over the past decade, we have been fortunate to establish research partnerships with Native American institutions for our work conducted on the Menominee reservation in Wisconsin and in Chicago. For example, our research grants have involved Northwestern University, the American Indian Center of Chicago and various institutions associated with the Menominee Tribe of Wisconsin and on the Menominee reservation. It is to the credit of the National Science Foundation that these partnerships do not involve subcontracts from Northwestern University to tribal institutions but rather parallel budgets with a Principal Investigator at each site. Further, our projects have supported students from these communities in developing research skills and in pursuing degrees. Our goal has been to increase research capacities of organizations and communities in a range of ways.

We are also developing a partnership with an indigenous Ngöbe community in Panama. When our research in Panama began three years ago, we focused on obtaining community consent and ensuring informed participation. Now we are moving towards community-based design and implementation of research. We regularly share research findings, solicit interpretations, present ideas for feedback, and work to generate questions of mutual interest with the community.

Recently, community input has redirected our research to new sets of issues in new domains (folkecology and systems). The joint design of research questions has become increasingly exciting as we gain familiarity with Ngöbe science and our Ngöbe colleagues gain familiarity with Western research paradigms. One branch of community-led research—an interview project to record and document Ngöbe linguistic and cultural knowledge—is already being carried out by two community-elected investigators, based on their own design and methodology. On the ground, we work most closely with the Community Working Group on Education, a group of about twenty community leaders, elders, and youth which was formed two years ago in conjunction with a collaborative community schooling project. However, we

also hold general community meetings to discuss new research and to share results.

The design of our studies is also based on an understanding of appropriate research methods for working with American Indian communities. There is a long history of research in Indian communities that has often not been in their best interest, a legacy that has made many Native communities suspicious of research. Over the years, indigenous researchers themselves have worked to develop appropriate research methods and criteria (Guyette, 1983; Hermes, 1999; Mihesuah, 1998; Smith, 2006). There are some general principles that have emerged. First, there is a consensus that the *participatory action research (PAR)* is the best framework of inquiry. PAR has generally been defined as an integrated approach that relies on the participation of community members to investigate the issues at hand (Hermes, 1999). PAR includes the following: elder input, use of traditional language, community participation in the research agenda, staff selection, budget, community payoff, respect of cultural values, and informed consent (Hermes, 1999; Hudson & Taylor-Henley, 2001). These values make sense for any community.

One byproduct of research partnerships is that they reduce the asymmetries in cultural research and they provide multiple perspectives. Having our research approved by Northwestern's Institutional Review Board is only one of several steps. For example, AIC community members and the Menominee Language and Culture Commission, the entity that serves as the official IRB approval board for the Menominee Nation, must also approve our research and they have an opportunity to bring their values to bear on the project. Multiple perspectives also come into play in the interpretation of results, as when our Ngöbe colleagues in Panama assist us in making sense of comparative data (and may be co-authors on these papers). This strategy seeks to ensure that community voice is engaged in an equal partnership in all aspects of research.

2. *Study sites.*

Our sites include Menominee and rural European American communities in Wisconsin, the American Indian Center of Chicago, Mayans of Guatemala, a Ngöbe community in Panama, and our own lab at Northwestern University where undergraduate participants congregate.

*Rural Menominee Wisconsin population.* The Menominee are the oldest continuous residents of Wisconsin. Historically, their lands covered much of Wisconsin but were reduced, treaty by treaty, until the present 95,000 hectares was reached in 1854. The present site was forested then and now-- there are currently about 88,000 hectares of forest. Sustainable

coexistence with nature is a strong value (Hall & Pecore, 1995). Hunting, fishing and berry-picking are important activities and children are familiar with the latter two before starting school and with the former by age 12. There are 4-5000 Menominee living on tribal lands. Over 60% of Menominee adults have at least a high school education and 15% have had some college. Exposing children to the Menominee language is an important focus of the tribe, but school instruction and everyday discourse is in English. A minority of parents send their children to schools off the reservation. The tribe operates a Head Start program in two locations, both a tribal and county elementary school, a middle school, and a high school. The tribe also has a college (The College of the Menominee Nation) that we commonly draw on for hiring research assistants. In addition to these formal educational institutions, the Menominee tribe has a forestry service whose goals include having an educated citizenry, especially with respect to participation in discussions of the tribal forestry management plan and related natural resource issues. We have good working relationships with all these entities.

*Rural European American population*. Our samples from rural European American communities are drawn from Shawano County, located adjacent to and just south of the Menominee reservation. This community is primarily working class, is based on small scale manufacturing and farming, and shares with our Menominee sample a focus on outdoor recreation, especially hunting and fishing. Shawano County does not have the continuous forest cover associated with the Menominee reservation but instead tends to have small-scale farms that often include 40 to 80 acre forest plots (this cover combined with adjacent cornfields is attractive to deer and many of Wisconsin's counties have deer populations that are twice the estimated carrying capacity). Differences between European American and Native American orientations towards hunting and fishing have been a source of inter-group conflict and stereotyping (Medin, et al., 2006).

*Urban Indian population.* The primary source of urban Native American participants is through the American Indian Center of Chicago (AIC). There are approximately 40,000 Indian people in Cook county, many of whom where relocated to the area during the 1950s and 60s during the federal relocation era. The Chicago community is quite diverse with individuals representing more than 100 tribes across the country. Native-American children are scattered across a number of schools in the district and are a minority in every classroom. The AIC is the oldest urban Indian center in the country and serves as the social and cultural center of the Chicago Indian community. Menominee and other Wisconsin tribes are well

represented at the AIC. The Chicago Indian community shares many of the problems of other urban communities, such as high rates of poverty and underemployment, lack of access to quality healthcare, poor schooling options, issues surrounding drug and alcohol abuse, and high rates of violence. The AIC has an after-school program and other community programs that serve the target ages of this study.

*Ngöbe Population.* The Ngöbe people of Panama are the second most populous indigenous group in Central America, after the Maya (Young, 2007), and are the oldest inhabitants of the southern regions of Central America. The Ngöbe community where we conduct research, a village of about 600 habitants, is located on a densely forested island in the Bocas del Toro Archipelago off the Caribbean coast. Community members largely subsist off the land and sea, practicing agroforestry, hunting, fishing, diving, artisan craftmaking, or participating in wage labor. The native language is Ngöbere, and the majority of the community is bilingual in Spanish and Ngöbere. The community hosts two Christian Evangelical churches as well as the Ngöbe syncretic Mama Tata Church. The village also has a public school offering primary and partial secondary education; in our samples adults have about six years of formal schooling on average. In most families, children are expected to achieve competence in domains beyond that of formal schooling, including farming, fishing, and various household contributions.

*Undergraduate Student Population.* We also conduct research with U.S. undergraduate students at a large Midwestern university. The students participate as part of a subject pool associated with an Introduction to Psychology class and receive partial course credit for participating.

With this brief background on the communities with whom we have collaborated in research, we now move on to discuss some complexities of cultural work.

## B. CULTURAL COMPARISONS ARE CHALLENGING

One of the authors is fond of saying that two things can happen when one does cultural comparisons and neither one is good news. First, one can invest the time and trouble, addressing all the pitfalls we described above, and compare two cultures but find no differences. In that case our costly and time-consuming efforts would have served only to verify only what our colleagues already (thought they) knew--that the results they had obtained with U.S. samples would generalize broadly.

The other possibility is that we invest the same time and trouble and *do* find reliable cultural differences. In a sense this is even worse news, because now we are challenged to figure out *why* we found differences (and

it better not be because of any of the pitfalls we've been discussing). The logic of cultural comparisons is just the opposite of the logic of a controlled experiment. In a well-designed study, there typically is an experimental condition and a control condition that differs from it only with respect to a single factor of interest. Then when you find a reliable difference it seems obvious that the single factor is what's responsible for it. But cultural comparisons inevitably confound tons of factors, literally tons. There is a sense in which comparing two cultures divides the world in two and any of the ways the two halves differ is potentially relevant.

There are at least three strategies for dealing with this problem. One is to bring in a third group that is similar to one group in many ways but also similar to the other group in some respects. This is what we did (by accident) in finding that U.S. biological experts reasoned in the same way as Itza' Maya elders, thereby ruling out a host of factors. This sort of triangulation strategy can be effective if you are lucky, and adding more comparison groups can also help if (again you are lucky and) they form a coherent pattern.

A second strategy is just to ignore the problem and make your best guess as to what is responsible for the difference that you observe. Studies on language and thought sometimes adopt this strategy by assuming that language differences are responsible for the observed differences. This isn't as rash as it sounds because the measures have been selected on theoretical grounds linking the measures to language (differences).[1]

Currently there is a great deal of cultural research comparing the cognitive consequences of Western individualism versus Eastern collectivism, also adopting this strategy. Even if individualism versus collectivism turns out not to be the critical factor, there is, at a minimum, an accumulating body of evidence showing that ways of thought are not universal.

The third strategy, already alluded to by an ecosystems approach, we call a systems level approach, and the idea is to conceptualize a culture as a complex system of related variables rather than independent variables. On

[1] All the same one should bear in mind that it is only an assumption. Le Guen (2011) studied use of absolute (e.g., to the north) versus relative (e.g., on the left) spatial referencing systems among Yukatek Maya in Mexico. Previous work has assumed that the differences in linguistic reference terms mediated (language) effects but LeGuen noted that children use an absolute system well before they acquire the Yukatek language reference system. Further studies showed that gesture was the critical factor--the Yukatek Maya use an absolute reference system in gesture. So in this case it's not a matter of language and thought but rather gesture and thought.

this view the kinds of measures that one collects in a typical study may tend to point to some common themes or abstract ideas that are important to a culture. For example, if politeness and respect are important for the functioning of a culture, it may be reflected in rules about bowing, honorifics in the language, themes of stories for children, taxi drivers wearing white gloves, and signs in public. If one contrasts two cultures that differ in the importance of politeness and respect, one might well observe cultural differences on a wide range of measures related to this theme. In short, this strategy consists of attempting to identify broad themes or principles that are important to a given culture and then and only then beginning to try to understand culture differences. One such broad theme consists of how human beings see themselves in relation to the rest of nature, or "folkecology" and "folkbiology." This issue will be a central focus in this chapter.

## III. FOLKECOLOGICAL THOUGHT IN CULTURAL PERSPECTIVE

In this section, we review findings on perspective taking and ecological reasoning among Native American communities. Throughout, we illustrate how local cultural ecosystems provide support for these cognitive orientations through convergence of beliefs, artifacts, practices, and environments.

### A. PERSPECTIVE TAKING ON AND IN (THE REST OF) NATURE

We will offer several sources of evidence suggesting that Native Americans are more likely to take on the perspective of non-human components of nature. The first is from results from an Unsworth et al.,(in press) study of 5- to 7-year-old Menominee and rural European American children's reasoning about ecological relations. The relevant measure is children's spontaneous imitation of an animal's sound. Even though young children's books and parents' play with toddlers may focus on animal sounds ("What does the cow say, Johnny? Moooo! Yes! What does the pig say? Oink!" etc.), not one of the 15 European American children spontaneously gave an animal's sound. The animals used in the ecological relations task (e.g., bee, deer, bear) are not included in typical parent-child play. Nonetheless, 6 of 17 Menominee children engaged in sound mimicry and this cultural difference was reliable.

Once this sort of practice is called to your attention it is easier to see it. Early in our efforts to create culturally- and community-based science education programs, we noticed that before going outside for some activity our (Native American) teachers often stopped and asked the children to "put

on your deer ears" to listen to what is happening outdoors (see Bang et al., 2010 for details).

A second relevant observation comes from our analyses of illustrations from children's books that are or are not authored and illustrated by Native Americans. Our coding scheme included two codes for "camera shots" that invite the reader to take a character's perspective: over the shoulder and embodied. In an *over the shoulder shot* the scene is presented as if one were looking literally over the shoulder of a protagonist and in an *embodied* shot the viewer sees the scene through the eyes of a protagonist (the latter is often indicated by a cut off view of the protagonist's arms impinging on the scene). Native books were substantially more likely to employ over the shoulder shots or embodied shots (67% of books versus 27%) than non-Native books, and when they did so, commonly presented a nonhuman actor's view.

Further analyses of these same books reveal that Native American illustrators are also reliably more likely to use a variety of viewing angles (e.g., high and low angle in addition to the standard, straight on view) and more likely to present a wide or panoramic view (despite the overall tendency to have more "up close" views). In other words, the Native children's books both invite the reader to take the perspective of an actor and employ devices that encourage multiple perspectives in their stories.

*1. Importance Rankings and Perspective*

Many environmental decision making issues reflect a conflict between human desires and what is best for the health of an ecosystem. Our studies with Menominee and European American hunters and fishermen reveal cultural differences in values, differences that are consistent with Menominee outdoorsmen incorporating a nature-centered viewpoint into their personal values. We'll describe one study with Menominee and European American hunters (Ross, Medin, & Cox, 2007) in some detail.

Initially we asked a sample of hunters to name the most important plants and animals of the forest. From the resulting list we selected 29 animal and 39 plant kinds. Next, we asked each hunter to indicate his familiarity with each kind ("have heard of the kind," "could recognize one," and "have seen one"). Participants were also asked to rate (on a 7-point scale) the importance of each kind to the forest ("How important is X to the forest?") and to themselves ("How important is X to you?"). Instructions were intentionally ambiguous to keep the rationale for an individual's ratings as unconstrained as possible.

Importance ratings directly test our hypothesis that European American and Menominee hunters evaluate nature from different

epistemological standpoints. If Menominee hunters are more likely to take a nature-centric perspective, we should find higher importance ratings for a greater range of flora and fauna for Menominee than for European American hunters. Epistemological differences should also show up in justifications and in the relation between importance to self and importance to the forest ratings. For example, if importance to self is based on personal goals, it may conflict with or be uncorrelated with importance for the forest ratings. Alternatively, if a hunter values the health of the forest, then there may be a correspondence between importance to the forest and importance to the self.

*Importance of Plants Ratings.* Menominee hunters gave reliably higher ratings than European American hunters for plants with respect to importance to the forest, and essentially the same pattern was observed for ratings of importance to the self. Again, the main effect is statistically reliable. One challenge in this sort of research is to determine whether the differences observed in ratings reflect use of the scale or real differences in valuation (Does a European American "5" reflect a higher value than a Menominee "6"?). To address this question we can look at justifications for answers.

First, nine of seventeen Menominee hunters provided justifications in terms of statements that every plant has a role or part to play and hence is important to the forest. No European American hunter provided this type of justification. Second, for the importance to self ratings, several Menominee hunters mentioned that if something is important to the forest, then it is important to them. Again, no European American hunter provided this kind of justification.

Another aspect of our group differences is that Menominee hunters view the forest from multiple perspectives and goals and not just as a source of game or timber. Menominee hunters mentioned more uses or sources of value for both plants and animals than did the European American hunters. There was a reliable difference for use of plant material and for justifications in terms of religious, cultural, or symbolic value.

The high importance values reported by the Menominee are just one side of the story. In comparison, European American hunters were more likely to report either that a plant had little use to the forest or that they could not think of any. We suspect that this reflects both a lack of knowledge and a more narrow definition of value.

*Importance of Animals Ratings.* The ratings of the importance of various animals to the forest allow us to see whether the two groups differ in their focus on game animals. Overall, Menominee hunters consistently gave higher ratings for both importance to the self and importance to the forest.

We found no difference for the rating of game animals. Menominee hunters, however, rated nongame animals significantly higher than European American hunters. This last result is important on two accounts. First, it further undermines the notion that group differences in ratings might reflect different use of the rating scale. If that were the case, Menominee hunters should be giving higher ratings in both cases. Second, it again supports the hypothesis that, in contrast to European American hunters, Menominee hunters use multiple perspectives to evaluate animals, hunting being only one of them.

The idea that everything has a role to play may promote deeper analysis of how a species may help the forest. A good example of this is the description of whether porcupines help or harm the forest. A common response among almost all majority-culture hunters was to note that porcupines are destructive because of their habit of girdling and killing trees. Menominees know about this effect too, yet some gave positive ratings and justified them by explaining that this action opens up light into the forest, which in turn allows smaller plants to grow, which in turn provide ground cover that helps maintain soil moisture.

In many respects our findings on importance ratings are striking. Although both groups were more or less equally familiar with the plants and animals employed, there was a large main effect of cultural group in all ratings. Menominee hunters consistently gave higher overall ratings. Justifications for ratings reveal that group differences derive from abstract principles and a variety of species-specific considerations. The abstract principle that many Menominees expressed is that every kind has a role in the life of the forest. In contrast, European American hunters were more likely to use a straightforward utility-based evaluation. Both groups have a rich understanding of the forest, but overall similarities help to highlight group differences.

Finally, we can add a piece of converging evidence from our studies of Menominee and European American fisherfolk. In one study (Burnett, Medin, Ross, & Blok, 2005) we asked for goodness of example ratings for local fish species. As expected, Menominee fishermen gave higher ratings overall. There were no reliable group differences for game fish or for food fish (e.g., bluegill, sunfish), but Menominee fishermen gave reliably higher ratings for what the Wisconsin Department of Natural Resources refers to as “rough fish.” Rough fish (e.g., suckers, dogfish, gar, carp), commonly referred to as “garbage fish,” are generally considered to be undesirable. Menominee fishermen might say of a fish like the gar, “I have no use for them, but they must have some function.”

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## B. CONTEXT AND ECOLOGICAL RELATIONS

### *1. Attention to and importance of context*

According to a prominent theory in social psychology known as "construal level theory" (Trope and Liberman, 2003), psychological closeness, among other things, is associated with increasing attention to context. Attention to context can be measured in a variety of ways (Masuda & Nisbett, 2006; Nisbett & Masuda, 2003). For example, Bang, Medin and Atran (2007) used a measure so simple that it almost doesn't qualify as a study. Our study context was an interview with urban Native American, rural Native American and rural European American adults, asking them a variety of questions related to nature and their goals for children or grandchildren for learning about nature. This included a probe where we invited them to tell us about the last time they went fishing or a particularly memorable time when they were fishing. Our dependent variable was how quickly adults "got to the point" by mentioning fish. Our idea was that attention to context would lead Native American adults to spend more time describing the context before talking about fish.

And that is what we found. The median number of words used before mentioning fish was 27 for European American adults and 83 for the Native American adults, a large and reliable difference. The reason we had to use medians rather than means is that several Menominee adults never got around to actually mentioning fish.

### *2. Taxonomic relations*

There is marked cross-cultural agreement on the classification of living things, such that plants and animals are grouped according to a hierarchical taxonomy with mutually exclusive groupings of entities at each level (Atran, 1993; Berlin, 1992) Furthermore, the genus (e.g., trout, oak) level appears to be consistently privileged for both naming (Malt, 1995) and inductive inference when generalizing properties attributed to one biological kind to others (Coley, Medin, & Atran, 1997).

One of the ways to assess how people conceptualize nature is to ask them to sort (names of or pictures of) biological kinds into groups that make sense to them. One can then ask them to either subdivide or to combine these initial groups to produce a hierarchical classification system. The idea behind this procedure is that similar kinds will be placed into the same grouping and dissimilar kinds will tend to be placed into different groups. One can then correlate sorting distance (e.g., things in the same lowest level category have distance zero, things joined at the next level of abstraction have distance one and so on) with taxonomic distance (measured the same

way) and when one does so one typically finds quite high (e.g., +.70) correlations (Atran & Medin, 2008). This suggests that a taxonomic organization is natural for participants.

There are two related, important observations associated with these findings. One is that a correlation of 0.70 explains about half of the variability (r-squared equal 0.49), leaving open the possibility that other factors may be playing a role in sorting. Second, the correlations may be driven in part by the fact that taxonomic similarity is correlated with other relevant dimensions or bases for sorting. For example, a sorting system based on land versus air versus aquatic animals may correlate with taxonomic distance because those spatial factors are correlated with taxonomic distance (birds are mainly air creatures, mammals mainly ground creatures, and so on). That brings us to ecological relations.

*3. Ecological relations*

Ecological relations can be explored in many ways, and here we focus on how relations among and between species are conceptualized. First we discuss conceptual organization of fish species along relational-ecological dimensions, then look at helping and hurting relations among those species.

In the first study we will describe, expert Menominee and European American fishermen from rural Wisconsin were asked to sort names of local species into categories (Medin, et al., 2006) and to explain the basis for their sorting. European American experts tended to sort taxonomically (e.g., these are the bass family, these are minnows and shiners, etc.) or on the basis of goals (e.g., these are large, prestigious gamefish, these are fish that are good for children to catch, these are garbage fish, etc.). Many Menominee experts also sorted by goals and taxonomic relations, but about 40% of them sorted ecologically according to habitat (e.g., these are the fish that are found in cool, fast moving water, these are found in stagnant ponds, etc.). This latter basis for sorting was rarely seen among the European American experts. In a follow up study with less expert but equally experienced Menominee and European American fishermen (Medin, et al., 2002), the European American sample was even more likely to sort by goals and the Menominee sample displayed ecological sorting at the same level as Menominee experts.

Given these findings, we decided to study ecological reasoning more directly. In our second study with fish experts we selected a subset of 21 species that all of the experts were familiar with, and for each of the 210 possible pairs asked about whether one fish affected the other or vice versa (e.g., “Does the northern affect the river shiner or the river shiner affect the northern?”). Relations between fish species can be identified as either positive “helping” relations or negative “hurting” relations (or both). The

task was completed in about an hour, so with more than 200 pairs you can imagine that we moved at a fairly rapid pace.

Generally, Menominee and European American fish experts agreed with each other on the relations present (Medin et al., 2006, Experiment 2). If we look at relations that were mentioned by at least 70% of one group, then 85% of the time 70% or more of the other group also mentioned a relation. But there were also striking differences. Only 1% of the time did European American experts mention relations that Menominee experts did not agree were present but 14% of the time Menominee experts reached consensus on relations that European American experts did not mention. Overall, Menominee experts reported reliably more ecological relations, including reliably more positive "helping" relations.

The 1% figure we just gave you may have been cases of over-generalizations driven by goals. For example, for the pair, river shiner and largemouth bass, European American experts tended to say that largemouth bass eat river shiners; for the same question Menominee experts generally said that they are not found in the same waters (and at least in this part of Wisconsin they are not).

It also appeared that European American fish experts were answering in terms of adult fish. For a pair like northern and musky (bigger cousins of northerns), European American experts usually only said that a musky will eat a northern. Menominee fishermen also mentioned this relation but, in addition, said that northern fry hatch out about two weeks earlier in the spring and that northern fry will eat musky fry. This latter observation was a big hint concerning the basis for our group differences.

The hint is that, in informal conversations, more than one European American fish expert had mentioned to Medin and Ross that northern fry hatch earlier than musky fry (and will eat them). Why didn't this knowledge come out on the ecological relations task? Perhaps we were looking at cultural differences in knowledge *organization* rather than differences in knowledge per se (after all, these guys were experts and had fished for decades). If your knowledge is organized in terms of goals or taxonomic relations, it should take more time to access ecological knowledge.

In a follow up study we again (now nearly two years later) gave the same species relation task, but reduced the number of pairs from 210 to 34, allowing us to move at a very leisurely pace. We made two predictions: 1. the group differences would disappear and 2. the European American fish experts would start to answer relation probes by referring to the entire life cycle of fish.

And that's what we found. The earlier probe of 34 pairs had yielded 28 relations for Menominee experts versus only 17 for European American experts; now the figures were 32 versus 29, a small, unreliable difference. The shift from 17 to 29 took the form of European American experts now mentioning relations involving spawn and fry. Overall, our data suggest a large cultural difference in conceptual organization, favoring ecological relations for Menominees and goals and taxonomic relations for European Americans.

*4. Developmental studies*

Once we had noted these cultural differences in adults a natural follow up question was whether we would also see parallel cultural differences among children. We already had a hint there might be from a study done by Ross et al., (2003), using an inductive reasoning task. In this method children are taught that some novel biological property is true for one biological kind (e.g., "has andro inside it") and asked whether it might also be true for other biological and nonbiological kinds. The idea is that children will tend to generalize to the extent that they see the base and target kinds as similar and that is what usually is observed (Carey, 1985). These same studies typically are done with children in and around major research universities and these schools almost always are located in urban areas.

For now, we focus on a single observation from Ross et al., 2003. Older rural European American children and Menominee children of all ages tended to generalize a property attributed to bees (e.g., "has andro inside") to bears, a biological kind not especially similar to bees. Sometimes children volunteered the basis for their answer by saying that a bee might sting a bear (transferring andro to them) or by mentioning that bears eat honey (with the unstated implication that andro was in the honey and would be transmitted by ingestion). In other words, rural children sometimes were employing ecological reasoning, a strategy we had not seen in urban children of any age. (See Medin and Waxman, 2007, for more details)

Given the intriguing Ross et al. (2003) observations, we decided to probe rural Menominee and European American children's ecological reasoning more directly (Unsworth et al. 2012). We already mentioned this study in describing Menominee children's spontaneous imitation of animals and now we are ready to give you results on ecological relations. Recall that seventeen 5- to 7-year-old Menominee children and fifteen 5- to 7-year-old European American children participated in this study. The materials included 30 pairs of pictures of plant and non-human animal species situated within their natural habitats. There were 15 animal-animal pairs (e.g., coyote, rabbit), 9 animal-plant pairs (e.g., frog, lily pad) and 6 plant-plant

pairs (e.g., moss, birch tree). All species represented in the pictures can be found in the state of Wisconsin.

We selected pairs that shared a variety of relations, including taxonomic relations (e.g., eagle and hawk are both birds), and ecological relations (e.g., eagle and hawk both eat small rodents). Many species depicted in the picture pairs shared morphological properties as well (e.g., eagle and hawk both have wings). For purposes of this study ecological relations were defined as responses about relations between the species; they included a) habitat relations (e.g., woodpeckers live in trees), b) food chain relations (e.g., chipmunk would eat the berries), and c) references to other biological needs (including water, sunlight, or soil).

Children in both cultures were more likely to mention habitat relations than either food chain or biological needs. Every child gave habitat responses, which may reflect the fact that habitat information was depicted in the pictures themselves (e.g., moss and a birch tree were both depicted in the forest). But Menominee children gave significantly more food chain responses and more relations involving biological needs than rural European American children.

In summary, the results of this experiment provide direct evidence for cultural differences in children's ecological reasoning; as with adults, Menominee children were more sensitive to ecological relations than European American children. These developmental studies indicate that an ecological orientation is not a perspective that only adults acquire, but instead may reflect the sort of epistemological framework for approaching the rest of nature that may be widespread in terms of both explicit and implicit practices in Native American communities.

*5. Summary*

If we do a tally, the overall picture on cultural differences is pretty impressive. Differences in perspective taking were revealed in spontaneous sound mimicry and in illustrations in Native versus non-Native children's books. These perspective differences, in turn, were reflected in importance ratings for plants and animals of the forest as well as goodness of example ratings of local fish species. The justifications for these judgments also reveal differences in taking multiple perspectives. We also found evidence of cultural differences in the importance of context revealed in stories about fishing. Finally, we found differences in ecological or relational orientation for both children and adults. These differences are supported by sorting studies, speeded versus unspeeded probes of ecological relations, children's use of ecological relations in reasoning and response to direct probes

concerning ecological relations. Overall our data nicely illuminate a consistent patterning of cultural differences.

## IV. TAKING MULTIPLE PERSPECTIVES ON CULTURAL DIFFERENCES

Although we only briefly mentioned the Trope and Liberman construal level theory, one could summarize the results presented so far by suggesting that they can be accounted for by a single factor: our Native American samples appear to be psychological closer to nature than our European American samples. From a sociology of science perspective this research framework isolates a single dimension-- in this case, distance-- and ignores everything else that might be relevant to cultural models and epistemological frameworks. Still, it doesn't actually ignore these other factors, because many of them may "come along for free," because they are correlated with distance.

We believe that distance by itself, even with its correlated interlopers, won't do all the work we want it to do. For example, within the context of being psychologically close there may be substantial differences in the nature of (close) relationships. Therefore, we must bring in additional ideas about cultural models and epistemological frameworks. In the following section we first consider Native American relational epistemology much more broadly than we have previously and offer additional analyses of Native and non-Native children's books in support of this broader framework. Then we return to the construct of psychological distance and describe some of its concrete limitations. Finally, we describe some cultural, developmental studies focused on one facet of cultural epistemologies, the relation of human beings to other animals.

### A. NATIVE AMERICAN RELATIONAL EPISTEMOLOGIES

Anything we write about relational epistemologies will be at once too little and too much. There is a substantial literature on relational epistemologies (e.g., Anderson, 1996; Deloria, 1998; Kawagley, 1995; Nasasdy, 2003; Pierotti, 2011; Pinxten, van Dooren & Harvey, 1983) and we cannot hope to provide more than a glimmer. We begin with a quote:

"If there is one truly universal Amerindian notion, it is that of an original state of nondifferentiation between humans and animals,.." Viveiros de Castro (2004, p. 464).

And later on: "….the relations between the human species and most of what we would call 'nature' take on the quality of what we would term

'social relations.'" (Ibid, p465)

Cajete (1999) argues that Indigenous thought is foundationally based on constructions and meanings of relationships. Some scholars suggest that conceptualizing nature in terms of social relations does not represent an application or transfer of the social world to the natural world so much as the absence of a distinction between the two.

Yet another factor motivating us to attend to relationality is the failure of another analysis we attempted to do with Native and non-Native children's books. For this iteration our goal was to code the books for moral content. Our subjective impression was that the Native-authored children's books were full of moral substance. Nonetheless our attempts to develop a coding system to capture moral teaching were utter failures; they felt very much like the proverbial effort to pound a round peg into a square hole. Put differently, the Native books seemed to deal with living in (proper) relationship(s) and it wasn't obvious that one could isolate any special subset of this relational complex and call it "morality."

*1. Living in Relation*

Before turning to further analyses of children's books, we want to make some rough and ready distinctions about what a relational epistemology might entail (bearing in mind that there may be many distinct systems that might fall into the category, relational epistemology). On one broad level one can ask what is being related to what, what is being attended to and what is the preferred mode for attending. This is like a list of characters in a play, the *dramatis personae* if you will. Although this may not seem to be central, we think it is, as cultures may differ dramatically in what they consider relevant and worthy of attention.

The second broad issue is, "What is the nature of the relation between and among the entities that are being linked?" For example, the relation could be one of reciprocity or it may be asymmetrical. In our work in Guatemala, Itza' Maya saw relations between many species of plants and animals to be reciprocal and positive, but Ladino informants denied that animals help plants and reported that the only positive relations were plants helping animals (Atran and Medin, 2008).

The third issue concerns the larger context and dynamics within which these relations operate. Recall, for example, that many Menominee hunters and fishermen assumed that "everything has a role to play," even if they had no specific idea about what that role might be.

Finally, this systems level focus might consider whether there are expressed or implied emergent properties that go beyond sets of pair-wise

relations. For example, cultural models may differ in the nature and depth of causal chains that are assumed, analyzed, or inferred.

One powerful example of "living in relations" comes from a storytelling task we conducted with Ngöbe adults and U.S. undergraduates (ojalehto, Medin, Horton, García, Kays, in prep). Participants narrated an illustrated nonfiction storybook (with text removed) about the coyote-badger hunting relationship that takes place in the American Southwest desert. Our focus was on how the (somewhat ambiguous) coyote-badger relationship would be described. A striking difference emerged in interpretations of the story. The majority (77%) of Ngöbes saw the coyote-badger hunting relationship as cooperative, compared with only 23% for U.S. undergraduates. Some descriptions were ambiguous, but 50% of the U.S. undergraduates talked about the relationship as competitive versus 5% of Ngöbes.

The coyote-badger case illuminates three elements of a "living in relations" framework. First, the storybook presents a naturalistic forum for exploring how nonhuman actors are construed as "dramatis personae" and what their relationships are. Ngöbes tended to emphasize how coyote and badger are social beings, but U.S. undergraduates tended to emphasize their roles as individual agents. Ngöbes also saw a more important role for the environment, pointing to things like affordances (the full moon is good for hunting) or dwelling places (homes, paths, refuges).

Second, these findings are nested within larger cultural systems for apprehending nature. Western scientists have only recently corrected their longstanding consensus that the coyote-badger hunting relationship was competitive; while Native American scientists have known all along that it was cooperative (Pierotti, 2011). In fact, Western biologists were aware of the Native American view but dismissed it in favor of the competition framework for decades (Minta et al., 1992). Both Pierotti (2011) and our Ngöbe colleagues propose that these distinct views can be partly explained by cultural beliefs about the "nature of relations" that can be seen in nature. Whereas Western models tend to assume that organisms compete in a "survival of the fittest," Indigenous models tend to emphasize co-evolutionary processes and (social) cooperation.

Our Ngöbe colleagues pointed out that appropriate knowledge comes from living in intimate cooperation with natural systems, and that cultural differences involve both ideas and practices. First, the "cultural idea of interaction" is all important in the Ngöbe community. Ngöbes prioritize interactions as objects of attention, observation, and explanation. Second, Ngöbe and Western scientists use different cultural practices such as

relaying on technologically mediated modes of inquiry (using pre-fabricated instruments to apprehend nature) rather than first-hand experience and studying nature as isolated parts (citing visiting biologists who study only endangered sea turtles, or only specific plants).

The observed cultural differences cannot be due to folkbiological knowledge *per se*, but must also reflect frameworks for seeing relationships and ecological interactions. When we shared these findings at a community presentation, many Ngöbes were bemused (but not surprised) that U.S. students believed coyote and badger were competing. To them, the competition hypothesis reflected a lack of common sense. As one colleague explained, "We knew by the way in which they were hunting. Like when you can't buy something alone, you'll go to buy it with another person, and the two of you will buy it together. We saw this in the story and knew they were hunting together to eat." We hazard a guess that this analogy with buying something is not the first thing that leaps to mind for most U.S. individuals who have grown up with a notion of *homo sapiens* as uniquely distinct from (other) animals.

In summary, the coyote-badger story illustrates how cultural frameworks influence our assumptions about the nature and explanatory depth of relations, and the kinds of actors likely to be involved in those relations. These assumptions are embedded in larger epistemological frameworks that give them their "common-sense" flavor.

*2. Culture and attention*

Human beings have a variety of methodologies for learning about the natural world. Observation is one such way (Kawagley, 2006). More than just seeing, observation is often driven by some specific theory (Kuhn, 1962) and sometimes is used to confirm theories. Observing involves the coordination of attention habits, domain knowledge, and theory (Eberbach & Crowley, 2009; Haury, 2002), but we know little about the cultural aspects of this process.

Several scholars have argued that the ability to attend to objects and events is culturally acquired through the negotiation of attentional directives and participation in routine activities (Cook, 1999; Garrett & Baquedano-López, 2002; Yont, Snow, & Vernon-Feagans, 2003; Correa-Chavez, Rogoff, & Mejía-Arauz, 2005; Orellana & D'warte, 2010). Work by Nisbett and colleagues shows that individuals from Eastern cultures tend to direct attention to the field while individuals from Western cultures often direct attention to an object (Nisbett, Peng, Choi, & Norenzayan, 2001). Similarly, our prior work provides evidence pointing to cultural variation in the kind of

relations (e.g., ecological, taxonomic, utilitarian, food chain, biological kind-natural inanimate) that young children attend to (e.g., Unsworth et al., 2012).

An indigenous relational epistemology is not simply an abstract stance or principle, but is embedded in practices that determine the expression of basic cognitive processes like observation and sense making. Drawing on anthropologists (see Ingold, 2001; Tulbert & Goodwin, 2011) we are beginning to think of attention as a choreographed practice and directives as embodied, (often) linguistic pointers that are used to *show* others what is worthy of attention and thereby structure learning experiences. Currently we are examining these attentional directives associated with outdoor practices such as forest walks and berry picking. An important future line of analysis is the relational aspect of participants' discourse. Our analysis of text in children's books is informative in this respect.

*3. Children's books again*

This iteration though Native and Non-Native authored children's books focused not on the illustrations, but the text. We entered the words from 44 Native-Authored and 44 non-Native authored children's books into searchable text files. In each case the 44 were a random subset of our original pool of books. [See Dehghani, et al., submitted for further details on the books, coding and analyses.]

The first analysis we report used the Pennebaker et al. (2007) LIWC (Linguistic Inquiry Word Count) application that is available on line. LIWC employs about 60 output categories that reflect linguistic and psychological processes categories. The application includes a "dictionary" of the assignment of words and word stems to these categories. For example, "we," "let's," "our," "ourselves," and "us" are some of the words that would be assigned to the personal pronoun category "we." Other categories correspond to tense, various grammatical categories, affect, time, quantities, some noun categories, and even forms of punctuation.

One advantage of LIWC is that it is easy to use and the categories have already been established so our own team's biases cannot affect the categorization scheme. But this advantage is also a disadvantage, precisely because the categories and the dictionary words assigned to them have not been developed with cultural epistemologies in mind.

Whenever we could make a straightforward connection between LIWC categories and epistemological orientations, we relied on LIWC. For example, our studies of indigenous scholarship suggest that Native texts should be more likely to establish context and two ways of doing so are to give background information, which requires the use of *Past tense*, and to describe relations, by using (primarily spatial) *Prepositions*. More

speculatively, we thought that the Native propensity for linking events might be reflected in the use of the LIWC *Cause* category. Hence, several of the LIWC categories were relevant and appropriate.

The results generally matched our expectations. Native-authored books were reliably more likely to use *Past tense,* more likely to employ (spatial) *Prepositions* and more likely to have words in the *Cause* category.

A second analysis relies on new word categories that we created. This is a more bottom up approach and involved building a different dictionary tailored to a relational framework. First, consider what is worthy of attention. We predicted that Native books would be more likely to include words corresponding to *Natural Inanimates* (e.g., *fire, ice, river, rock, ground, beach, sun, moon, wind*) and *Cycles* and *Seasons* (*birth, death, winter, spring*). They should be also more likely to name nonhuman biological kinds (e.g., *tree, cedar, pine buffalo, coyote, deer, eagle, spider, fish, salmon, turtle*) and when they do so, to mention native rather than exotic species. All of these predictions were reliably supported (see Dehghani, Bang, Medin, Marin, Leddon, and Waxman, submitted, and table 1).

Table 1: Results for LIWC and non-LIWC Categories

| | Native Storybooks | | Non-Native Storybooks | |
|---|---|---|---|---|
| Category | Mean | SD | Mean | SD |
| Past (LIWC) | 6.216 | 3.104 | 4.285 | 3.608 |
| Prepositions (LIWC) | 12.607 | 1.510 | 11.470 | 3.305 |
| Cause (LIWC) | 1.155 | 1.064 | 0.758 | 0.762 |
| Natural Inanimate | 4.213 | 2.049 | 2.519 | 2.272 |
| Cycles-Seasons | 0.262 | 0.487 | 0.010 | 0.050 |
| Native Animals | 2.066 | 2.031 | 1.180 | 2.040 |
| Kin Terms-2$^{nd}$ order | 0.242 | 0.512 | 0.041 | 0.119 |

We also analyzed kin terms and separated them as primary (so-called nuclear family terms like father, mother, brother sister) versus second order [no value attribution intended] or extended family (grandmother, uncle). The two sets of books did not differ on the frequency of primary kin terms but Native books used extended family terms reliably more often than non-Native books.

Assigning single words into categories allows us to examine some aspects of cultural framework theories but the gain in reliability may come at the cost of richness. There's a lot more work that might be done to capture the complexity of what we gloss as "living in relation." Consider, for example, one of our favorite children's books, Yetsa's Sweater by Sylvia Olson, which describes the Cowichan Sweaters knitted by Coastal Salish women. Yetsa and her mother go to see Yetsa's grandmother. They gather and clean fleece (including Yetsa taking "sheep poop" out of it), tease the wool, and watch the grandmother spin it and then knit the sweater with its characteristic whales, waves, wooly clouds, and blackberries. The grandmother says to Yetsa that the sweater tells a story about her family--the flowers are there because her mother loves her garden and the salmon symbolizes her father's love of fishing. It literally seems as if everything is connected with everything else and the sweater is far more than a sweater. We need a coding scheme that captures this network of inter-relationships.

B. CONCRETE PROBLEMS WITH DISTANCE AS A PROXY FOR CULTURAL MODELS

*1. Is distance necessarily symmetrical?* The overall construct of psychological distance assumes that distance is symmetrical and this may miss some important distinctions. If A is uphill from B, then the psychological distance from B to A may be greater than the distance from A to B. Saying that A is like B (e.g., wolves are like dogs) means something different than saying B is like A (e.g., dogs are like wolves; Bowdle & Gentner, 1997, 2005; Medin, Goldstone, & Gentner, 1993). In our example of dogs and wolves, one could also have a nondirectional comparison by simply stating that dogs and wolves are similar and that may bring different things to mind than either directional comparison. In addition, we prefer to compare the variant to the ideal or standard rather than the standard to the variant. For example 99 may be more similar to 100 than 100 is to 99 and we say that the teacher met the President of the United States rather than the President of the United States met the teacher (Gleitman, Gleitman, Miller, & Ostrin, 1996; Tversky, 1977).

The issue of ideals and direction of comparison is especially significant for conceptions of humans in relation to the rest of nature. Is there an ideal or standard? If so, is it human beings? Are comparisons nondirectional or directional and if directional, what is the direction of comparison? For example, having a clan system based on animals (e.g., the major Menominee clans are bear, eagle, moose, wolf, and crane) may carry the implicit assumption that humans and other animals are similar

(nondirectional comparison) or that humans are like other animals (a directional comparison).

The Menominee origin story has people emerging from the bear so one might even consider the bear as an ideal or standard (Grignon, et al, 1998). Now consider a typical animated movie (e.g., the Dreamworks film "Over the Fence") where animals wear clothes, drive cars and so on. These movies have the implicit message that animals are like humans, a clear directional comparison, presumably with humans as the standard. Psychological distance, by itself, does not capture these distinctions.

*2. Is closeness sufficient to explain cultural differences?*

Psychological closeness may increase attention to context and situation, but this may not be sufficient, in itself, to encourage an ecological orientation or systems level thinking. In particular, one can be psychologically close to the biological world and still adopt a markedly anthropocentric orientation (Epley, Waytz, & Cacioppo, 2007; Waytz, Cacioppo, & Epley, 2010). We suggest that Native American communities' practices--both direct and indirect--encourage taking multiple perspectives on nature, promote psychological closeness to it, but are not anthropocentric.

Much of the work on psychological distance has contrasted situational versus dispositional interpretations of human social behavior but has not elaborated on a relational orientation more broadly, even for human social behavior. Native American epistemological orientations elaborate psychological closeness by focusing on principles of "living in relation," where the relations include not only plants and animals but also natural kinds (e.g., rocks, water).

There is a great deal more that can be said about the particulars of relational epistemologies including such things as spiritual entities, grandfather rocks, and the like. In the remainder of this chapter, however, we will focus on some developmental, cultural studies looking at only the relation between human beings and other animals. This work will address the claim that children's biological cognition includes a mandatory stage of anthropocentrism.

## C. IS A HUMAN-CENTERED BIOLOGY HARD-WIRED?

In an important book, Carey (1985) proposed a view of knowledge acquisition built on framework theories and different causal principles that vary across domains. For example, the (physical) laws that apply when a bat hits a baseball may be different from those that apply when a parent tries to get her child to "hit the books." Candidates for distinct domains are physical processes and events (naïve or folk physics), biological processes and events (naïve or folk biology), and psychological events and processes

(naïve or folk psychology).

One of the most closely examined domain distinctions is that between psychology and biology (see Carey, 2009; Herrmann, et al, 2010; Medin, et al, 2000 for reviews). For U.S. adults who may subscribe to a dualism between mind and body, psychology and biology are distinct domains with distinct causal principles. Carey (1985) argued that (young) children do not distinguish between psychology and biology, but rather that biology is initially understood in terms of psychology. On her view, naïve biology emerges as a distinct domain only in older children.

Carey (1985) offered some striking evidence to support her strong claims. The logic of her predictions is as follows. Human beings may not be the prototypical animal, but they are the premier psychological beings. If children's biological reasoning is organized in terms of a naïve psychology, then human beings should be the paragon or prototype, despite the fact that they are not typical animals. On this view, the distance between humans and other animals is not symmetrical, but rather animals are compared to humans rather than vice versa.

The strongest evidence for a human-centered stance in young children's biological reasoning comes from Carey's own pioneering research (Carey, 1985). In an inductive reasoning task involving children (ranging from 4 to 10 years of age) and adults from Boston, participants were introduced to a novel biological property (e.g., "has an omentum"), taught that this property is true of one biological kind (either a human, dog, or bee), and then a few days later asked whether other entities might have this property.

Carey found striking developmental changes in inductive generalizations. First consider the data from the youngest children. If the novel property had been introduced as true of a human, 4- to 5-year-olds generalized, or projected, that property broadly to other biological kinds as a function of their similarity to humans. But if the identical property was introduced in conjunction with a nonhuman animal (dog or bee), 4- to 5-year-olds made relatively few generalizations to other animals. This produced a pattern of generalization that violates intuitive notions of similarity. For example, 4- to 5-year-old generalized more from human to bug (stinkoo) than from bee to bug. Overall, Carey (1985) provided two strong indices of anthropocentric reasoning in young children's judgments: (1) projections from humans to other animals were stronger than projections from dog or bee; and (2) there were strong asymmetries in projections to and from humans (e.g., inferences from human to dog were stronger than from dog to human).

Older children and adults showed no indications of anthropocentric reasoning. Instead they tended to generalize novel biological properties broadly from one biological kind to another, whether the property had been introduced as a property of a human, dog, or bee. Moreover, unlike the 4-year-old children, their tendency to generalize a novel property was a function of the (intuitive) similarity of the base kind to target kinds (e.g., a dog or human base led to more generalization to other mammals than to invertebrates or insects).

Carey (1985; Carey & Spelke, 1994) argued from these data that children begin with a human-centered, psychological understanding of biology and later on must reorganize their conceptual system to reflect the understanding that, biologically speaking, humans are one kind among many. More precisely, her claim is that young children view the biological world from the perspective of a naïve psychology, a perspective that must subsequently be overturned as children acquire the mature perspective of a naïve biology.

Carey's provocative proposal stimulated a great deal of subsequent research and we cannot do justice to it. Some research showed that young children have understandings of distinctively biological mechanisms such as growth (Hickling & Gelman, 1995), and inheritance (e.g., Hirschfeld & Gelman, 1994, see also Gelman, 2003). One intriguing suggestion offered and supported by Inagaki and Hatano is that young Japanese children have a distinctively biological framework theory based on the principle of vitalistic energy (Hatano & Inagaki, 2000; Inagaki & Hatano, 2002). They proposed that cultural models espoused within a community shape children's biological reasoning. Their studies revealed that 5- to 8-year-old Japanese children understand many bodily processes in terms of vitalism – a causal model that is pervasive in Japan and that relies on the distinctly biological concept of energy. It remains to be seen whether this is a specific cultural notion or whether biological notions involving energy might be more widespread. Inagaki and Hatano's work stimulated our own interest in the role of culture in children's biological cognition. Before describing that work we take a brief detour into expertise.

*1. Expertise*

In the mid- to late 1990's Medin teamed with cognitive anthropologist Scott Atran and a bunch of bright graduate students and postdocs to explore the role of culture and expertise in people's understanding of biology. Our idea was that Carey's results reflect urban children having a lack of intimate

contact with nature relative to rural children.[2] When we did so, we did not observe that 4-to 5- year-olds engaged in the sort of human-centered reasoning that Carey had noted (e.g., Atran et al., 2001; Ross, Medin, Coley, & Atran, 2003). At least this is what we thought these studies showed.

Meanwhile an ingenious study by Inagaki and Hatano also pointed to the importance of experience and expertise. Inagaki and Hatano (Inagaki, 1990; Inagaki & Hatano, 2002) found that urban children raised in Tokyo who were closely involved with raising goldfish generalized biological facts to kinds similar to humans *and* to kinds similar to goldfish. This suggests that the relative advantage for humans over nonhuman animals as bases for induction derives from children's greater willingness to generalize from a familiar base than from an unfamiliar base. The anthropocentric pattern produced by urban Japanese children who did *not* raise goldfish converged well with Carey's (1985) results. But the full pattern of results points to a different interpretation--urban children's propensity to view humans as a privileged base may be driven by the fact that humans are the only biological kind that they know much about.

But there are two problems with this picture. One is that the results with rural populations could just mean that rural children get the relevant experience for conceptual change sooner than urban children (that is, maybe all children pass through a human-centered stage but rural children do it sooner). The other issue is methodological. Carey's procedure involved teaching a child about only one base and then bringing them back a few days later for generalization tests. Most other researchers, ourselves included, tested for generalization right after training and, after using one base and one novel biological property, went on to present another base biological kind and a new property, following by a new set of generalization tests, and so on.

Without going into details, we now know that a key procedural

[2] We struggle with this terminology that carries with it an implicit understanding of nature with which we disagree. All children have equal exposure to nature unless some have found a way to travel on a different plane of existence. "Intimate contact" is a goofy term designed to capture aspects like psychological distance, salience of biological kinds in one's daily life, diversity of experience, but none of these will hold up to closer scrutiny. As an example, Winkler-Rhoades, et al. (2010) asked urban and rural children and adults (including rural Menominee children and adults) to name all the animals they could think of. Notably, urban participants tended to name exotic animals (mainly African mammals) and most notably, rarely were urban, native animals (e.g., squirrel, rabbit) mentioned. Arguably, urban participants see squirrels much more often than rural participants, but rural participants were more likely to mention them.

variable is whether children are trained on just one base (as in Carey's study) versus multiple bases and whether *Human* appears as the first base versus later. These order effects take the following form: young children's tendency to generalize a novel property from a human base to the other animal targets is considerably stronger when the human serves as their first, as compared to a later, base (Anggoro, et al., 2010). This raises the possibility that anthropocentric reasoning would have been observed if these studies varied bases between participants where each child sees only a single base.

Even if these methodological issues are resolved, how do we know that our rural samples have not gone through the stage of a human-centered biology, but just did it sooner than urban children? The obvious way to address this question is to run 3- to 4-year-old rural children on the induction task. That's a nice idea but there's a problem--for a task like this, four years old is about as young as one can go and still get meaningful data. Younger children will answer your questions but they may say "no" to everything or "yes" to every probe.

Fortunately for us, Patricia Herrmann in our lab was able to solve this challenge by borrowing a procedure that has been used before with toddlers. One of the problems with the usual procedure is that it is given by an adult, who presumably knows more about biological kinds than does the child. Children may find this arrangement strange since children normally are asking questions of adults. Herrmann modified the usual method by introducing two puppets, each of which is right some of the time and wrong some of the time (as established in a warm-up task). For the induction task the two puppets disagree about whether some biological kind has the property in question and the child acts as a mediator and casts the decisive vote. With this method 3-year-olds produce systematic, meaningful data.

*2. Cultural models matter*

Instead of initially testing 3-year-old rural children we started with urban 3-year-olds. One reason for doing so is that they were more accessible and we wanted to iron out any procedural wrinkles. The other reason was our hunch that a human-centered biology may reflect a cultural model and perhaps one that urban 3-year-olds have yet to acquire. Unlikely as it may seem from the idea that experience and expertise is the key, we thought that urban 3-year-olds would *not* show a human-centered biology.

And that is what we found (Herrmann et al., 2010). Three-year old urban children responded systematically, generalizing more from a dog base than from a human base and showing no reliable human, dog asymmetries. To make sure that the puppet procedure didn't introduce some artifact, we also ran urban 5-year-olds with puppets and they showed the now familiar

pattern of generalizing more from a human base than a dog base as well as substantial human, dog asymmetries. This pattern has been replicated often enough that we are quite confident of these findings.

We have also used the puppet procedure with 4-to 5- year-old rural European American and Menominee children just in case using the puppets changes the pattern of performance. They show no evidence of a human-centered biology. Furthermore all of these studies employed Carey's between participant design so the methodological concerns from other studies do not apply (and again, with urban 4- to 5-year-olds we do replicate Carey's results).

*3. Summary of induction studies*

These results offer unambiguous evidence that the anthropocentric pattern of reasoning observed in urban 5-year-old children is not an obligatory initial step in reasoning about the biological world. Instead, the results show that anthropocentrism is an acquired orientation, one that emerges between 3 and 5 years of age in American children raised in urban settings. Notably rural Native American and European American 5-year-old children do not show human-centered reasoning. One interpretation of this finding is that they have less exposure to anthropomorphic media but another possibility is that they have alternative cultural models that compete successfully with the human-centered one. Answers to these questions await further research.

In summary, cultural models embody different relationships between humans and the rest of nature. Furthermore, as anticipated by Epley, et al., 2007 and by Waytz, et al., 2010, these differences in models cannot be understood by an appeal to psychological distance. Carey (1985) may have been correct in thinking that biological cognition may involve competing, incommensurable models, but we suggest that these are competing cultural models, not some acultural naïve psychology or naïve biology. We need to understand the dynamics of these various cultural models, which appear to vary both across cultures and within individual minds, depending on the context.

We could now present yet another analysis of children's books, but the differences are so enormous that we see little point in providing numbers. Children's books by non-Native authors including animals are overwhelmingly anthropomorphized, with animals wearing clothes, driving cars, living in houses, and so on. Native-authored children's books hardly ever depict animals this way. Sometimes the animals in Native-authored books talk with each other (in English), but we would argue that this reflects sentiments about communication, not anthropomorphism.

## V. THE SYSTEMS LEVEL PERSPECTIVE: CULTURES AS ECOSYSTEMS

We began our discussion by proposing that concepts (or frameworks) have cultures, and that cultures are like ecosystems. Here, we attempt to put these metaphors to work by situating the research findings we have reviewed in an ecosystems framework.

First of all, it is notable that biologists are increasingly drawn to social and cooperative (ecological) frameworks in their quest to understand structures even among such "simple" organisms as bacteria (Cordero et al., 2012; Helmreich, 2009). The fact that bacteria (and many other organisms) demand a newly sociological and computational perspective serves to undermine scientific distinctions between the "social" and "biological." In essence, we are seeing a cross-wiring of "social/biological" systems across the sciences, often integrated through a complex systems approach (e.g., Helmreich, 2009; Mitchell, 2009).

We believe that the psychological study of cultures will benefit from an ecosystems perspective, for several major reasons outlined below.

### *1. Idea habitats: contextually-embedded concepts*

Systems-level dynamics allow us to conceptualize how concepts "have cultures" by thinking about idea habitats and niche construction. If ideas are like species, they may grow better in certain ecologies than others. Research has suggested that certain ideas persist and spread if they are frequently triggered by "cues" in the environment, thus engendering more or less robust "idea habitats" for certain proverbs or slang words (Berger and Heath, 2005).

The notion that concepts are contextually embedded in "idea habitats" provides a useful perspective on the research reviewed in this chapter. Rather than seeing perspective-taking, ecological relations, and folkbiological induction as separate variables (or as multiple "dependent" variables dependent on a single "independent" cultural factor), we could see them as interdependent elements of a shared cultural-ideological habitat. (And they are not only cognitive elements, but also are expressed and rooted in practices, artifacts, and environments.)

The proposal that some ideas persist because they are frequently cued by relevant "idea habitats" has a circular or tautological quality to it. Note, however, that a powerful force in biological evolution is "niche construction"—the processes whereby organisms not only adapt to their environments, but also adapt their environments to themselves. (For example, the shape of a finch's beak may adapt to a certain kind of seed, but,

in turn, because those seeds are better spread and fertilized by the finch's role, the finch is also creating a favorable environment for itself). Likewise, we suggest that ideas, practices, and artifacts can create environments that support and perpetuate themselves and closely related notions.

*2. Undermining distinctions between culture and cognition*

An ecosystems approach insists that culture and cognition are part of the same system, thereby motivating exploration of the interactions between these "levels" or "domains" (artifacts, practices, beliefs, frameworks, environments). Our own research illustrates how collectively, ideas, practices, and artifacts create local conditions mutually conducive to one another's existence. Perspective-taking of nonhuman animals, for example, is made possible in part by respect for nonhumans as intelligent beings (an explicit cultural belief), but also by the cultural practice of "putting oneself in the other's shoes" ("put your deer ears on") and the cognitive habit of thinking in terms of relationships rather than individual entities (an implicit framework). Children practice perspective-taking activities in everyday life, as when they read storybooks with multiple points of view. They may hear elders talking about how "everything has a role to play" in nature, and may come to recognize this firsthand through outdoor activities taking multiple points of view on nature.

By the same token, ecological reasoning depends on some minimal degree of knowledge about the organisms involved in a relation (experience and expertise), but also on attending to the multiple perspectives each organism brings to the relationship (e.g., how one species helps or hurts the other, or how the two interact). And of course, acknowledging symbiotic, mutually beneficial relations is unlikely unless one has considered the relationship from at least two points of view, is open to the idea of social cooperation in nature (which varies with cultural beliefs), and takes a systems-level point of view that spans temporal and ecological scales (e.g., the porcupine-forest example with Menominee versus European American hunters).

*3. Encouraging shifting levels of analysis and notions of domains.*

Another benefit of an ecosystems perspective is that it brings flexibility to the study of cultural cognition by constantly shifting our frames of reference. We think of this as searching for "the difference that makes a difference" when looking at systemic patterns within diversity. Imagine comparing two ecosystems: a Pacific Northwest forest ecology and a Caribbean island tropical ecology. Shifting our analysis from the presence of trees (yes, both places have them) to the species of trees and their interactions with soil characteristics will change our conclusions

considerably. As we suggested earlier, cultural systems may offer unique "soil characteristics" (foundational assumptions and principles) that strongly interact with the development of concepts and cognitive frameworks.

Take the case of cognitive domains. Recall that Carey (1985) proposed that (all) children begin with a human-centered folkbiology (premised on folkpsychology) and only gradually acquire a distinction between folkbiology and folkpsychology. Our studies showed that an anthropocentric folkbiology is neither a starting condition nor culturally universal.

Recently we have begun to wonder if the very notion of domains and domain-specificity could be culturally specific. (Note that the answer to this question is not going to be a simple yes or no; instead, it will depend on the differences that make a difference at the level of analysis deemed most relevant.) Clearly the notion of domains directs our attention in ways that may be limiting.

Although we ourselves have found the notion of folkbiology as a domain to be productive, it had unwelcome consequences when our attention turned to folkecology. In both Guatemala and in Wisconsin our studies of ecological relationships focused exclusively on plants and animals (living things), thereby ignoring natural inanimates such as soil, sun, wind and water. For the Itza' Maya of Guatemala, spiritual entities also play a role in protecting the forest. Note that if we had started with folkecology as the focal domain we would have been led to quite different and likely richer observations.

Many Indigenous communities teach their children that Nature is sentient (Fienup-Riordan & Rearden, 2011), and believe that nonhuman animals are intelligent social beings (Pierotti, 2011). These cultural axioms make it possible to observe and engage in social relationships with other beings where it would be unlikely given a different set of cultural axioms (e.g., that nature is inert, or that animals are unsophisticated thinkers).

We are now working on similar challenges with folkpsychology as a domain. Here, we find that Ngöbe adults and U.S. undergraduates have plenty of shared knowledge but organize this knowledge differently. Ngöbes tend to focus on an organism's relational capacities like interaction and communication, while U.S. undergraduates focus on internal capacities like thinking and information-processing. We believe that this distinction could matter a great deal in that Ngöbe cognitive scientists might well have found folkcommunication to be a more natural domain or framework. These frameworks converge in many cases (e.g., animal and human minds), but diverge in others, as in the case of plants. Many Ngöbes endorse mind-like

communication capacities for plants, while U.S. undergraduates tend to deny such capacities.

Recent research indicates that the Ngöbe are right (Davies and Schuster, 1981, Heil & Ton, 2008). Scientifically speaking, plants can communicate[3] and compute, but our U.S. participants judge them mind-less because they have no brain, so presumably do not experience a sense of "thinking."

Perhaps academic psychology's own cultural concepts (e.g., information-processing) underappreciated the relevance of communicative capacities when considering "theory of mind" concepts. Of course, if folkpsychology is organized around communicative rather than thinking capacities, then, as we have seen, plants are well-qualified members of the category. Academic psychology's own distinction between "folkpsychology" and "folkbiology" may be flavored by folk-concepts shared among Westernized individuals (so they typically work just fine in research with Western folks).

These findings illustrate how cultural groups and the scientists who study them (Medin & Bang, in press) can possess similar sets of knowledge but organize them differently, which occasionally leads to different readings of the world. One might ask, "Do Native and non-Native individuals "basically" think in the same domain-specific ways? Or do they "basically" diverge in conceptual organization and what counts as a domain?" The culture-as-ecosystems approach readily deals with both possibilities while recognizing that neither is complete. However, taking our cue from ecological models and Indigenous science, we propose that attending to interactions and relations raises productive new questions for cognitive psychology.

Researchers have traditionally been focused on folkbiology, folkphysics, and folkpsychology. These domains seemed self-evident, "carving nature at its joints," because they reflected basic ontological categories (kinds of things) and causal mechanisms (domain-specific interactions). But why not leave the joints intact and observe nature's movement patterns? From an Indigenous perspective, it makes sense to parse domains according to basic process categories (kinds of relationships) and systems-level principles (how diverse systems interact). In this analysis, "basic" conceptual domains emerge in the form of folkecology, folk-dynamics, and folk-sociology.

[3] Indeed they may even communicate using sound (Gagliano, Mancuso, & Robert, 2012).

Viewed through shifting levels of analysis, cognitive domains and their defining characteristics begin to appear more conventional than cognitive, at times revealing culturally-specific intuitions. In our view, the question is not which parsing of domains or level of analysis is "better," but rather which shifts in analytic perspectives will lead to deeper insights and move us to new territory.

*4. Acknowledging Complexity: Shifting from explanatory factors to systems*

Some scientists have argued that cognitive constraints prohibit the adequate conceptualization of multiple variables engaged in complex interactions and have inevitably led to our current environmental crisis, by fostering faulty models and deceptive simplifying premises (Buchanan, 2012).If so, are we cognitive scientists, embodying the same cognitive constraints, fated to misunderstand culture and cultural processes?

An alternative view is that these constraints may be cultural as well as cognitive and from this point of view, we urgently need multiple cultural perspectives on culture. We think that this would require more than good ethnography and, at a minimum, empowering other points of view. In our own work we have shifted from a Western perspective focused on the single dimension of psychological distance to a more relational, systems level orientation. It is very likely nonaccidental that this shift has been correlated with having members of our research team in central roles from indigenous cultures where relational epistemologies find fertile ground.

## VI. CONCLUSION

The markers of relational epistemologies we have reviewed here—including perspective-taking, ecological relations, conceptual organization, and attention to context—all point to ways of engaging nature from diverse perspectives and viewing it as an interconnected system. These perspectives support a view of nature in which humans are only one element, not the centerpiece, of life on Earth. Not only do Indigenous cultural systems embed these relational principles in cognitive frameworks, but they also mobilize these principles in practical interactions with nature. By enacting principles of "living in relation," with plants, animals, and other natural kinds (e.g., rocks, water), Indigenous communities may be uniquely equipped to recognize complicated dynamics in the natural world and to mobilize strategies that appreciate that complexity and use it to support sustainability. We could do worse.

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