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Human-centeredness is not a universal feature of young children's reasoning: Culture and experience matter when reasoning about biological entities☆

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ABSTRACT

We consider young children's construals of biological phenomena and the forces that shape them, using Carey's (1985) category-based induction task that demonstrated anthropocentric reasoning in young urban children. Follow-up studies (including our own) have questioned the generality of her results, but they have employed quite different procedures and either have not included urban children or, when urban samples were included, have failed to reproduce her original findings. In the present study of 4–10-year-olds from three cultural communities, our procedures followed Carey's more closely and replicated her findings with young urban children. However, they yielded quite different results for young rural European American and young rural Native American children. These results underscore the importance of a complex interaction of culture and experience – including both day-to-day interactions with the natural world and sensitivity to the belief systems of the communities – in children's reasoning about the natural world.

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1. Introduction

An important focus in the cognitive sciences is to identify how knowledge develops and how it is shaped by experience. Within this tradition, the domain of naïve biology – commonsense reasoning about biological phenomena – has attracted considerable interest. In a now classic study, Carey (1985) proposed that naïve biology is a distinct module, but one that is not acquired until sometime after age 6–7. This proposal has had a powerful impact but has also engendered controversy focused on how best to interpret the developmental data (Carey, 1995; Inagaki & Hatano, 2002) and the implications for broader issues, including how we reason about the relation between human beings and the rest of nature. Here we engage these issues but focus especially on the contributions of culture and experience in children's reasoning about the biological world.

Although issues of culture and experience have been addressed in other work (including our own), previous studies have a potentially serious limitation—their procedures have differed rather substantially from Carey's original methodology. Consequently, failures to replicate Carey's findings in other studies may simply reflect these procedural differences. Indeed, the one study using these other procedures that also included an urban sample (Ross, Medin, Coley, & Atran, 2003) did not replicate Carey's original results. Hence, the bearing of these other studies on Carey's main thesis is ambiguous at best. To foreshadow the current results, we offer evidence to suggest that cross-cultural and experiential differences go beyond methodological matters and reflect instead robust differences that emerge even when the methods employed are held constant across different communities. To set the stage, we begin with a brief review of the extant developmental evidence.

1.1. Category-based induction as a metric of reasoning about biological phenomena

How do young children reason about the biological world? Interestingly, research suggests that when young children consider the natural world, they adopt an anthropocentric stance, privileging humans over non-human animals in their reasoning. The strongest evidence for this anthropocentric stance in young children comes from Carey's (1985) pioneering research. In an inductive reasoning task, adults and 4–10-year-olds were introduced to a novel biological property (e.g., "has an omentum"), told that this property is true of one biological kind (either a human, dog, or bee), and later asked to identify other entities that share this property. Carey reported striking developmental changes in inductive generalizations. If the novel property had been introduced as true of a human, 4-year-olds generalized, or projected, that property broadly to other biological kinds as a function of their similarity to humans. Yet if the very same property had been introduced in conjunction with a non-human animal (dog or bee), they made relatively few generalizations to other animals. Carey (1985) pointed to two indices of anthropocentric reasoning in young children's judgments: (a) projections from humans were stronger than projections from dog or bee; and (b) strong asymmetries in projections to and from humans (e.g., inferences from *human* to *dog* were stronger than from *dog* to *human*).

In contrast, 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 or non-human (dog, bee) animal. Moreover, unlike 4-year-olds, their tendency to generalize a novel property was a function of the (intuitive) similarity of the base kind to target kinds (e.g., projections from either a *dog* or *human* base led to more generalization to other mammals than to invertebrates or insects). This pattern of induction was taken as evidence that for older children and adults, reasoning about the biological world is organized around a concept of *animal* that includes both human and non-human animals.

But what does the younger children's human-centered reasoning pattern in this task reveal about their perspective on the biological world? Carey (1985, 1994) has argued forcefully from these data that children hold a qualitatively different (and incommensurate) understanding of biological phenomena than do adults, and that development within the domain of biological knowledge entails fundamental conceptual change. More precisely, her claim is that young children (universally) view the biological world from the perspective of a *naïve psychology* (viewing humans as the paragon or prototype), a perspective that must be replaced as children acquire the mature perspective of a *naïve biology* (viewing humans as one biological kind among many).

Subsequent research stimulated by Carey's findings has called several aspects of this interpretation into question. For example, some have asked whether humans serving as a privileged inductive base is a universal feature of the mind or derives from young urban children's simply knowing more about humans than non-human animals (Hatano & Inagaki, 1994; Hatano & Inagaki, 1999; Inagaki & Hatano, 2002). Consistent with this alternative, Inagaki and Hatano (2002) and Inagaki (1990) 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 non-human animals as bases for induction derives from children's greater willingness to generalize from a familiar base than from an unfamiliar base. This is an important observation because it may be nearly universal that young children's experience with humans outweighs their experience with non-human animals, and this experience may lead them to privilege humans as an inductive base.

Other researchers, asking whether an anthropocentric pattern of reasoning is in fact universal among young children, have conducted cross-cultural, developmental studies on biological knowledge and reasoning in several different cultural communities (Anggoro, Waxman, & Medin, 2005; Atran et al., 2001; Medin & Atran, 2004; Ross et al., 2003; Waxman, Medin, & Ross, 2007), including comparisons of urban and rural European American children and comparisons of rural European American children and rural Native American (Menominee) children. The logic underlying the urban-rural comparison is straightforward: with regard to experience, rural children are the analog to Inagaki and Hatano's goldfish-raisers, except that they likely have even more extensive experience with a wide variety of biological kinds. The logic of the European American-Menominee contrast is also transparent: how is children's reasoning about biological phenomena affected by cultural orientations toward the natural world? Note that neither culture nor experience is an independent variable, nor are they independent of each other. For example, rural European American and rural Menominee groups report engaging in outdoor activities for comparable amounts of time, but the specific activities engaged in and whether such activities tends to fore-ground (e.g., forest walk) or background (e.g., playing football) the natural world differ substantially across groups (Bang, Medin, & Atran, 2007).

These cross-cultural data apparently indicate that anthropocentrism is not a universal feature of young children's biological reasoning. Five-year-old children raised in some communities do not favor humans as an inductive base. As noted earlier, however, this view rests on data involving substantial procedural changes from Carey's original work. For example, Carey tested for generalization days later, while other studies have used immediate testing. Reinforcing this concern is the observation that when young urban children participate in these modified versions of the induction task, they too fail to exhibit the anthropocentric stance reported by Carey (Anggoro, Medin, & Waxman, in press; Ross et al., 2003). In short, previous work demonstrates differences in children's biological inductions across cultures and communities, but their bearing on Carey's data and her associated claims is, at best, clouded by methodological matters. The present work is aimed at clarifying these matters.

1.2. Methodological issues

In Carey's original study, training was extensive and detailed and inductive generalization was assessed days later. More recent procedures have used more superficial training and an immediate generalization test. In addition, in Carey's study each child performed the induction task only once, using a single base (e.g., either a human or a dog or a bee); in more recent implementations, each child performs the induction task more than once, each time using a different base (e.g., both a human and a dog, presented in counterbalanced order across participants) (Anggoro et al., in press; Atran et al., 2001; Ross et al., 2003). These more recent studies have revealed no evidence of human-centered reasoning, even in young urban children. An additional concern about these studies is evidence of order effects in their within-participants designs. Specifically, young children's tendency to generalize a novel property from a human base to other animal targets is considerably stronger when the human serves as their first, as compared to a later, base. Moreover, this order effect is evident across communities, including urban children raised in Indonesia and the USA (Anggoro et al., in press). This raises the possibility that anthropocentric reasoning would have been observed had these studies varied base between rather than within participants.

This order effect, interesting in and of itself, is consistent with Medin and Waxman's (2007) analysis of the sources underlying asymmetries in inductive reasoning tasks. They proposed that the distinctive features of a target (including its distinctive category label) will reduce generalization from a base to a target. For example, when a human is the target, distinctive features of humans are activated (likely including the everyday senses in which humans are not animals). The order effects suggest that when these distinctive features are activated, they influence children's judgments on subsequent trials, including those in which humans serve as the base. The activation of distinctive features presumably holds for all targets, but humans may have more distinctive features than other target categories (e.g., other animals), including the contrastive sense of human (Leddon, Waxman, & Medin, in press; Anggoro, Waxman, & Medin, 2008). Children's spontaneous comments during Anggoro et al.'s induction task fit well with this interpretation. When a non-human animal served as the base for induction (and therefore a human appeared first as a target), children typically did not extend the novel property to the human, and in their spontaneous comments often mentioned that 'humans are not animals'. But when a human served as the first base, children virtually never mentioned that 'humans are not animals" or that the target category was not a human. The order effects suggest that this focus on distinctive features of humans ('humans are not animals') carries over to subsequent trials in which a human serves as the base.

Clearly, a goal for future work will be to pursue the source of these order effects and their implications for young children's intuitions about the place of humans in biological reasoning. For the moment, however, we focus on a procedure that follows Carey's original procedure more closely and avoids such order effects.

1.3. The present experiment

Here we adopt a procedure patterned closely after Carey's original between-participants design to examine the reasoning patterns of children from three distinct US populations: urban, rural European American, and rural Native American (Menominee). Although the logic of our design and our analysis entails two pairwise comparisons, we resist the idea that a single factor is being varied while holding other factors constant. We compare urban and rural European American children to assess the role of "direct" experience with the natural world in biological induction.[1] If extensive contact with biological kinds shapes the trajectory of children's biological reasoning (Inagaki & Hatano, 2002), rural children should be less likely than urban children to favor humans as an inductive base. Note, however, that this urban, rural contrast is associated with a wide range of correlated differences (for example, hunting and fishing may receive greater emphasis in rural contexts, urban children may be exposed to anthropomorphic images to a greater degree, pets may play a different role in households, etc.).

In addition, we compare the rural European American children and rural Menominee children to identify the role of cultural factors in biological induction. If Menominee children view humans as qualitatively less separate and distinct from other animals than do their European American counterparts (Bang et al., 2007), they should be less likely to adopt an anthropocentric stance or to focus on the category *human* (vs *animal*). As a consequence, asymmetries favoring humans over non-human animals as an inductive base, if present at all, should be attenuated in Menominee children.

2. Method

2.1. Participants

Children were recruited from public schools in rural Wisconsin and urban Chicago, Illinois, and from a Wisconsin Menominee Head Start program, a county grade school, and the tribal school on the

[1] We recognize that we are implicitly making assumptions about "direct experience" and "natural world" that would not hold up under closer scrutiny. It is literally true that we all live in the natural world all the time. Our statement should be read as a gloss on the intuition that plants and animals are more salient in the daily lives of rural populations than they are for urban populations. It remains to be seen whether researchers can deliver on this notion of salience (for one effort in this direction, see Bang et al., 2007).

Table 1
Number of participants for each community and age group.

Population	Base	Age		
		4–5	6–7	9–10
Urban	Human	22	25	15
	Dog	25	24	15
Rural	Human	25	23	13
	Dog	28	23	15
Menominee	Human	21	25	19
	Dog	20	21	22

Menominee reservation. We briefly describe our populations below (see Medin, Ross, & Cox, 2006; Medin, Ross, Cox, & Atran, 2007; Ross, Medin, & Cox, 2007 for additional background and details on the Wisconsin populations). In each of the three populations (urban, rural, Menominee), children were drawn from three age groups: 4–5-year-olds, 6–7-year-olds, and 9–10-year-olds. See Table 1 for sample sizes.

2.1.1. *Rural Native American (Menominee) population*

The Menominee ("Wild Rice People") are the oldest continuous residents of Wisconsin. Original Menominee lands encompassed about 9 million acres and these were reduced, treaty by treaty, until they reached the current 234,000 acres. The present lands are a proper subset of the original lands and they contain numerous culturally significant sites. About 4000–5000 Menominee live on the reservation and perhaps an equal number live off it (Grignon et al., 1998). Extensive efforts are underway to revive Menominee language but all our Menominee sample use English as their first language. The Menominee are renowned for their sustainable forestry practices (Hall & Pecore, 1995) and the reservation is largely forested and contains numerous lakes and streams. Hunting and fishing are important activities and even very young children are introduced to fishing. It is also worth noting that in contrast to what children are taught in school (that only plants and animals are alive) the traditional Menominee notion of *alive* includes natural inanimates (e.g., rocks and water) and may even include artifacts, depending on the purpose for which they were made.

The Menominee have an animal based clan system featuring five major clans (bear, wolf, crane, eagle, moose). In addition, in the Menominee origin story, humans evolved from the bear and the bear clan is currently the largest on the Menominee reservation. Because the bear occupies a special status in Menominee culture, we included a bear among the target animals. We thought that Menominee children would generalize a novel property more readily from a human base to a bear target than would children from the two non-Native populations.

2.1.2. *Rural European American population*

Adjacent and to the south of the Menominee reservation is Shawano County. It is replete with farmland, small forest plots, and lakes and rivers. The town of Shawano has a population of approximately 8000. Hunting, fishing, and water recreation are popular outdoor activities for adults and children, and children are also introduced to fishing at an early age (Medin et al., 2006).

2.1.3. *Urban population*

The urban children were recruited from a racially and ethnically diverse public magnet school. Their direct contact with animals is generally limited to visits to the zoo, caring for family pets, and noticing the native animals (squirrels, pigeons) that live in urban areas.

3. Procedure

Children were interviewed individually by a trained female researcher in a quiet place in their school on 2 days. Menominee children were interviewed by a Menominee researcher, and European American children by a European American researcher.

Day 1: On the first day, the child was introduced to a base kind (either a human or a dog) and taught that a novel property (e.g., "...has an omentum") applied to that kind of object. The researcher showed the child a line drawing of the base, drew a small yellow circle in the abdomen to represent the omentum, and asked the child to do the same on their own copy of the drawing. The researcher also showed the child a photograph of the base, and pointed out the location of the omentum. Children were encouraged to repeat the word, "omentum" several times. To identify how children interact with animals in their daily lives, children were asked questions about their day-to-day experiences with animals: whether they owned a pet, went hunting or fishing, and if they had visited a zoo.[2] After this interval, the researcher asked the child if they remembered the new word they had learned and asked the child to point out its location on the photograph of the base. If the child did not remember "omentum", the researcher repeated the word.

Day 2: A day or two later, the same researcher engaged children in the category-based induction task. To insure that children could identify the target items, the researcher first presented a color photograph of each of the 16 target items (human, dog, bear, aardvark, eagle, toucan, trout, angelfish, bee, fly, maple, dandelion, sun, rock, computer, pencil), one at a time in random order, and asked the child to identify them by name. On the rare occasion that a child named an item incorrectly, the researcher offered the correct name. Next, in the category-based induction task, the researcher asked, for each photograph, "Do *X*s have an omentum?" The inclusion of the original base in this set can be seen as a retention test and in the rare circumstance when a child did not attribute the property to the base item we excluded that child's data.

4. Results

Children in all three populations and at all three ages understood the demands of this task and were able to respond systematically. For example, their tendency to project the novel property was consistently high for the animal targets ($M = 0.66$) and consistently low for the nonliving things ($M = 0.12$).[3] We focused our analyses around the indices of human-centered reasoning developed by Carey (1985).

First, we considered the relative strength of a human base versus a non-human base for projecting the novel property to other animals. For this analysis, we calculated each child's tendency to generalize the novel property from either the human or dog base to the remaining animal targets (bear, aardvark, eagle, toucan, trout, angelfish). Because our goal in this analysis was to consider children's tendency to generalize a novel property beyond the animal on which it was introduced, we excluded the dog and the human as targets (see Fig. 1). (In addition, because very young children are unsure about the status of insects as animals (Coley, Shafto, Stepanova, & Barraff, 2005; Inagaki & Sugiyama, 1988), we excluded the bee and fly from this analysis as well.) Second, we considered asymmetries in reasoning. For this analysis, we focused specifically on the dog and human targets, calculating for each age and each population the proportion of children projecting the novel biological property from the human base to the dog target or from the dog base to the human target (Fig. 2). To be included in these analyses, children had to generalize the novel property from the base to the target object from the same category (e.g., from the human base to the human target; from the dog base to the dog target). Of the 381 children interviewed, 16 were excluded for failing to meet this criterion. Another seven were excluded because they said 'yes' to all targets.

[2] Menominee and rural European American children were more likely than urban European American children to own a dog (65%, 66% and 17%, respectively), and more likely to own any pet (75%, 81%, and 43%, respectively). Menominee dog owners, however, were more likely (70%) than rural (34%) or urban (10%) to report that at least one of their dogs lived outdoors. While both Menominee and rural European American children were more likely than urban European American children to have hunted (48%, 32% and 6%, respectively) or fished (77%, 89% and 34%, respectively), Menominee children were less likely than rural and urban European American children to have visited a zoo (81%, 92% and 98%, respectively). Following Inagaki and Hatano (1993), we examined whether pet ownership affected children's inductive generalizations. We found no reliable effects of pet ownership on patterns of generalization.

[3] See http://groups.psych.northwestern.edu/medin/Publications.html for a table of means for each target for each population at each age.

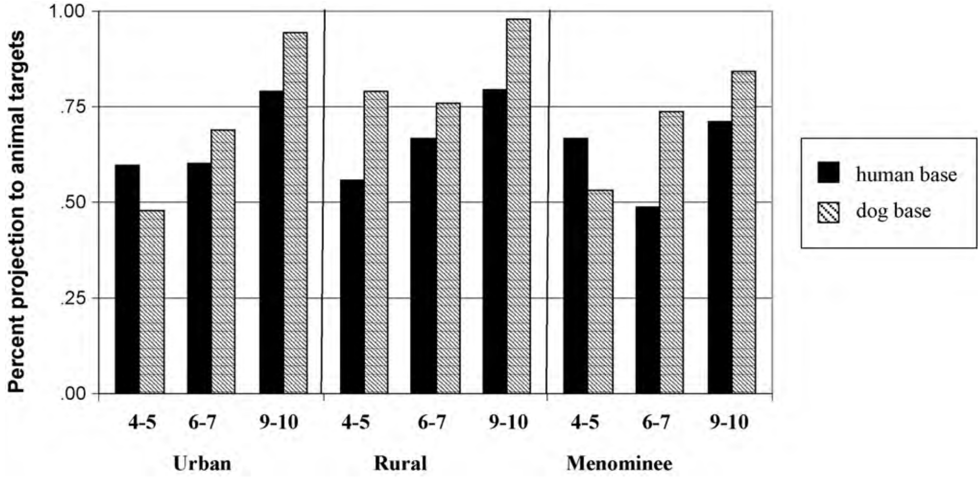

Fig. 1. Projection to animals from human base and from dog base for each population and age group.

4.1. Developmental profiles of each population

We begin with a brief description of the patterns observed in each population, noting especially how performance compares to previously reported evidence, and then turn to urban–rural and cultural comparisons.

4.1.1. Urban population

A key finding is our replication of Carey's (1985) finding of human-centered reasoning for 4–5-year-olds in both their generalization patterns and asymmetries. Also, 9–10-year-olds replicated Carey's results on both measures. But the 6–7-year-olds showed a somewhat different pattern. Children at this age did not favor humans in their generalization patterns (in contrast to Carey, 1985), yet did favor humans in the analysis of human–dog asymmetries (replicating Carey, 1985).

4.1.2. Rural European American population

In contrast to their urban counterparts, in this population, the generalization patterns of even the youngest children showed that the dog was a more effective inductive base than the human. At

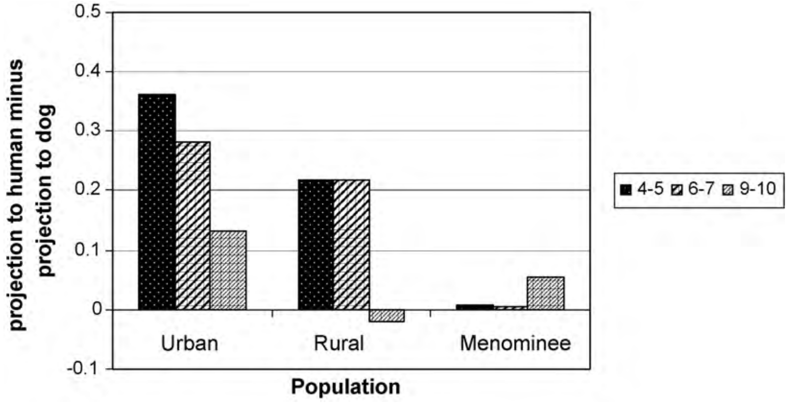

Fig. 2. Asymmetries of projections from human to dog and from dog to human.

the same time, in the analysis of human–dog asymmetries, 4–5-year-olds and 6–7-year-olds favored humans over dogs. This outcome, as well at the data from 6- to 7-year old urban children, provides evidence that these two indices (asymmetries and generalizations) are separable.

4.1.3. Rural Menominee population

Like their urban counterparts, 4–5-year-old Menominee children favored the human over the dog as a base when generalizing a novel property to other animals. In part, this may reflect the cultural significance of bear: generalizations from human to bear are especially strong (0.86) for 4–5-year-old Menominee children, compared to urban (0.67) and rural European American (0.52) children. In contrast to urban children, young Menominee children showed no evidence of human–dog asymmetries.

4.2. Comparisons between populations

4.2.1. Urban vs Rural European American

If close experience with animals and participation in nature-based activities influence patterns of reasoning about biological properties, urban children may display more human-centered patterns of induction than rural children, and this should be seen in both their tendency to generalize novel properties and in their human–dog asymmetries.

4.2.1.1. Generalization to non-human animal target categories. In the first analysis, we ask whether children's tendency to generalize a novel property to the non-human animal targets varies as a function of the base on which the property was introduced. At each age, we submitted each child's proportion of generalizations to the non-human animal targets to an analysis of variance (ANOVA) with Community (2: Urban, Rural) and Base (2: Human, Dog) as between-participants variables.

The results for the 4–5-year-olds are of greatest theoretical interest. As predicted, there was an interaction between community and base ($F(1, 86) = 4.67$, $MSE = .146$, $p < 0.05$). Post hoc analyses of this interaction revealed that when a human served as the base, children from the two communities performed comparably, $F(1, 42) = .09$, $MSE = .168$, $p = .765$), but when a dog served as the base, urban children were less likely than rural children to generalize the novel biological property to non-human animal targets, $F(1, 44) = 8.89$, $MSE = 1.117$, $p < .01$.

For the 9–10-year-olds, there was a main effect of base, $F(1,54) = 9.61$, $MSE = .042$, $p < 0.01$), indicating that for rural and urban children alike, dog served as a stronger inductive base than did human at this age. The 6–7-year-olds' data mirror this pattern, but did not reach significance. These results are illustrated in Fig. 1.

4.2.1.2. Asymmetries in inductive inferences. We next consider whether urban children show more asymmetric generalization, favoring humans as the inductive base, than rural children. We focused specifically on generalizations from human to dog and from dog to human. For each age group, we submitted the Human–Dog Values to an ANOVA with Community (2: Urban, Rural) and Base (2: Human, Dog) as between-participants variables.

The results are depicted in Fig. 2. A main effect of base indicated that there were reliable asymmetries favoring humans in 4–5-year-olds, $F(1,86) = 8.86$, $MSE = .213$, $p < 0.01$, and in 6–7-year-olds: $F(1.90) = 7.26$, $MSE = .201$, $p < 0.01$. There was no such asymmetry for 9–10-year-olds.

4.2.2. Rural European American vs Rural Native American (Menominee)

If the belief systems of a given community influence children's reasoning about biological phenomena, rural Menominee children should be more likely than rural European American children to consider the relation between humans and other animals, especially clan animals, in their reasoning.

4.2.2.1. Generalization to non-human animal target categories. For each age group, we submitted each child's proportion of generalizations to the target animals to an ANOVA with Community (2: Rural European American, Rural Menominee) and Base (2: Human, Dog) as between-participants variables. For the 4-5-year-olds, there was a Community by Base interaction, $F(1,72) = 4.30$, $MSE = .142$, $p < 0.05$. Follow-up analyses of this interaction revealed that when a dog served as the base, rural European

American children were more likely than Menominee children to generalize a novel biological property to the remaining animal targets, $F(1, 37) = 4.86$, $MSE = .130$, $p < .05$, but that when a human served as the base, children from the two rural communities performed comparably, $F(1, 35) = .664$, $MSE = .155$, $p = .421$. For each of the two older age groups, there was a main effect of base, indicating that in both populations, dog served as a stronger inductive base than did human at this age – 6–7-year-olds, $F(1,87) = 5.21$, $MSE = 0.130$, $p < 0.05$; 9–10-year-olds, $F(1,65) = 6.76$, $MSE = 0.06$, $p < 0.05$.

4.2.2.2. Asymmetries in inductive inferences. We next focused on children's generalizations from human to dog and from dog to human. For each age group, we submitted children's generalizations to an ANOVA with Community (2: Rural European American, Rural Menominee) and Base (2: Human, Dog) as between-participants variables. Although at 4–5-years and 6–7-years, Menominee children appear to exhibit much less pronounced asymmetries than do their counterparts in the European American population, the difference between populations was not reliable at any age.

5. Discussion

Our goal in this cross-cultural, developmental study was to consider young children's construals of biological phenomena and the forces that shape them. Given that several previous studies have followed up Carey's 1985 finding, there is a sense in which our current contribution is primarily methodological: Previous critiques of the generalizability of Carey's results to other samples may seriously confound procedure with study population. We followed Carey's method with enough fidelity that we were able to replicate her finding of human-centered reasoning in 4–5-year-old urban children. With worries about procedure more or less out of the way, we found that neither rural European American children nor rural Menominee samples demonstrated Carey's two markers of anthropocentrism (human–animal asymmetries and humans as a more effective base than animals). Although our interpretation of these cultural and experiential differences draws on ideas from previous work, we now do so on much more solid empirical grounds.

The current results advance our understanding in several ways. First, our findings document that the human-centered pattern reported by Carey for young children is far from universal. Second, we establish that two signatures of anthropocentric reasoning in Carey's account – generalization and asymmetries – are in fact distinct (Medin & Waxman, 2007). This is important because it reveals that these two measures do not necessarily tap a single underlying model or construal of biological phenomena.

These results also underscore the importance of experience – including both children's day-to-day interactions with the natural world and their sensitivity to the belief systems of their communities – in children's reasoning about the natural world. Unlike their urban counterparts, young rural European American children show no sign that humans are a privileged inductive base when reasoning about biological phenomena. The comparison between young urban and young rural European American children suggests that day-to-day interaction with the natural world (and correlated values and beliefs) has an impact on children's patterns of inductive inference. The comparison between rural European American and rural Menominee children reveals that the culturally held belief systems within a community also appear to influence children's reasoning about biological phenomena. Taken together, our findings suggest that the impact of culture and experience are most pronounced in our youngest samples. (See Waxman et al. (2007) and Anggoro et al. (in press), for converging evidence that the most pronounced effects are observed in young children.)

Our results further undermine the idea that children's initial biology is universally human-centered. Beyond that, it is not easy to pinpoint the basis for specific patterns of induction. Consider, for example the finding that the youngest rural Menominee children generalized less from a dog base than did the youngest rural European American children. One explanation for this finding is that rural European American children are more likely than Menominee children to have dogs as indoor pets and to learn more about them. This greater familiarity and expertise with respect to dogs may lead to dogs being a stronger base for induction (Inagaki & Hatano, 2003). But a competing explanation is that young Menominee children are more likely to think about ecological relations among biological entities (Ross et al., 2003) and therefore less likely than European American children to generalize from a domestic base animal (dog) to wild target animals. It would take other observations and studies to distinguish these two interpretations (see, for example, Coley, Vitkin, Seaton, & Yopchick, 2005, and Coley, 2007, for studies using different kinds of properties to differentiate alternative generalization strategies). We suggest that to obtain more leverage in understanding children's biology and the role of cultural and experiential factors, it is essential to extend research beyond the induction task to include multiple converging measures (Anggoro, 2006).

Perhaps most importantly, the current work provides strong evidence that the anthropocentric pattern displayed by young urban children is not a universal starting point for development, but is itself culturally inflected, likely reflecting urban children's sensitivity to an anthropocentric cultural model that is passed along within the discourse of their communities. Several implications follow from this view. First, there should be evidence that the input to children being raised in urban communities differs from that to children raised in rural communities. Recent research is consistent with this possibility. In urban and rural communities, where parents have quite different distributions of expertise and day-to-day experience with the biological world, researchers have uncovered differences in children's reasoning (Ross et al., 2003; Tarlowski, 2006; Waxman et al., 2007). Additional research is required to capture fully the input available to young children from different communities and to characterize its influence.

Second, if the human-centered reasoning pattern seen in young urban children represents the acquisition of a culturally transmitted anthropocentric model, this should also have developmental implications. It may be the case that urban children younger than 4–5 years of age, who have received less exposure to the anthropocentric model, do not (yet) favor humans over non-human animals in their reasoning. Recent evidence with 3-year-old urban children provides support for this possibility. Unlike 4–5-year-old urban children, 3-year-olds show no hint of anthropocentricism in their reasoning (Herrmann, Waxman, & Medin, 2007, submitted for publication).

In conclusion, it is important that our theories of development be sufficiently comprehensive to accommodate evidence from the range of communities in which children are raised and the breadth of community-held beliefs that figure centrally in each. This is not simply a call for methodological consistency or for broader and more representative sampling. It is also a petition to consider carefully the contribution of children's culture and experience as they acquire systems for reasoning about the biological world.

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