Discussion

Perception, ontology, and word meaning*

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In their commentary on our paper (Soja, Carey, & Spelke, 1991), Landau, Jones and Smith (1992) (hereafter LJS) clarify the position taken by Landau, Smith, and Jones (1988), and briefly describe results from several subsequent papers. As they describe their research program, they are concerned with the relations between the syntactic category of a newly heard word (count noun, adjective, preposition), the ontological category of the word's referent, and the perceptual basis of projecting the meaning from the referent to other entities. Their experiments provide evidence that, by age 3, a count noun referring to an object is projected on the basis of shape similarity to the referent, an adjective is projected on the basis of color or texture similarity to the referent, and prepositions are projected on the basis of spatial relations between the referent and other objects.

On some points, we are in agreement with LJS. Like them, we are concerned with the role of syntax in lexical development. Of most relevance to our concerns is LJS's restriction of the projection of word meaning on the basis of shape to cases of count nouns referring to rigid objects. They state that "implicit in our

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approach was the assumption that children have a category 'object' prior to language learning" (LJS, p. 88). What was implicit in their approach was precisely what we set out to test. Our concern is with the period prior to where they begin. We ask whether children distinguish between the ontological categories of objects and substances before they learn the syntax of quantification, and whether this prelinguistic distinction guides children's inferences about the meanings of words.

We have three remaining disagreements with LJS. These concern: (1) the role of shape in children's projections of words referring to objects; (2) the relation between word projection and word meaning; and (3) the proper interpretation of Quine (1960). Let us take these in turn.

Our first area of disagreement concerns the perceptual bases of naming. Although the LJS thesis – count nouns referring to objects are projected on the basis of shape – is consistent with the LJS body of data, we doubt that it captures the actual basis of the child's inductions concerning what or how words are used to name. Rather, we suspect that from the very beginning a different generalization, which is also consistent with their data, is correct: *count nouns referring to objects pick out objects of the same kind*. On our view, children and adults show a shape bias in the LJS studies because shape is often (although not always) a good source of information about object kind.

These two theses diverge sharply in the relations they posit among an object's ontological type (in Sommers', 1963, sense, wherein distinctions between kinds of animals, plants, artifacts, etc., are ontological distinctions), its shape, and the projections of the nouns that refer to it. LJS argue that shape similarity is so important to the projection of count nouns that it frequently overrides differences in ontology: "naming practices often focus on similarity in object shape over predicted ontological categories" (LJS, p. 89). We counter that children and adults expect objects of distinct ontological types to be named by distinct nouns, even if the objects have similar shapes.

LJS raise counter-examples to our position: words like "bear" can be used to label real bears or toy bears. Another of their examples is the 100-foot Oldenburg statue of a clothespin, which Philadelphians call, "the clothespin," not "the statue of a clothespin." LJS argue that the reason one word can be used to label both an animal and an artifact, or both an artifact and a piece of art, is the similarity in shape between the two in each case. We counter that the underlying reason for using "bear" to label toy bears is not because the toy shares the shape of the bear, but because it *represents* the animal. Similarly, the statue is a *representation* of a clothespin. Representations are special cases where qualifiers such as "toy" can be dropped. The qualifier can be dropped not only when the representational object has the same shape as its referent (e.g., a bear-shaped statue of a bear) but also when it does not (e.g., a rectangular painting of a bear's head, a footprint of a bear, or indeed the words "a bear"). This usage does not imply that the representations are in the extension of the term "bear." Rather, these cases are

analogous to the case of pointing to a picture of a boy named Jesse and saying "This is Jesse." The speaker does not take "Jesse" to be the boy, the picture, and all other representations of him. "This [picture] is Jesse" and "This [toy] is a bear" are not the same kind of statements as "This [boy] is Jesse" or "This [animal] is a bear." In the first case, "is" means "depicts;" in the second case, "is" denotes membership in the kind *bear*, and "bear" names its members.

LJS make one other linguistic argument in support of their view that naming behavior depends on perceived object shape. They argue that in cases in which there is a head noun and a qualifier (e.g., "toy monkey") the head noun always indicates shape whereas the qualifier shifts ontological kind: "It is difficult to think of any good cases where the head noun ignores the shape identity of two objects and gives them different names on the basis of so-called 'deeper' differences" (LJS, p. 89). Their examples are again drawn from the special case of depictions, but in general this claim is false. There are many examples in which the qualifier specifies shape and the head noun indicates ontological kind. Consider "starfish," "acorn squash," "butterfly shrimp," "star fruit," "string bean," "horseshoe crab," "tree fern," "mushroom cloud," "dragon fly," and "T-maze." Neuroanatomy provides further examples: there are "mitral cells," "pyramidal cells," and "hair cells," not "cell pyramids," "cell hairs," or "cell mitres."

Finally, there are many, many counter-examples to LJS's generalization that naming behavior depends upon shape. Take the shape *sphere* and the nouns "orange," "grapefruit," "berry," "apple," "melon," "Milkdud," "rock," "stone," "moon," "sun," "earth," "ball bearing," "ball," "paperweight," and "bubble." Or take the shape *torus* and the nouns "donut," "lifesaver," "bagel," "innertube," "tire," "ring," "bracelet," and "necklace." Or fill in your own examples of different kinds that share the shape *disk* ("plate," "cracker," . . .) or *mushroom* ("mushroom," "cloud", "lamp," . . .). This exercise could continue for pages. Some of these examples show that even within ontological category, distinct kinds sharing shape are labeled with distinct count nouns. Symmetrically, objects of different shapes belonging to a single kind are labeled with a single count noun: consider the varieties of shapes of objects named by each of "telephone," "clock," "tree," and "table." These examples suggest to us that in general names for things pick out objects of the same kind, not objects of the same shape.

The thesis that count nouns refer to shapes fits into a long tradition of thinking and research within developmental psychology, based on the premise that cognition builds directly on perception. We find more reasonable a different view, that cognition and language build not only on perceptual experience but on an initial body of concepts as well. Armed with a set of ontological categories such as "kind of object" and perhaps "kind of stuff," the child can sift through perceptual experiences in order to learn about different kinds of things and about the perceptible properties by which those things can be recognized. Our child is both

more constrained than LJS's (because of the ontological distinctions that her language and concepts must reflect) and less constrained (because she is open to discovering what perceptible features bear on membership in a given object kind, and therefore on the projection of a count noun to members of the kind). She may have a harder time working out the projections of individual terms like "tomato" and "telephone," because she cannot follow the simple rule that each word applies to all objects with the shape of the initial referent. Unlike LJS's child, however, she will be able to learn names for object kinds in a world in which there is no single perceptual feature, such as shape, that reliably indicates what kind of thing each object is.

Although neither LJS nor we have the evidence to decide between our two positions, research by Flavell, Flavell, and Green (1983) and by Keil (1989) bears on this decision. Flavell et al. (1983) showed that 4-year-olds know that a foam rubber rock is not "really really" a rock. Asked what it is, they reply, "a sponge." Keil (1989) demonstrated that 9-year-olds do not believe that a racoon could become a skunk even if it came to have the same shape (and other perceptual properties) of skunks. Asked what such a transformed object is, they reply, "a racoon." Significantly, 5-year-olds do not accept that an object could become a member of a different ontological category, if it is transformed so as to have the shape and other perceptual properties of objects in the second category. That is, a porcupine is still a porcupine (and is still called "porcupine") even if it has the same shape as a cactus. We take these findings as evidence that children infer that nouns referring to objects pick out objects of a single kind. Children may never take shape as a basis for the meanings of count nouns.

Our second disagreement concerns the relation between naming and word meaning. LJS accept that ontological type may play a large role when determining the *meaning* of words, but argue that shape is critical for determining which words to use when *naming* objects. We take issue with this claim for two reasons. First, it is simply not true that a given count noun can be used to name any pair of objects that share shape, as indicated above. Even the lexicons of very young children contain numerous distinct count nouns for different objects of a single shape. Second, LJS's thesis places an added burden on the word learner. This thesis requires that children learn two things about every count noun: what it names and what it means. We believe that the relationship between naming and meaning is tighter. Once children induce the meaning of a new word, they can use the word to name any members within the extension of its meaning.

Finally, LJS accuse us of getting Quine wrong. We would like to defend our analysis of Quine, for we believe we have Quine right. We consider his position both extremely interesting and a very real possibility, and his position underscores the complexity of the relation between perceptual properties such as shape and the logical functioning of count nouns.

Quine's proposal is that the ontology that underlies language is a cultural

construction. Before the child has mastered this cultural construction, the child's conceptual universe consists of representations of histories of sporadic encounters, "a scattered portion of what goes on" (Quine, 1960, p. 92). Quine speculates as to the representations underlying the toddler's uses of the words "water," "red," and "mama."

> His first learning of the three words is uniformly a matter of learning how much of what goes on about him counts as the mother, or as red, or as water. It is not for the child to say in the first case, "Hello, mama again," in the second case "Hello, another red thing," and in the third case, "Hello, more water." They are all on a par: Hello, more mama, more red, more water. (Quine, 1960, p. 92)

The child masters the notion of an enduring object in the course of getting the hang of what Quine calls "divided reference," and this through the process of mastering quantifiers and words like "same."

> The contextual learning of these various particles goes on simultaneously, we may suppose, so that they are gradually adjusted to one another and a coherent pattern of usage is evolved matching that of one's elders. This is a major step in acquiring the conceptual scheme that we all know so well. For it is on achieving this step, and only then, that there can be any general talk of objects as such. (Quine, 1969, pp. 9–10)

And in another place he finishes the same idea with a bootstrapping metaphor, underlining the degree of conceptual change he thinks is occurring: "The child scrambles up an intellectual chimney, supporting himself against each side by pressure against the others" (Quine, 1960, p. 93). Quine also states that once the child has mastered the notion of an enduring object, and got the trick of divided reference, he goes back and reanalyzes "Mama," so that it is now the name of a unique enduring person.

In *The Roots of Reference* (Quine, 1973), Quine had been convinced by Bower that he had underestimated the baby's understanding of objects. This is where he talks of people as inherently "body minded animals." But Quine never retracted his view that the infant lacks the conceptual resources to represent count nouns (divided reference). Quine's view can be schematized as follows. Figure 1 shows
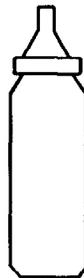
Figure 1. *Bottleness.*
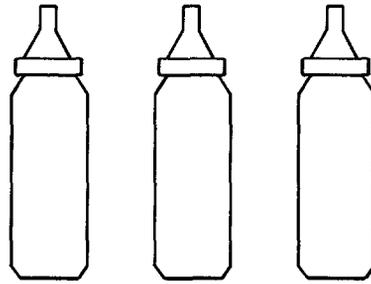
Figure 2.   *Bottleness.*

an example of a portion of experience that one might call "bottleness." The child can learn to associate bottleness with milk, or with the word "bottle." Figure 2 shows another example of bottleness, from which the infant could also expect to obtain milk (indeed, more milk) and to which the child could also refer with the word "bottle." Shape may be important to the identification of bottleness, just as the shape of the individual grains is important for distinguishing rice from spaghetti from macaroni. And even if mama is a scattered portion of what goes on, shape may be important for distinguishing mama from Rover or from papa. Thus, the importance of shape for determining what scattered portion of experience constitutes mama or bottleness does not imply that the baby is capable of representing "a bottle," "two bottles," or "the same bottle I had yesterday."

The Quinian notion of "body" is not the notion of object that supports the meanings of count nouns. What is needed are sortal concepts specifying kinds of objects. Such concepts provide conditions of individuation and numerical identity (see Macnamara, 1986; Wiggins, 1980); they support divided reference. On Quine's view, the child masters the crucial distinction between entities quantified as enduring individuals and those quantified as portions only upon mastering the language's quantificational resources. The interpretation LJS offer Quine, that some nonlinguistic conceptual system might embody the same quantificational devices, is utterly foreign to Quine's way of thinking, as he believes that the notion of a nonlinguistic representational system is incoherent. This interpretation also stands at odds with Quine's claim that the adult ontology is a cultural construction. It is, of course, exactly the hypothesis we set out to test. The studies in Soja et al. (1991) are just the first step in testing this hypothesis.

Let us emphasize that in spite of our disagreements we greatly admire the LJS research program. Thanks in large part to their research, we believe the fields of semantic and conceptual development have arrived at a point where research can resolve the difficult questions that remain.

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