Paper

Human Development 2007;50:23–30
DOI: 10.1159/000097681

Human Development

Experience and Cultural Models Matter: Placing Firm Limits on Childhood Anthropocentrism

Sandra Waxman Douglas Medin

Northwestern University, Evanston, Ill., USA

Key Words
Anthropocentrism · Biological concepts · Cognitive development · Culture · Experience · Language development

Abstract
This paper builds on Hatano and Inagaki's pioneering work on the role of experience and cultural models in children's biological reasoning. We use a category-based induction task to consider how experience and cultural models shape rural and urban children's patterns of biological reasoning. We discuss the implications of these findings for developmental theory and educational practice.

The Concept 'Alive' – A Developmental View

Considerable developmental research has been devoted to understanding the acquisition of biological concepts and reasoning. This work has roots in the piagetian tradition, which claimed that children's reasoning about core biological concepts, such as the concept 'alive,' was qualitatively different than that of adults [Piaget, 1954]. In particular, young children's responses in Piagetian interviews led to a widely held view that they were animistic in their thinking, attributing living kind status to a broad range of nonliving entities (e.g., clouds, bicycles). In other tasks, however, young children respond differently, tending to attribute living kind status to an overly restricted set of entities (to animals, but not plants) [Hatano, et al., 1993; Keil, 1983; Opfer & Siegler, 2004; Stavy & Wax, 1989]. Another key finding in this arena concerns young children's apparent *anthropocentrism,* in which they tend to rely heavily on humans as a privileged inductive base whenever they are asked to attribute biological properties (e.g., being alive, having a heart) to other animals. Clearly, questions concerning the nature of the biological concepts held by children and their relation to those held by adults are very much alive.

KARGER

Fax +41 61 306 12 34
E-Mail karger@karger.ch
www.karger.com
Accessible online at:
www.karger.com/hde

Sandra Waxman, Department of Psychology
Northwestern University, Swift Hall
2029 Sheridan Road, Evanston, IL 60208 (USA)
Tel. +1 847 467 2293, Fax +1 847 491 7859
E-Mail s-waxman@northwestern.edu

The Pioneering Contributions of Giyoo Hatano

Giyoo Hatano's fresh insights into this area of inquiry cannot be overestimated. In his pioneering work with his longtime collaborator Kayoko Inagaki, he has made lasting theoretical and educational contributions regarding the biological concepts held by children. Our goal in this paper is to honor their contributions, pointing out the ways in which their insights into the role of experience and cultural models have shaped our cross-cultural developmental research program on biological reasoning.

Culture, Experience and Childhood Anthropocentrism

Captivated by the issue of biological concepts and reasoning, domain specificity, and developmental change, Hatano and Inagaki [Inagaki & Hatano, 1993, 1996, 2002; Hatano & Inagaki, 1994, 1999, 2000] launched a multifaceted developmental research program. In one line of work, they considered how the cultural models espoused within a community shape children's biological reasoning. These 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.*[1]

In another facet of their ingenious program, Inagaki and Hatano [Inagaki, 1990; Hatano & Inagaki, 1994; Inagaki & Hatano, 2002] focused on children's direct experience and identified a potential source for the *anthropocentric* pattern we described earlier. Of course, children's experiences with the biological world are varied, including not only the cultural models and beliefs espoused within the community, but also their habitual surroundings (e.g., rural vs. urban), their informal learning opportunities (e.g., direct hands-on experience, including farming, fishing, summer camp activities), and perhaps more remotely, their experiences in more formal learning environments and access to videos, books, and visits to the zoo [Inagaki, 1990; Rosengren, Gelman, Kalish, & McCormick, 1991].

Hatano and Inagaki examined the role of experience by identifying urban Japanese children who had cared for and raised goldfish in their homes, and those who had not. When they then assessed these children's attributions of biological properties, they found that children without goldfish-raising experience showed an anthropocentric pattern, but that those who had raised goldfish did not. This suggests that anthropocentrism may be mediated by children's experience, a point to which we will return below.

Still, the anthropocentric pattern produced by urban Japanese children who did not raise goldfish converged well with Carey's [1985] results with urban Boston children's performance in a category-based induction task. In this task, an interviewer introduced children to a picture of a biological entity (either a human, dog, or bee) and taught them about an unfamiliar biological property (e.g., has an omentum) of that entity. Next, children were asked whether that novel property could also be generalized to other entities [including other humans, nonhuman animals, inanimate natural kinds (e.g., sun), and artifacts (e.g., garlic presses)]. Carey [1985] reported

[1] Vitalism is not restricted to Japanese children: Australian children also preferred vitalistic explanations for bodily phenomena [Morris, Taplin, & Gelman, 2000].

that 4- and 6-year-olds, unlike older children and adults, hold an anthropocentric conception of the biological world, treating *human* as a privileged inferential base.

She took this finding as evidence that young children's knowledge pertaining to the biological world is organized around a model in which humans stand as the prototypical exemplar, and that development in this domain is characterized by pervasive conceptual change which is necessary to catapult children from this anthropocentric model to the more adult (Western science-oriented) model in which humans stand as one animal among many (Medin and Waxman [in press] provide an extended discussion of alternative interpretations of these asymmetries in induction).

Limits on Childhood Anthropocentrism

Importantly, however, the evidence from Hatano and Inagaki suggested that there may be limits on this anthropocentrism: this pattern may not be universal, but may instead be mediated by experience. This also challenged the view that development within the domain of biological knowledge necessarily entails radical conceptual change [Carey, 1985]. In fact, it suggested an alternative: urban children's propensity to view humans as a privileged inductive base may be driven by their relatively impoverished knowledge about animal kinds other than humans. If this interpretation is correct, then children with more knowledge and experience with the biological world should be less likely to reason anthropocentrically. This, of course, is exactly the pattern observed in urban Japanese goldfish-raising children.

In our research, we have been inspired by Hatano and Inagaki to pursue this possibility experimentally. We are involved in a cross-cultural developmental series of studies on biological knowledge and reasoning spanning several different communities [Anggoro, Waxman, & Medin, 2005; Ross, Medin, Coley, & Atran, 2003, Medin & Atran, 2004; Waxman, Medin & Ross, in press]. In this paper, we focus on urban versus rural children being raised in the USA. The logic underlying this urban-rural comparison is straightforward: with regard to experience, rural children are the counterpart of Inagaki and Hatano's goldfish raisers, except that they likely have even more extensive experience with a wider variety of biological kinds. Thus far, our results with rural children offer no evidence for an anthropocentric pattern, providing support for the view that children's experience with a biological kind affects the strength of that kind as an inductive base [Atran et al., 2001; Ross, et al., 2003; Medin & Waxman, in press]. However, the performance of our urban Chicago preschool-aged children throws a fly in the ointment: they too have failed to show the anthropocentric pattern [Anggoro, et al, 2005].

Why might this be the case? Perhaps this discrepancy in the performance of urban children in our work and in Carey's and Hatano and Inagaki's studies reflects, at least in part, a methodological difference in experimental design. In these latter versions, information about a biological kind is gathered at one point in time, and children participate in the category-based induction task several days later. Carey's version involved explicit teaching. Children were introduced to a base object (either a human, dog, or bee) and taught extensively about a novel property of that object (e.g. 'has an omentum'). In Inagaki and Hatano's designs, there was no explicit teaching: they simply measured the cognitive consequences of intensive experience raising goldfish. We refer to procedures like these, in which training occurs prior to the

category-based induction test, as 'spontaneous generalization' tasks. In contrast, in our lab we have relied upon what we might call 'prompted generalization': we teach children that some biological entity (e.g., a human or a dog) has some biological property (e.g., an omentum) and then immediately observe children's inductive inferences from this base to a variety of other kinds.

Investigating Anthropocentrism in US Children from Rural and Urban Communities

To examine the consequences of this methodological difference, we designed a close conceptual replication of Carey's procedure. On day 1, children were introduced to a novel property and were taught that this was a property true of either humans, dogs, or bees. On day 2, children were given an opportunity to project that property to a range of kinds in a spontaneous generalization task. To examine the role of experience, we worked with urban and rural children. If the discrepant results for young urban children reflect primarily methodological differences, then in the current task, urban children should reveal an anthropocentric pattern, treating humans as a stronger inductive base than either of the nonhuman animals (dog, bee). Moreover, if experience with biological kinds shapes the trajectory of children's biological reasoning, then rural children should not treat humans as a privileged inductive base.

We tested 203 4- to 7-year-old children from public schools in Shawano, Wisc. (rural) and Chicago, Ill. (urban). Shawano County is replete with farmland, small forest plots, and lakes and rivers. Hunting, fishing, and water recreation are popular activities for adults and children. For children in Chicago, recruited from a racially and ethnically diverse public magnet school, direct contact with animals is generally more limited to visits to the zoo, caring for pets, and noticing the native animals (squirrels, pigeons) that live in urban areas. Table 1 shows the number of children in each community and age group.

Children were interviewed individually in a quiet place in their school on two different days. On the first day, they were introduced to an object (either a human, a dog or a squirrel) and taught that a novel property (e.g., 'has an omentum') applied to that kind of object. Children then answered a few questions about their pets and outdoor activities. A day or two later, children completed the category-based induction task, involving color photographs of 16 target items, including a person, dog, bear, aardvark, bee, fly, eagle, toucan, trout, angel fish, maple tree, dandelion, sun, rock, computer, and pencil. For each photograph, children were asked, 'Do *X*s have an omentum?'[2] We computed each child's tendency to generalize the novel property from their designated base to the targets.

The results, depicted in figure 1, indicated that the anthropocentric pattern was apparent only in the youngest urban children, and only weakly so at that. In every other group, nonhuman animal bases (both dogs and bees) were on at least equal footing with humans in their inductive strength. Thus, in this 'spontaneous' version of the category-based induction task, we more or less replicated Carey's and Inagaki and Hatano's anthropocentric pattern – but only with our youngest urban children.

[2] We described the base and target items with generic nouns to clarify the category-based nature of the task.

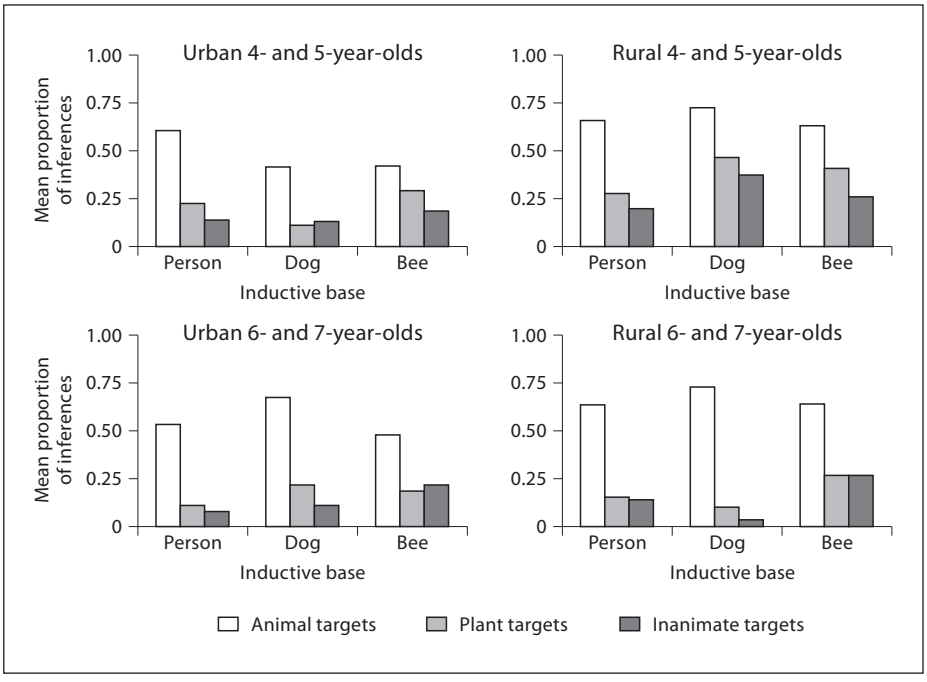

Fig. 1. Mean proportion of inferences from each inductive base to each target category, expressed as a function of age and community.

Table 1. The number of children in each community and age group who were trained on each base

	Person	Dog	Bee
Urban 4- and 5-year-olds	20	20	19
Urban 6- and 7-year-olds	14	15	15
Rural 4- and 5-year-olds	19	15	22
Rural 6- and 7-year-olds	16	15	13

We did not observe an anthropocentric pattern in any other population – including the young rural children.

This pattern of results suggests that although procedural differences may be instrumental in the expression of an anthropocentric pattern in young urban children, a thorough developmental account will need to go beyond task and age considerations alone. Perhaps most importantly, the current results underscore the importance of considering the role of experience in the development of core biological concepts and reasoning. This focus on experience brings us full circle back to the insights provided by Hatano [Hatano & Inagaki, 1994; Inagaki & Hatano, 2002].

(Re)conceptualizing 'Experience' and Development

First, how can we best conceptualize the role of experience in children's biological reasoning? Perhaps children across the world's communities undergo a universal developmental trajectory. Perhaps, as Carey suggested, this trajectory involves radical conceptual change, in which a new domain (folkbiology) emerges from a previously established domain (folkpsychology). In her view, it is this developmentally prior domain of folkpsychology that undergirds the anthropocentric pattern, in which humans are seen as the prototype. On this view, perhaps rural children fail to show an anthropocentric pattern simply because their richer experience with the natural world permits them to move more rapidly along this universal trajectory. If this is correct, then we should find evidence of an anthropocentric pattern in rural children, but at a still younger age. We are currently pursuing this possibility.

There is, however, an alternative interpretation. Perhaps there is a universal developmental trajectory, but one that does *not* necessarily include an early anthropocentric period. Perhaps the anthropocentric pattern is itself culturally inflected, reflecting urban children's sensitivity to an anthropocentric cultural model that is passed along within the discourse of their communities.

Parental Input to Young Children

This interpretation becomes plausible when considered in conjunction with recent evidence concerning parental input to young children. First, in their analysis of conversations between mothers and their 2-year-old children, Gelman, Chesnick, and Waxman [2005] observed an intriguing phenomenon: when conversing about a picture of an individual object (e.g., a dog), these mother-child dyads tended to focus their remarks on the category of object represented in the picture. However, when they were presented with a toy object (rather than its picture), they focused more on the individuals themselves, including a considerable amount of anthropomorphizing. More specifically, both mothers and children tended to (a) talk directly to the objects (e.g., 'Hi there! How are you?'), (b) provide proper names for the objects (e.g., 'This dog is called Fred.'), and (c) talk 'for' the object (e.g., 'I'm hungry!'). This suggests that an anthropocentric model is presented to children by their parents. But because the study by Gelman et al. [2005] was conducted with urban and suburban dyads, whether rural parents would provide the same model is an open question. Certainly, there may be differences in urban and rural communities' patterns of discourse about biological kinds and if this is the case, it is very likely that children from these two settings are exposed to quite different distributions of experiences concerning the biological world [Tarlowski, 2006]. More broadly, our current work echoes Hatano's suggestion that differences in cultural models matter.

In another line of research, we have noted differences in biological induction tasks among children raised rurally, but in different cultural communities (Native-American Menominee versus European-American majority culture) [Ross et al., 2003]. These differences correlate well with cultural differences in adult frameworks for approaching nature [Bang, Townsend, Unsworth, & Medin, 2005; Medin, Ross, Cox, & Atran, in press]. If rural parents provide their children with less exposure to an anthropocentric model, then perhaps rural children (or rural children in some

cultural groups but not others) will not reveal an anthropocentric pattern of inductive inference, no matter how young they are when tested. Moreover, if the anthropocentric pattern represents the acquisition of a culturally transmitted anthropocentric model, then perhaps very young urban children may also fail to show this pattern. These possibilities are currently under investigation.

Another intriguing question is why the 4- to 5-year-old urban children 'take up' an anthropocentric model if only to discard it a few years later. Answering this question will require additional experimental evidence, but we have observed a similar developmental pattern in a different task – an adoption task designed to examine children's intuitions regarding the mechanism by which an individual's kindhood is transmitted [Sousa, Atran, & Medin, 2002; Waxman et al., in press]. Both in Brazil and in the Native-American Menominee culture, there is considerable community-wide discourse about blood and blood quantum. And in both communities, this elevated level of discourse has documented developmental consequences: Brazilian and Menominee 5-year-olds are more likely than children from the non-Native US communities to judge that an individual's blood content is relevant to kindhood. This difference, which disappears in older children, indicates that young children are especially sensitive to the discourse of the adults in their communities [Sousa, et al., 2002; Waxman et al., in press].

Children's notions of the biological world are tuned by their direct experience and by community-wide discourse.

Putting these findings together underscores Giyoo Hatano's insight: an individual's 'experience' within the biological domain includes not only their habitual contact or familiarity with biological entities, but also the culturally prevalent models about the biological world and about the relation between humans and the rest of nature. Anthropocentrism may not be an inevitable result of urban children's greater familiarity with humans, but rather may be a consequence of their sensitivity to discourse supporting an anthropocentric model.

An important direction for future research will be to pursue the course set by Giyoo Hatano, adopting a richer, more precise and more nuanced approach to the global concept of 'experience.' Pursuing this course will not only advance our theories of the acquisition of biological knowledge, but will also inform our recommendations for how to best guide our children's learning in both formal and informal settings.

Acknowledgements

We thank Erin Leddon, Andrzej Tarlowski, Will Bennis, Sara Unsworth, Melissa Luna, Jessica Umphress, and Flo Anggoro for discussion of this work and Kay Fredrick, Nancy Wilkinson, Lisa Kunschke, Julie Schoenike, Nathan Winkler-Rhoades, and Karina Shah for their expert data collection. We are especially indebted to Jennifer Woodring for her contributions at every step along the way. Many thanks also to the principals, teachers and students of the following schools: Walt Disney Magnet, Olga Brener Elementary, and Lincoln Elementary. This research was supported by NIH grant R01 HD41653-01 and NSF grant BCS 0132469 to the first and second authors.

References

Anggoro, F.K., Waxman, S.R., & Medin, D.L. (2005). The effects of naming practices on children's understanding of living things. In B. Bara, L. Barsalou, & M. Bucciarelli (Eds.), *Proceedings of the twenty-seventh annual meeting of the cognitive science society* (pp. 139–144). Mahwah: Erlbaum.

Atran, S., Medin, D.L, Lynch, E., Vapnarsky, V., Ucan E., & Sousa, P. (2001). Folkbiology doesn't come from folkpsychology: Evidence from Yukatec Maya in cross-cultural perspective. *Journal of Cognition and Culture, 1,* 4–42.

Bang, M., Townsend, J., Unsworth, S., & Medin, D. (2005). Cultural models of nature and their relevance to science education. Paper presented at the 2005 annual meeting of the American Education Research Association, Montreal.

Carey, S. (1985). *Conceptual change in childhood*. Cambridge: Bradford Books.

Gelman, S.A., Chesnick, R., & Waxman, S.R. (2005). Mother-child conversations about pictures and objects: Referring to categories and individuals. *Child Development, 76,* 1129–1143.

Hatano, G., & Inagaki, K. (1994). Young children's naïve theory of biology. *Cognition, 50,* 171–188.

Hatano, G., & Inagaki, K. (1999). A developmental perspective on informal biology. In D.L. Medin & S. Atran (Eds.), *Folkbiology* (pp. 321–354). Cambridge: MIT Press.

Hatano, G., & Inagaki, K. (2000). Domain-specific constraints of conceptual development. *International Journal of Behavioral Development, 24,* 267–275.

Hatano, G., Siegler, R.S., Richards, D.D., Inagaki, K., Stavy, R., & Wax, N. (1993). The development of biological knowledge: A multi-national study. *Cognitive Development, 8,* 47–62.

Inagaki, K. (1990). The effects of raising animals on children's biological knowledge. *British Journal of Developmental Psychology, 8,* 119–129.

Inagaki, K., & Hatano, G. (1993). Young children's understanding of the mind-body distinction. *Child Development, 64,* 1534–1549.

Inagaki, K., & Hatano, G. (1996). Young children's recognition of commonalities between animals and plants. *Child Development, 67,* 2823–2840.

Inagaki, K., & Hatano, G. (2002). *Young children's thinking about the biological world.* New York: Psychology Press.

Keil, F.C. (1983). On the emergence of semantic and conceptual distinctions. *Journal of Experimental Psychology: General, 112,* 357–385.

Medin, D.L., & Atran, S. (2004). The native mind: Biological categorization, reasoning and decision making in development across cultures. *Psychological Review, 111,* 960–983.

Medin, D., Ross, N., Cox, D. & Atran, S. (in press). Why folkbiology matters: Resource conflict despite shared goals and knowledge. *Human Ecology.*

Medin, D.L., & Waxman, S.R. (in press). Interpreting asymmetries of projection in children's inductive reasoning. In A. Feeney & E. Heit (Eds.), *Inductive reasoning.* New York: Cambridge University Press.

Morris, S.C., Taplin, J.E., & Gelman, S.A. (2000). Vitalism in naive biological thinking. *Developmental Psychology, 36,* 582–613.

Opfer, J.E., & Siegler, R.S. (2004). Revisiting preschoolers' living things concept: A microgenetic study of conceptual change in basic biology. *Cognitive Psychology, 49,* 301–332.

Piaget, J. (1954). *The construction of reality in the child* (transl. by M. Cook). New York: Basic Books.

Rosengren, K.S., Gelman, S.A., Kalish, C.W., & McCormick, M. (1991). As time goes by: Children's early understanding of growth in animals. *Child Development, 62,* 1302–1320.

Ross, N., Medin, D.L., Coley, J.D., & Atran, S. (2003). Cultural and experiential differences in the development of folkbiological induction. *Cognitive Development, 18,* 25–47.

Stavy, R., & Wax, N. (1989). Children's conceptions of plants as living things. *Human Development, 32,* 88–94.

Sousa, P., Atran, S., & Medin, D.L. (2002). Essentialism and folkbiology: Evidence from Brazil. *Journal of Cognition and Culture, 2,* 195–223.

Tarlowski, A. (2006). If it's an animal it has axons: Experience and culture in preschool children's reasoning about animates. *Cognitive Development, 21,* 249–265.

Waxman, S.R., Medin, D.L., & Ross, N. (in press). Folkbiological reasoning from a cross-cultural developmental perspective: Early essentialist notions are shaped by cultural beliefs. *Developmental Psychology.*