Psychology of Language and Communication 1997, Vol. 1, No. 2

SUSAN A. GELMAN
University of Michigan, Ann Arbor

DEVELOPING A DOCTRINE OF NATURAL KINDS

We here propose that children adhere to a notion that is simple yet fundamental, referred to as a "doctrine of natural kinds" (Lakoff, 1987), in which they assume that (a) categories map onto natural discontinuities in the world, and (b) words in ordinary language map onto these structures. This doctrine has implications for inferences, word-learning, and categorization, even in young children (2-5 years of age). Parents do not explicitly teach children this doctrine. However, parents may subtlely convey information about category structure by means of implicit linguistic constructions, such as generic noun phrases. The paper concludes with a discussion of distinctions among human concepts, and with speculations concerning developmental changes from a notion of "kind" to a notion of "essence."

Not all categories are kinds (cf. Markman, 1989). Whereas a category is any grouping together of two or more discriminably different things, a kind is a category that is believed to be based in nature and capturing many deep regularities. An example of a category that is not a natural kind is the set of things with stripes, including tigers, striped shirts, and barber-shop poles. In contrast, an example of a kind is the set of tigers. The distinction between a category and a kind has powerful implications for how we reason. On the positive side, kinds are precursors to scientific thought. The same impulse that leads us to treat certain categories as "real" also leads scientists to search for deeper regularities in nature. On the negative side, kinds foster stereotyping. For example, treating race classifications as natural kinds encourages the mistaken belief that there are deep, immutable differences linked to race.

Related to the notion of "kind" is that of "essence." Framed as an intuitive folk construal, psychological essentialism is the belief that members of a kind share some underlying

---

This work was supported by NSF Grant 91-0034. I am grateful to Twila Tardif for presenting this paper at the workshop. I also wish to thank Marilyn Shatz, Twila Tardif, and other members of the University of Michigan Language Development Laboratory for providing helpful feedback on an earlier draft. Address for correspondence: Susan A. Gelman, Department of Psychology, 525 E. University Ave., University of Michigan, Ann Arbor, MI 48109-1109. E-mail: gelman@umich.edu.

quality or substance that confers identity and is causally responsible for observable similarities among category members (Medin, 1989; Gelman, Coley, & Gottfried, 1994). For example, one plausible essence for the category of tigers might be shared DNA structure, which (according to folk belief) is what ultimately gives tigers their identity. Thus, the major difference between kind and essence is that the latter incorporates the former and adds to it the idea that there is a part, substance, or quality (i.e., the essence) that causes the properties shared by the kind. In the literature, the two notions have often been treated as interchangeable. However, in this paper I will explore the possibility that focusing on essentialism is misleading. Categories can be bound together in crucial ways, without cognizers having any particular essence in mind. This might be particularly true for children. Thus, developmentally, I predict that a notion of "kind" precedes a notion of "essence".

The developmental issues here concern when and why children treat categories as natural kinds, even if they do not yet appeal to a localized essence. The remainder of this paper is divided into two parts: First, I will review some evidence for the emergence of a notion of "kind" by 2-1/2 years and perhaps earlier. Next, I will address the issue of origins: how is it that children have this expectation? Here what I say will become quite speculative, providing a sketch of some ongoing efforts rather than well-worked-out evidence.

Evidence for an early-emerging notion of "kind"

The evidence for natural kinds in children comes from several sources, including inductive potential, innate potential, and internal/hidden similarities. Here I skim through a selection of these findings.

Inductive potential. Children draw many rich inferences from one member of a kind to another, even when the instances appear very different on the surface, and even when only the label tells children that they are the same kind of thing. For example, Ellen Markman and I (Gelman & Markman, 1986, 1987) presented 4-year-olds with triads such as a "bird" (blackbird), a "bat" (with outstretched wings, like the blackbird), and a "bird" (flamingo). Children as young as 3 or 4 years of age inferred that the blackbird feeds its young the same kind of food as the flamingo, not the bat – even though the blackbird is superficially more similar to the bat than the flamingo. My collaborators and I have replicated this finding with hundreds of children between 2 and 7 years of age, with numerous controls, and the effect is very robust (see Gelman & Coley, 1991, for review).

Innate potential. Children assume that members of a biological kind are alike in their innate potential. This potential is inherited from the parents of the animal in question and is inherent in the animal, emerging even with no support from the environment. For example, Henry Wellman and I (Gelman & Wellman, 1991) told 4-year-old children stories with a nature-nurture conflict – an animal from one species was raised among animals of another species. On one item, they heard that a newborn cow was raised among pigs and never saw another cow. Children reported that the animal would nonetheless have cow properties as an adult – she would have a straight tail and say moo. In other words, cows have inborn qualities that inevitably emerge over time. Hirschfeld (1996) and Springer (1992; Springer & Keil, 1989) obtain similar findings in other categories of living things. The interpretation of these findings has been a matter of much recent debate (Solomon,

Johnson, Zaitchik, & Carey, 1996). However, much of the disagreement revolves around the question of how specifically biological children's understanding is, with rather more consensus regarding children's early essentialist, kind-like construal.

Internal similarities. Finally, children expect members of a kind to be alike on the inside. Henry Wellman and I found (Gelman & Wellman, 1991) that 4- and 5-year-olds use internal properties to make judgments of identity. For example, a dog with no insides is no longer a dog, whereas a dog with no fur is still a dog. These data fit well with recent findings from Keil (1989, 1995) and Rochel Gelman (1990). Moreover, we recently found that 3- and 5-year-old children also use knowledge of internal parts to interpret new words (Diesendruck, Gelman, & Lebowitz, 1996). For example, when children learn that 2 different animals have the same internal parts – the same bones, brain, blood, etc. – they are less likely to make mutual exclusivity errors in naming them.

I interpret these varied findings as demonstrating the presence of a notion of "kind" in preschoolers. Recently, however, there has been a serious challenge to this interpretation from recent work by Imai, Gentner, and Uchida (1994) and Genter & Imai (1994). In an intriguing set of studies, Imai et al. find that children use shape – not taxonomic kind – when extending new words. For example, if preschool children learn that a birthday cake is a "fep", and are asked to find another fep, they will pick a hat of the same shape, rather than a pie (which is the same taxonomic kind), or a gift (which is thematically related).

Similarly, Smith and Jones (1993) point out that we often extend words on the basis of shape, for example, referring to a real bear and a toy bear both as "bears": "What is a toy bear if not a bear? ... For the purposes of naming, living bears and toy bears are the same in important ways. ... when people call a toy bear a 'bear', it seems to us they mean exactly what they say." This observation would seem to contradict the claim that children map the notion of kind onto language.

However, I would like to raise the question of whether children are using shape as the basis of kind membership, or instead as an indirect indicator of kind membership (see also Soja, Carey, & Spelke, 1992; Waxman & Braig, 1996). In particular, kinds are typically basic-level categories. When children cannot find a basic-level match, they may rely on shape because it tends to correlate with taxonomic kind. I have four preliminary pieces of evidence consistent with this claim:

(1) First, Masha Kirzhner and I conducted a word-learning study exactly analogous to the Imai et al. work, but with basic-level categories. For example, children learned that a baseball was a fep, and then they were asked which of the following was also a fep: a football (taxonomic match), an orange (shape match), or a baseball bat (thematic match).

Table 1. Gelman & Kirzhner's basic-level sorting task, mean number of choices (out of 9) in the Word Learning and "Goes With" conditions.

	Word Learning	"Goes With"
Taxonomic	5.65	2.49
Shape	2.93	1.72
Thematic	0.43	4.80

Table 2. Gelman & Nguyen's superordinate-level sorting task, mean number of choices (out of 8) in the "Same Insides" and "Goes With" conditions (* indicates a significant condition difference)

	Same Insides	Goes With	
Taxonomic	3.00	1.00	*
Shape	2.67	2.43	
Thematic	2.33	4.57	*

Here we found that taxonomic relatedness wins out over shape: children were more likely to extend the word to a football than to an orange (see Table 1). Golinkoff, Shuff-Bailey, Olguin, and Ruan (1995) also found more taxonomic responding for basic- vs. superordinate-level matches, though their work examined overall similarity rather than shape per se.

(2) Second, Simone Nguyen and I have an ongoing study with the same kinds of triads, but here preschool children are asked to make inferences about internal parts, rather than to extend new words. For example, they first see an elephant, and then they are asked which of the following has the same kinds of internal parts as the elephant: a porcupine (taxonomic match), a teapot (shape match), or a circus tent (thematic match). We are finding that taxonomic relatedness is slightly preferred over shape, even at the superordinate level (see Table 2). So, when the task is sufficiently clear, children access a notion of "kind" that cannot be reduced to shape.

(3) Soja, Carey, and Spelke (1992) suggest that it is not shape per se that children (or adults) are naming; rather, children are attempting to name that which the shape represents. A toy bear is called a "bear" because it represents a bear, not because it is shaped like a bear. Indirect support for this argument comes from the observation that objects not designed to represent another kind of thing are rarely mislabeled (e.g., footballs are rarely called "eggs"). Gelman and Ebeling (in progress) have conducted a pilot study designed to test this hypothesis more directly. Subjects were 3-year-old children who saw a series of line-drawings roughly shaped like various nameable objects, such as a bear. For half the subjects, we described each line drawing as depicting a shape that was created intentionally – for example, someone painted the picture. For the remaining subjects, we described the same drawing as depicting a shape that was created accidentally – for example, someone spilled the paint. For each item, subjects first heard the brief (two-sentence) story, then were shown the corresponding line-drawing and asked, "What is this?" Children's open-ended responses were coded as naming the shape (e.g., "a bear"), naming the actual materials (e.g., "paint"), or other (e.g., "this looks like a bear", "I don't know").

We hypothesized that subjects' use of shape as the basis of naming would be influenced by the representational status of the pictures, as conveyed by the verbal information: when the drawings were intended, subjects should name the shapes; when the drawings were unintended, subjects should refer to the pictures in some other way (e.g., describing the literal materials). The findings fit the predictions: Children named on the basis of shape (e.g., referring to the bear-shaped drawing as a "bear") significantly more often when the shape was intended (80%) than when it was not (47%).

Table 3. Some potential sources of input to children regarding natural kinds and essences

	Child	Others
Domain-specific	innate module (Atran, 1995; Pinker, 1994)	biological knowledge religious beliefs
Domain-general	"essentialist assumption" (Gelman, Coley, & Gottfried,1994)	logic of count nouns (Carey, 1995; Mayr, 1991)

(4) Finally, we have taken a detailed look at overextensions in 2-year-olds, with the question being whether these naming errors are based primarily on shape, or whether taxonomic kind also plays a role (Gelman, Croft, Fu, Clausner, & Gottfried, 1996). For example, a child might say "apple" to refer to a baseball (shape-based error), to a banana (kind-based), or to an orange (based on both). What we are finding is that the majority of children's productive overextensions are based on a combination of shape and taxonomic kind (79% at age 2 years, 74% at age 2-1/2 years, and 83% at age 4 years).

Altogether, then, the data suggest that in a word-learning task, children are looking for a basic-level kind match. When they cannot find it, they sometimes go for shape, which is generally a good indicator of kind. But shape does not seem to precede a notion of kind for preschool children.

Origins of a notion of "kind"

How is it that children adhere to a doctrine of natural kinds? Why do they treat certain categories as "real" in this way? For simplicity's sake, we consider two major dimensions: whether the child or others play an active role, and whether the assumption is general across the board or tied to a particular domain (see Table 3). Is a concept of "kind" constructed by the child or provided in the input – either by parents or others? Is it a domain-specific or a domain-general stance? There are theoretical possibilities to fill all the cells. Atran (1995) and Pinker (1994) suggest that children have an innate module specific to the domain of living things that treats living kinds as having essences. Children could instead have a domain-specific view that is not innate but imparted from others. For example, children might be convinced that kinds are real based on specific pieces of biological knowledge, such as learning about DNA. Religious teachings could have the same effect – for example, children might assume that biological species are immutable natural kinds, if they believe that God is the creator of species. In contrast, others have argued for a broader, domain-general assumption. This may be an innate "essentialist assumption." Or, as Carey (1995) and Mayr (1991) have suggested, children may learn that the logic of count nouns encourages essentialist reasoning.

We have begun to look at both these issues. For the role of parental input, we have been looking closely at what parents say. Surprisingly, up to this point almost no one had examined the input for evidence of what parents might say to convey a notion of kind. We have conducted a study examining parental input, in which we videotaped and transcribed the speech and gestures of parents who were looking through specially-prepared

Table 4. Gelman, Coley, Rosengren, Hartman, & Pappas: Explicit information provided by parents regarding essences or inductive potential, while looking through picturebooks with their 35-month-old children (mean number per 100 utterances; * indicates a significant condition difference)

	Animals	Artifacts
"all" referring to entire category	0.19	0
insides	0	0.57
kinship	0.19	0
origins	0.06	0.07
teleology	0.19	0
appearance-reality contrast	1.30	0.71 *

picturebooks with their 35-month-old children (Gelman, Coley, Rosengren, Hartman, & Pappas, submitted). If children have a natural kind assumption because their parents train them to do so, we might expect to hear parents discussing and explaining inductive potential, internal parts, kinship, origins, teleology, and appearance-reality contrasts. For example, parents might say the following (note that these are hypothetical examples):

"Did you know that all bats give milk to their babies."

"This dog has blood and bones inside. He needs them if he wants to stay strong and healthy."

"The kitty has stripes because her mommy and daddy have stripes."

"That bird came from an egg that grew inside her mama."

"Polar bears are white because that helps them hide in the snow."

"Birds and bats look the same on the outside, but inside they're different in ways you can't see."

Based on these a priori hypotheses, we coded the data. In contrast to the hypothetical remarks, adults provided statements that were considerably less informative. Here is a sample of actual statements concerning inductive potential, internal parts, kinship, origins, teleology, and appearance-reality contrasts:

"I think ... roosters all have that thing."

"Batteries go in the car and the other car and the clock."

"There's the mother cat and there's the baby."

"That's where we get our milk. The cows give us all the milk that we drink."

"Look at his nose. That's for eating ants."

"These look like snakes, but they're called eels."

Not only were the actual examples parents provided less detailed than the hypothetical examples, but also these kinds of statements were extremely rare. Table 4 shows the mean number of times parents make these statements, out of every 100 utterances. There were only 3 times, in the entire corpus, when parents used "all" to refer to the full set of category members. Likewise, even though children have a rich set of beliefs about insides, kinship, origins, and teleology as properties that hold biological kinds together, parents provided almost no input about these topics. Appearance-reality statements were a bit more common. However, parents never resolved appearance-reality contrasts in terms of internal parts, inheritance, or the like. Altogether, these explicit statements about essences account for less than 2% of parents' speech. It therefore seems implausible that children learn about essences or kinds from this kind of direct statement.

For the issue of domain-specificity vs. domain-generality, we have been looking at children's natural language talk about kinds (Gelman & Rodriguez, in preparation). Although Wierzbicka (1994) suggests that a concept of kind can be gauged by examining children's use of the word kind, this approach is limited in two respects: the word kind is not frequent in very early language, and it is used primarily to refer to subtypes (e.g., "a collie is a kind of dog") rather than basic-level categories. In order to assess children's talk about kinds, we have instead been examining children's use of the generic – sentences such as "Lions are scary" or "A dog is an animal with 4 legs". Linguists who have analyzed generics stress that they refer to qualities that are essential (not accidental), enduring (not transient), and timeless (not contextually-bound) (Carlson & Pelletier, 1995). Compare "this lion is scary" vs. "Lions are scary." The first refers to an individual; only the second refers to the kind per se.

We assume that generics are an index that the child treats a category as a kind. Our focus is on generic noun phrases in particular, for example, lions and dogs. We are studying 8 English-speaking children followed longitudinally and represented in CHILDES database (MacWhinney, 1995). Here are some actual examples from Roger Brown's Adam: "Ladies go work." "A horse can't dance." "Why not they don't got some teeth?" "I like cups." "Indians live in Africa." "Raccoons have something around their mouth." "Why clocks break?" Previously, in our study of parental input (Gelman, Coley, Rosengren, Hartman, & Pappas, submitted), we found that parents were between 6 and 20 times more likely to use generics for animal kinds vs. artifact categories, despite equal opportunities to talk about both. Our question in examining the children, then, is whether children's utterances are similarly domain-specific. In particular, there are at least two distinct developmental possibilities, with radically different implications for the role of domain. If Atran and Pinker are correct that children have a domain-specific module, then children should make as clear a domain differentiation as adults, perhaps even more so. On this view, children should start out using generics for biological kinds, and with age begin extending this mode to other domains, such as personality traits or social groupings. In contrast, if Carey is correct, that children start out with a domain-general assumption, then they should apply generics quite broadly, only gradually learning to restrict it to the domain of living kinds.

Tables 5a and 5b present preliminary data from a subset of the children we are studying, showing frequency of child generics as a function of age and domain, focusing on the four most frequent domains. Although these findings cannot be considered complete, a few findings emerge. Children at each age provided more generics for liv-

Table 5a. Gelman & Rodriguez: Mean percent of generics as a function of age and domain.

	People	Animals	Artifacts	Food
2 years (N = 6)	12	25	17	36
3 years (N = 6)	33	22	18	13
4 years (N = 5)	25	28	22	13
5 years (N = 3)	36	26	8	17

Table 5b. Mean percent of subject-position generics as a function of age and domain (all children)

	People	Animals	Artifacts	Food
2 years	29	39	15	9
3 years	36	39	11	6
4 years	41	32	14	5
5 years	48	28	8	3

ing kinds (M = 52%) than artifacts (M = 16%), $p < .05$. Generics that were syntactic subjects (e.g., BIRDS fly), arguably most important for conveying properties of the generic category, were especially domain-specific (Table 5b). However, three points argue against Atran's suggestion that this is a biologically specific assumption: (a) Generics referring to kinds of people included many social (possibly non-biological) categories (e.g., "bad people", "carpenters"); (b) 2-year-olds were more likely than older children to include generics referring to the non-biological category of food, $p < .001$; (c) only 2% of children's generics referred to non-food plants. We have also begun to analyze the generics as a function of the total number of noun phrases searched in each domain (e.g., the number of animal generics divided by the total number of noun phrases referring to animals, including both generics and non-generics). This controls for the frequency with which children talk about each of the domains. Preliminary analyses reveal that, controlling for domain frequency in speech, children produced more generics for people and animals than for artifacts and food. If this pattern holds up over the entire sample, it would imply that domain differences do not simply reflect differences in the salience of each domain. Thus, children as young as age 2 spontaneously talk about categories as abstract "kinds," in a manner that is domain-specific but not specifically biological.

A final question concerns what exactly this sense of kind consists of. Gail Gottfried and I have recently completed a set of studies suggesting that children have a notion of kind that is not tied to a particular essence (Gottfried & Gelman, submitted). The work was inspired by some intriguing studies by Johnson (1990), who questioned children about brain transplants. For adults in the U.S., a person's psychological essence is thought to be housed in the brain. Do children think that brain transplants lead to fundamental changes in how one thinks and remembers – or do they think that there is an enduring sense of kind that is distinct from the brain?

We described hypothetical "brain transplants" to children – for example, from a cow to a horse. Here's a sample item. We started with a series of control questions:

See this cow? It has a brain inside. Does it think about things?

See this horse? Somebody took the brain out, and there is no brain left inside. Does it think about things?

Now, somebody took the brain out of the cow and put it into the horse. Which one has the brain now? Where did the brain come from?" Then we presented the crucial test question: "What does this one [the horse] think about: does it think about running fast or does it think about giving milk?" On the control questions, children at all ages were near ceiling (Ms = 95%, 94%, and 97% correct at kindergarten, first grade, and third grade, respec-

tively). They knew that the brain is required for thinking and remembering. They also had no difficulty remembering the premises of the story – where the brain was from and where it is now. In contrast, on the test questions, there was a sharp increase in performance between first grade and third grade. Kindergarteners report that a brain transplant leaves thinking and remembering unaffected (27% of responses indicated that the brain affected thoughts and memories). They appeared to consider the brain to be like a battery – necessary, but not where thoughts and memories are stored. In contrast, third-graders reported that a brain transplant does affect thinking and remembering (71% of responses indicated that the brain affected thoughts and memories). In other words, by third grade, a localized essence takes precedence over the kind.

Children's justifications were also revealing. To justify answering based on the species, children often mentioned the species name (e.g., the monkey with a kangaroo brain thinks about swinging from trees because "he's a monkey"; a horse with a cow brain thinks about running fast "Because horses run fast and cows just do milk"). To justify answering based on the brain, children typically mentioned the brain or mind (e.g., the pig with a sheep brain remembers being a baby pig, "Because it has the pig's mind"). These data imply that the youngest children have a notion of kind that is not tied to a particular known or localized part, even though they have sufficient knowledge about the function of the part to enable localizing it.

We then conducted a follow-up study in which we told children about transplanting all insides. Here we were interested in whether children think that there is some internal essence, even if they do not localize it in the brain. The results were very similar to the patterns in the switched-brains condition. At kindergarten age, 46% of responses indicated that the insides transplant affected thoughts and memories, whereas by third grade, 88% of responses indicated that the insides transplant affected thoughts and memories. Thus, the younger children apparently did not localize the kind in any particular internal part.

Conclusion

To conclude: The concept of "kind" emerges early in development. It is expressed spontaneously in language by at least 1-1/2 or 2 years of age Preliminary evidence suggests that it is domain-specific (used more frequently for animals and people than for artifacts) by age 2 years. Parents do not explicitly teach this concept. The assumption of "kind" seems to be separate from and prior to an assumption of "essence".

References

Atran, S. (1995). Causal constraints on categories and categorical constraints on biological reasoning across cultures. In D. Sperber, D. Premack, & A. Premack (Eds.), *Causal cognition: A multidisciplinary debate* (pp. 205-233). Oxford: Oxford University Press.

Carey, S. (1995). On the origins of causal understanding. In D. Sperber, D. Premack, & A. Premack (Eds.), *Causal cognition: A multidisciplinary debate* (pp. 268-302). Oxford: Oxford University Press.

Carlson, G. N., & Pelletier, F. J. (1995). *The generic book*. Chicago: Chicago University Press.

Diesendruck, G., Gelman, S. A., & Lebowitz, K. (1996). Conceptual and linguistic biases in children's word learning. Manuscript submitted for publication.

Gelman, R. (1990). First principles organize attention to and learning about relevant data: Number and the animate-inanimate distinction as examples. *Cognitive Science*, 14, 79-106.

Gelman, S. A., & Coley, J. D. (1991). Language and categorization: The acquisition of natural kind terms. In S. A. Gelman & J. P. Byrnes (Eds.), *Perspectives on language and thought: Interrelations in development* (pp. 146-196). Cambridge: Cambridge University Press.

Gelman, S. A., Coley, J. D., & Gottfried, G. M. (1994). Essentialist beliefs in children: The acquisition of concepts and theories. In L. A. Hirschfeld & S. A. Gelman (Eds.), *Mapping the mind: Domain specificity in cognition and culture* (pp. 341-365). Cambridge University Press.

Gelman, S. A., Croft, W., Fu, P., Clausner, T., & Gottfried, G. (1996). Why is a pomegranate an "apple"? The role of shape, taxonomic relatedness, and prior knowledge in children's overextensions. Paper presented at the Tenth Biennial International Conference on Infant Studies, Providence, RI.

Gelman, S. A., & Markman, E. M. (1986). Categories and induction in young children. *Cognition*, 23, 183-209.

Gelman, S. A., & Markman, E. M. (1987). Young children's inductions from natural kinds: The role of categories and appearances. *Child Development*, 58, 1532-1541.

Gelman, S. A., & Wellman, H. M. (1991). Insides and essences: Early understandings of the nonobvious. *Cognition*, 38, 213-244.

Gentner, D., & Imai, M. (1994). A further examination of the shape bias in early word learning. *Proceedings of the Child Language Research Forum*. Stanford, CA.

Golinkoff, R. M., Shuff-Bailey, M., Olguin, R., & Ruan, W. (1995). Young children extend novel words at the basic-level: Evidence for the principle of categorical scope. *Developmental Psychology*, 31, 494-507.

Hirschfeld, L. A. (1996). *Race in the making*. Cambridge, MA: MIT Press.

Imai, M., Gentner, D., & Uchida, N. (1994). Children's theories of word meaning: The role of shape similarity in early acquisition. *Cognitive Development*, 9, 45-75.

Johnson, C. N. (1990). If you had my brain, where would I be? Children's understanding of the brain and identity. *Child Development*, 61, 962-972.

Jones, S. S., & Smith, L. B. (1993). The place of perception in children's concepts. *Cognitive Development*, 8, 113-139.

Jones, S. S., Smith, L. B., & Landau, B. (1991). Object properties and knowledge in early lexical learning. *Child Development*, 62, 499-516.

Keil, F. C. (1989). *Concepts, kinds, and cognitive development*. Cambridge, MA: MIT Press.

Keil, F. C. (1995). The growth of causal understandings of natural kinds. In D. Sperber, D. Premack, & A. Premack (Eds.), *Causal cognition: A multidisciplinary debate* (pp. 234-262). Oxford: Oxford University Press.

MacWhinney, B. (1995). *The CHILDES project*, 2nd ed. Hillsdale, NJ: Erlbaum.

Markman, E. M. (1989). *Categorization and naming in children: Problems of induction*. Cambridge, MA: MIT Press.

Mayr, E. (1991). *One long argument: Charles Darwin and the genesis of modern evolutionary thought*. Cambridge, MA: Harvard University Press.

Medin, D. L. (1989). Concepts and conceptual structure. *American Psychologist*, 44, 1469-1481.

Pinker, S. (1994). *The language instinct*. New York: William Morrow.

Schwartz, S. P. (Ed.) (1977). *Naming, necessity, and natural kinds*. Ithaca, NY: Cornell University Press.

Smith, L. B., & Jones, S. S. (1993). Cognition without concepts. *Cognitive Development*, 8, 181-188.

Soja, N. N., Carey, S., & Spelke, E. S. (1992). Perception, ontology, and word meaning. *Cognition*, 45, 101-107.

Solomon, G. E. A., Johnson, S. C., Zaitchik, D., & Carey, S. (1996). Like father, like son: Young children's understanding of how and why offspring resemble their parents. *Child Development*, 67, 151-171.

Springer, K. (1992). Children's awareness of the biological implications of kinship. *Child Development*, 63, 950-959.

Springer, K., & Keil, F. (1989). On the development of biologically specific beliefs: The case of inheritance. *Child Development*, 60, 637-648.

Waxman, S. R., & Braig, B. (1996). Stars and starfish: How far can shape take us? Paper presented at the Tenth Biennial International Conference on Infant Studies, Providence, RI.

Wierzbicka, A. (1994). The universality of taxonomic categorization and the indispensability of the concept kind. *Rivista di Linguistica*, 6, 347-364.