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The Structure and Origin of Semantic Categories in the Language-Learning Child

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Introduction

Scholars have often sought clues to the ultimate nature of the human symbolic capacity in the process by which children acquire man's foremost symbolic tool, language. Most studies of language as an emerging symbol system have focused on how the child becomes capable of using one item to stand for or represent another (see, for example, Bates *et al.*, 1977; Piaget, 1962). But symbolism draws heavily on a second cognitive capacity into which language development also offers intriguing glimpses: the ability to regard discriminably different stimuli as equivalent, or to categorize.

In the present chapter, two basic aspects of the development of categorization as it relates to symbolism are explored through a study of how children acquire and use words in the second year of life. First, what categorizational processes are available to very young children as they attempt to identify novel referents for a word? The structural principles children use in categorizing for purposes of word use are found to be far more similar to those used by adults than is often supposed. Prototype-based models of category structure that have been proposed for adult categories are particularly applicable. Second, where do the categories symbolized by children's early words come from? In a former era, the tutorial role of linguistic input was emphasized. More recent theorizing, in contrast, has granted almost no role at all to input, but instead stresses the contribution of the child's lan-

guage-independent cognitive growth. Data presented here indicate that both these positions are too one-sided: There appears to be a complex interaction in word acquisition between children's own predispositions to categorize things in certain ways and their attention to the words of adult language as guides to concept formation.

The primary data used in investigating these issues were collected from my two daughters, Christy and Eva. Christy is the older by $2\frac{1}{2}$ years. Their semantic and syntactic development has been followed closely by tape recording and daily diary notes from the time of their first words. Detailed records cover the developmental history of almost all their early words from the time they began speaking to about 24 months, with more selective records continuing beyond that point.

The Structure of Categories in Childhood and Adulthood

The ability to categorize plays at least two important roles in symbolic activity. First, it permits symbols such as words to stand not only for unique objects and events but also for whole arrays of discriminably different stimuli. Consider, for example, the diversity among the objects, actions, spatial relationships, events, etc. that we regard as essentially the same kind of thing and classify together as *chair*, *open*, *in*, *justice*, and so on. A second critical role that categorization plays in symbolism is to enable us to leap established category boundaries to equate items that are normally thought of as belonging to *different* categories. This is at the heart of man's ability to create and understand nonarbitrary symbols, including metaphors.

When children are in the early stages of language development, it is often impossible to determine whether in applying a word to a certain referent they intend it literally or metaphorically. For example, when a child calls a cat *doggie*, should we assume, along with Clark (1973) and many others, that he is identifying the cat as a member of the category symbolized by his word *doggie*? Or is it more likely, as Bloom (1973) and Nelson *et al.* (1978) have argued, that he means to express the idea that the cat is *like* a doggie (although it is not really a doggie)?

No principled grounds have yet been advanced for selecting between these alternatives in individual instances of word use. The metaphor argument is not implausible, but it has two important drawbacks. First, it does not provide any account of how children draw category boundaries in the first place—for example, how they decide what is and is not a member of the "doggie" category. Second, inferences about which word uses are literal and which are metaphorical are hopelessly subjective, usually being based

on our knowledge of where *adult* category boundaries fall.¹ The hypothesis that word use in young children involves routine acts of categorization rather than metaphorical extension at least does not by-pass the problem of initial boundary formation, and it also has consistency to recommend it, since all word uses are interpreted in the same way.

Still a third possibility should be considered: that early in development it makes little sense to ask whether a child intends a word literally or metaphorically because he has not yet drawn any sort of boundary between the two. Rather, he simply sees some sort of similarity between an "old" object or event (one for which he already knows a word) and a new object or event, and extends the word accordingly. Only later does he gradually come to sense that there is such a thing as a distinction between literal and metaphorical usage and begin to get an idea of where the former leaves off and the latter begins. This hypothesis is favored by the fact that the exact placement of the lines between category membership, membership by metaphorical extension, and nonmembership is often culture-specific, as will be discussed at the end of this chapter. Since children do not come predisposed to learn one language rather than another, it seems unlikely that they pre-judge the position of these boundaries. It is more plausible that they learn them gradually on the basis of experience with the language to which they are exposed.

Regardless of whether we interpret young children's word usage as strictly literal, sometimes metaphorical, or not clearly either one or the other, it provides an excellent guide to the structural principles available to young children when they categorize.

Noncomplexive versus Complexive Categories

Children's categorizational abilities are commonly considered both qualitatively different from and inferior to those of adults. When faced with a concept formation or concept identification task, they generally do not, as adults do, attempt to sort or group objects or rationalize their choices on the basis of one or more attributes shared by all exemplars. Rather, they form *complexes* in which items are grouped by principles other than possession of a common attribute (Bruner *et al.*, 1966; Piaget and Inhelder, 1959; Vygotsky, 1962). For example, in the familiar chain complex, which Vygotsky considered the purest form of complexive thinking, the child links new exemplars to older ones by a process of end-to-end matching. In a block sorting task, for instance, he might put a red triangle with a blue triangle,

¹ Oddly, the application of this knowledge of adult category boundaries is usually limited to "miscategorized" objects. Thus, *doggie* for a cat is often considered a metaphorical extension, but no one has suggested that when a child says *open* while turning on a TV or *off* while unfolding a newspaper (as in examples to be discussed in the following) she "really" means 'this action is *like* opening something' or '... *like* taking something off.'

then add a red circle, then a yellow circle, then a yellow square, and so on. Vygotsky and others have argued that children's complexive groupings stem from their inability to abstract out an attribute from a concrete object or event and endow it with special, concept-defining status.

Many investigators (see, for example, Vygotsky, 1962; Werner, 1948) have supported their assumption that children initially think in complexes with examples of early complexive word use. An often cited example is that of the child who applied *quah* first to a duck swimming in a pond, then to liquids in general, including milk in his bottle, then to a coin with an eagle on it, and then to round, coinlike objects in general (Vygotsky, 1962: 70). Vygotsky argued (1962) that "complex formations make up the entire first chapter of the developmental history of children's words [p. 70]."

The view that young children's early use of words is necessarily complexive contrasts interestingly with more recent theories of the acquisition of word meaning proposed by Clark (1973) and Nelson (1974). Although these investigators differ from each other in many respects, both have assumed that children identify words from the start with one or more stable elements of meaning that determine how the word will be applied in new situations. For example, *doggie* might be identified with the meaning 'four-legged,' and thereby be extended to all four-legged creatures; similarly, *ball* might be identified with the meaning 'something that bounces and rolls' and extended to all objects that show this behavior.

Bloom (1973) has attempted to integrate evidence for both complexive word use (e.g., *quah*) and noncomplexive word use (e.g., *doggie* only for four-legged animals) by proposing that the two styles of word use predominate at different periods of development. Like Vygotsky, she argues that complexive usage is more primitive, and suggests that it is associated with lack of the concept of object permanence. According to her hypothesis, only when the child achieves the concept that objects have a stable, enduring existence (about 18–24 months in Piagetian theory) can he begin to identify words (at least for objects) with consistent features.

How accurate is this view of the young child's categorizational abilities as revealed through his use of words? The supporting data provided by most investigators—for example, isolated examples like *quah* or *doggie* collected from different children—are insufficient proof. In order to make a careful test of the hypothesis that complexive word use reflects an earlier and more primitive stage of concept development, one must inspect in detail the history of word use in *individual* children. Such an analysis of the data collected from Christy and Eva offers little support for the hypothesis (Bowerman, 1976, 1978).

Early Noncomplexive Categories

According to the "stage" theory, complexive usage reflects a primitive stage of mental development and tends to fade out, being gradually replaced

by the putatively more advanced noncomplexive use of words in which all referents for a word share one or more attributes. However, both Christy and Eva used some words noncomplexively virtually from the start of the one-word period. That is, they stuck to consistent classificational criteria in extending certain words to novel situations; their attention was not diverted by salient but irrelevant attributes of the new referents or by possibilities for thematic groupings.

Three examples are presented in Table 1. Example 1 shows that from 13 months Eva used *ball* exclusively in connection with rounded objects of a size suitable for handling and throwing (Christy's early use of *ball* was similarly consistent). From 15 months, Christy used [a:] *off/on* (Example 2) (these were among her first words; lack of final consonants in her speech at this time made it difficult to tell if one word or two were involved) in connection with the separation and joining of objects or parts of objects. It was broader than any everyday adult category, being applied not only to

TABLE 1
Some Words used Noncomplexively^a

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1. Eva, *ball*. From 13;5 for rounded objects of a size suitable for handling and throwing.

Fourteenth month: (first use) as spies a large round ball in adjoining room, then goes to pick it up; as picks up rounded cork pincushion, then throws it; as looks at a red balloon; later, also as handles it. Fifteenth mo.: whenever sees or plays with balls or balloons; as holds an Easter egg, then throws it; after picking up a small round stone, then throws it; as sees plastic egg-shaped toy; as holds a round cannister lid, then throws it; etc.

2. Christy, [a:] *off/on* (not clear if two words or one). From 15;12 in connection with situations involving separation or rejoining of parts.

Sixteenth to seventeenth months: in connection with getting socks on or off; getting on or off spring-horse; pulling pop-beads apart and putting them together; separating stacked paper cups; unfolding a newspaper; pushing hair out of M's face; opening boxes (with separate or hinged lids as well as sliding drawers); putting lids on jars, cap on chapstick, phone on hook, doll into highchair, pieces back into puzzle; while M takes her diaper off; trying to join foil-wrapped torn-apart towelettes, etc.

3. Eva, *off*. From 14;18 in connection with separation of things *from the body* only (as request or comment).

Fifteenth to seventeenth months: for sleepshades, shoes, car safety harness, glasses, pinned-on pacifier, diaper, bib. Starting in sixteenth mo.: *open* begins to be used in other 'separation' situations; e.g., for opening doors, boxes, cans, toothpaste tubes; pulling pop beads apart; taking books out of case, tip off door stop, wrapper off soap; cracking peanuts; peeling paper off book cover, etc. *Off* still used for taking things off the body.

^a Ages given in months and days, or examples listed chronologically within the month. All examples in all tables are spontaneous; there was no prior modeling of the word in the immediate context. All utterances were single words unless otherwise marked.
M = Mother

situations in which adults would say *take off* or *put on* but also to those they would encode with *unfold* or *fold*, *take apart* or *put together*, *take out* or *put in*, and *open* or *close*. Eva's use of *off* (Example 3) was just as consistent as Christy's, but the category underlying it was much less abstract: The word referred only to the removal of objects from the body and did not generalize beyond this domain, even to other situations an adult would refer to by *take off*, for many months. During this time Eva simply did not refer to other kinds of separation, although she engaged in activities involving the separation and joining of objects and their parts as much as Christy had.

The complexive use of words also began during the one-word period for both children, but it flowered somewhat later than these early noncomplexive uses and continued into the third year and even beyond for certain words (examples will be introduced in the following). This pattern (early onset of noncomplexive word use; later contemporaneous occurrence of words used complexively and words used noncomplexively) indicates that the complexive use of words does not necessarily stem, as Vygotsky (1962), Bloom (1973), and others have postulated, from an inability to abstract out attributes and hold them constant over a wide range of referents. To the contrary, early consistent uses like Eva's *ball* and *off* in the fourteenth and fifteenth months suggest that the capacity of very young children to form categories on the basis of stable, consistent attributes has been underestimated.² However, if complexive word use does not reflect an incapacity to form noncomplexive categories, why does it occur? Recent evidence on the nature of adult semantic categories, coupled with close analyses of children's complexes, helps to answer this question.

The Role of Prototypes in Adult and Child Categories

Conceptions of the nature of adult categories have been undergoing radical change in the last few years. No longer do investigators assume that most categories entertained by mature, sane, conscious, and civilized representatives of the human species are definable in terms of a conjunction of *critical attributes*, with category membership being an all-or-nothing matter. According to an alternative conception, category membership is more typically a matter of degree. At the core of a category there may be one or more prototypical, or "best," exemplars; these are "surrounded by" other less

² Rosch *et al.* (1976) have recently shown that children at least as young as 3 (the youngest age tested) can sort objects noncomplexively as long as the objects provided permit sorting according to *basic level* categories (e.g., dogs, cars) rather than superordinate categories (e.g., animals, vehicles). Like the present data, this indicates that children are capable of using adult-like categorization principles when they are free to group at their preferred level of abstraction. (However, the extremely abstract category underlying Christy's use of *off* at 15 months indicates that children's preferred level is by no means always relatively concrete, as is often assumed).

prototypical members at increasing distances from the center. Noncentral instances shade off at some point from being poor or peripheral members of the category to being nonmembers, but the borderline between membership and nonmembership, or membership only by metaphorical extension, is often fuzzy and ill-defined (Fillmore, 1975; Rosch, 1975; Smith *et al.*, 1974). The prototype model of category structure accounts well for certain phenomena that embarrass the "categories-as-conjunctions-of-criterial-attributes" model—for example, the fact that criterial attributes are impossible to identify for many categories (e.g., "furniture"; see Rosch and Mervis, 1975) and the fact that some category members seem to speakers to be more central to or representative of their category than others (Rosch, 1973).

Several researchers have suggested the applicability of the prototype model of category structure to children (see, for example, Anglin, 1977; Fillmore, 1975; Rosch and Mervis, 1975), but the matter has been relatively little explored, especially with children under two years of age. A close examination of Christy's and Eva's early language records indicates that the model is indeed useful: It provides an excellent account of their early complexive word uses, almost all of which are describable as a set of variations around prototypical exemplars.

Prototypicality could not be determined, of course, by directly probing the child's view on the representativeness of various category exemplars. It was judged instead on the basis of how the attributes of category exemplars were distributed within the category. Among the referents to which each complexively used word was extended, a small set of attributes repeatedly figured. Although many referents shared no discernible attributes with each other (which is, of course, why the category had to be considered complexive), there was at least one referent (or group of highly similar referents) with which they *all* shared one or more attributes. In this prototypical referent, all the attributes associated with the category (to judge from the way in which the word was extended to novel referents) were maximally clustered. This structure conforms closely to Rosch and Mervis's (1975) "family resemblances" model of the internal structure of prototype-based categories. According to Rosch and Mervis's studies, the degree to which adults perceive category members as prototypical is, for many semantic categories (e.g., "furniture," "chair"), a function of the internal distribution of attributes. Category members that are seen as most prototypical share many attributes with other category members (and particularly with each other), while category members perceived as less prototypical or as poor exemplars share fewer attributes with other category members.

In addition to being central in terms of the way the attributes associated with a given category were distributed within the category, the children's prototypes had other claims to special status. In almost all cases, the prototype was the child's *first* referent for a word. Additionally, it was invariably the referent to which the word had been applied most frequently or exclu-

sively in parental speech. It appears, then, that the children learned and first used certain words in connection with frequently modeled category exemplars. After periods ranging from a few days to a few months they began to extend the words to never-modeled referents sharing one or some combination of the attributes of the original. The interval between first use and extension beyond prototypical exemplars may reflect the length of time it took the child to analyze the prototype into some of its attributes and to begin to recognize these attributes when they occurred independently of each other, recombined with other attributes in new configurations.

Some examples of word use revolving around prototypical exemplars are presented in Table 2. Consider Example 1, Eva's use of *kick*. She produced

TABLE 2
Some Complexively Used Words with Prototypical Referents

1. Eva, *kick*.

Prototype: kicking a ball with the foot so that it is propelled forward.

Features: (a) *waving limb*; (b) *sudden sharp contact* (especially between body part and other object); (c) *an object propelled*.

Selected samples. Eighteenth month: (first use) as kicks a floor fan with her foot (Features *a, b*); looking at picture of kitten with ball near its paw (all features, in anticipated event?); watching moth fluttering on a table (*a*), watching row of cartoon turtles on television doing can-can (*a*). Nineteenth mo.: just before throwing something (*a, c*); "kick bottle," after pushing bottle with her feet, making it roll (all features). Twenty-first mo.: as makes ball roll by bumping it with front wheel of kiddicar (*b, c*) pushing teddy bear's stomach against Christy's chest (*b*), pushing her stomach against a mirror (*b*); pushing her chest against a sink (*b*), etc.

2. Christy, *night night*.

Prototype: person (or doll) lying down on bed or crib.

Features: (a) *crib, bed*; (b) *blanket*; (c) *nonnormative horizontal position of object* (animate or inanimate).

Selected examples. Sixteenth month: (first use) pushing a doll over in her crib; from this time on, frequent for putting dolls to bed, covering, and kissing them (Features *a, b, c*). Seventeenth mo.: laying her bottle on its side (*c*). Eighteenth mo.: watching Christmas tree being pulled away on its side (*c*); after puts piano stool legs in box, one lying horizontally (*c*); after putting a piece of cucumber flat in her dish and pushing it into a corner (*c*). Nineteenth mo.: as M flattens out cartons, laying them in pile on floor (*c*); often while looking at pictures of empty beds or cribs or wanting a toy bed given to her (*a*, sometimes *b*); laying kiddicar on its side (*c*). Twentieth mo.: "awant night night," (request for M to hand her blanket); she then drapes it over shoulders as rides on toy horse (*b*), etc.

3. Eva, *close*.

Prototype: closing drawers, doors, boxes, etc.

Features: (a) *bringing together* two objects or parts of the same object until they are in close contact; (b) *causing something to become concealed* or inaccessible.

Selected examples. From Sixteenth month: for closing gates, doors, drawers (Features *a, b*). Nineteenth mo.: "open, close," taking peg people out of their holes in bus built for them and putting them back in (*a*). Twenty-first mo.: Frequent from now on while pushing handles of scissors, tongs, tweezers together and for getting people to put arms or legs together, e.g., "close knees" (*a*); "close

TABLE 2 (Continued)

it," as tries to push pieces of cut peach slice together (*a*); trying to fold up a towellee (*a*, (*b*?)); "open, close," as unfolds and folds a dollar bill (*a*, (*b*?)). Twenty-second mo.: "open, close," after M has spread doll's arms out, then folded them back over chest (*a*). Twenty-fourth mo.: "that one close," trying to fit piece into jigsaw puzzle (*a*, [*b*?]); "I close it," as turns knob on television set until picture completely darkens (*b*); "Mommy close me," (twenty-sixth mo.: "I will close you, o.k.?" both in connection with pushing chair into table (*a*), etc.

4. Christy, *open*.

Prototype: opening drawers, doors, boxes, etc.

Features: (*a*) separation of parts which were in contact; (*b*) causing something to be revealed or become accessible.

From middle of seventeenth month: *open* starts to take over the function of *off* (see Example 2, Table 1) for 'separation' situations, both with and without 'revealing.' (First use) for cupboard door opening (*a*, *b*); pointing to spout in salt container that M had just opened (*a*, *b*); trying to separate two frisbees (*a*). Eighteenth mo.: for opening boxes, doors, tube of ointment, jars (*a*, *b*); trying to push legs of hand-operated can opener wider apart than they can go; spreading legs of nail scissors apart (both *a*). Nineteenth mo.: several times in connection with pictures in magazine; wants M to somehow get at the pictured objects for her (*b*); request for M to unscrew plastic stake from a block (*a*); request for M to take out metal brad that holds 3 flat pieces of plastic together (*a*). Twentieth mo.: request for M to take stem off apple (*a*); "awant mommy . . . open," request for M to pry pen out of piece of styrofoam (*a*); request for M to take pegs out of pounding bench (*a*); "awant open hand," request for M to take leg off plastic doll (*a*); request for M to turn on electric typewriter (*b*); trying to pull pop beads apart (*a*). Twenty-first month: request for M to turn on water faucet (*b*); request for M to take pieces out of jigsaw puzzle (*a*, (*b*?)); trying to get grandma's shoe off her foot (*a*); "open light," after M has turned light off, request to have it turned on again (*b*). Twenty-second mo.: "awant that open," trying to pull handle off of riding toy (*a*), etc.

5. Eva, *open*. (See Table 1, Example 3 for initial uses.)

Selected examples. Eighteenth month: request for M to take apart a broken toothbrush (*a*), and for M to pull apart two pop beads (*a*), and for M to take pieces out of jigsaw puzzle (*a*, (*b*?)). Nineteenth mo.: pulling bathrobe off M's knee to inspect knee (*a*, *b*); request for M to turn television on (*b*); "open tape," request for M to pull strip off masking tape (*a*). Twentieth mo.: "open tangle," bringing M pile of tangled yarns to separate (*a*); taking stubby candle out of shallow glass cup (*a*). Twenty-first mo.: "open mommy," trying to unbend a small flexible "mommy" doll (*a*); unfolding a towellee (*a*, *b*); request for M to put legs apart (*a*). Twenty-second mo.: "open slide," request for M to set slide in yard upright (*a*, (*b*?)); "I'm open it," after rips apart two tiny shoes that were stuck together (*a*). Twenty-third mo. and beyond: "my knee open," as unbends her knee (*a*); "I will open it for you," before taking napkin out of its ring for M, does not unfold it, then says "I open it" as report on completed action (*a*); "I'm gonna leave this chair open like this, I'm not gonna shut it," as leaves table with chair pulled out (*a*), etc.

6. Eva, [gi]. (from "giddiup")

Prototype: bouncing on a spring-horse

Features: (*a*) horse (later, other large animals and riding toys which one sits astraddle); (*b*) bouncing motion; (*c*) sitting on toy (especially astraddle).

Selected examples. Fifteenth month: (first use) bouncing on spring-horse or as request to be lifted onto it (*a*, *b*, *c*); as picks up tiny plastic horse, then tries to

(continued)

TABLE 2 (Continued)

straddle it (*a, c*); getting on toy tractor (*c*); looking at horses on television (*a*); getting on trike (*c*); seeing picture of horse (*a*); bouncing on heels while crouching in tub (*b*); climbing into tiny plastic blow-up chair (*c*); looking at hobby horse (*a*); bouncing astraddle M's legs (*b, c*). Later, continues to be used for pointing out horses, generalizes to other large animals like cows, and while pointing out or riding on trikes, tractors, kiddicars.

7. Eva, moon.

Prototype: the real moon

Features: (*a*) shape: circular, crescent, half-moon (these shapes were distinct—i.e., a stretch of curved surface not enough to elicit "moon"; (*b*) yellow color; (*c*) shiny surface; (*d*) viewing position: seen at an angle from below; (*e*) flatness; (*f*) broad expanse as background.

Selected examples. Sixteenth mo.: (first use) looking at the moon (all features). Seventeenth mo.: looking at peel-side of half-grapefruit obliquely from below (*a, b, d*); playing with half-moon-shaped lemon slice (*a, b, e*); touching circular chrome dial on dishwasher (*a, c, d, e, f*); playing with shiny rounded green leaf she'd just picked (*a, c, e*); touching ball of spinach M offers her (*a*. Spheres were usually called "ball." There was perhaps a limited chaining effect here to the leaf, a referent earlier the same day, through shared greenness). Eighteenth mo.: holding crescent-shaped bit of paper she'd torn off yellow pad (*a, b, e*). Nineteenth mo.: looking up at inside of shade of lit floor lamp (*a, b, d*); looking up at pictures of yellow and green vegetables (squash, peas) on wall in grocery store (*a, b, d, e, f*); looking up at wall-hanging with pink and purple circles (*a, d, e, f*). Twentieth mo.: pointing at orange crescent-shaped blinker light on a car (*a, (b?), c, e*). Twenty-first mo.: looking up at curved steer horns mounted on wall (*a, d, f*); putting green magnetic capital letter D on refrigerator (*a, d, e, f*); picking up half a Cheerio, then eats it (*a, (b?)*); looking at black, irregular kidney-shaped piece of paper on a wall (*a, d, e, f*). Twenty-fourth mo.: "my moon is off" after pulling a hangnail (a routine usage) (*a, e*).

this word starting at seventeen and one-half months both in situations in which an adult would also be able to use *kick*, as when she kicked a fan, and in strangely diverse and (to adult eyes) inappropriate situations such as while she watched a fluttering moth, when she bumped a ball with the front wheel of her kiddicar, making it roll, and when she pushed her stomach up against a mirror. What does the bumping of a ball with a kiddicar wheel or the pushing of a stomach against a mirror have in common with a fluttering moth? Probably nothing. But all three referents share one or more attributes with a very common referent for *kick* (exceptionally, not Eva's first referent but implicit in her second referent), the situation in which someone kicks a ball with a foot, propelling it forward. The moth referent shares with it an attribute we may refer to (very schematically) as 'a waving limb.' The kiddicar referent shares with it 'sudden sharp contact' and 'an object (ball) propelled.' And the stomach-against-mirror referent shares with it—and with the kiddicar referent but not with the moth referent—'sudden sharp contact.'

Example 2 illustrates that for Christy, *night night* was associated with at

least three features that are all present simultaneously in the typical situations in which children learn this word: beds or cribs, blankets, and the horizontal position of an object that is usually vertical. These features were present one-, two-, or three-at-a-time in the various situations to which Christy extended *night night*. For example, her attention to 'nonnormative horizontal position' in the absence of beds or blankets is found in her production of *night night* while watching cardboard cartons being flattened, while witnessing a Christmas tree being hauled away, and after laying her kiddicar on its side.

Examples 3, 4, and 5 show that, for both Christy and Eva, *open* was associated with the 'separation of parts' and the 'revealing of something,' while *close* was associated with the reverse features of 'joining' and 'concealment.' Both features of each pair co-occur in typical *open* and *close* situations involving doors, jars, boxes, and the like (these were the children's first referents for *open* and *close*), and they occur one-at-a-time in referents like turning on or off water faucets, lights, television, or radio (revealing or concealing without separation or joining) and taking a stem off an apple, buckling a wrist strap, and pulling a chair out from a table or pushing it in (separation and joining without revealing or concealing).

Eva first used *giddiup* in connection with bouncing on her spring-horse, the only referent situation in which it had ever been modeled to her. Example 6 shows that she subsequently extended it to horses and other large animals, riding toys, sitting on or (particularly) astraddle, and a bouncing motion, all of which were present simultaneously in the original spring-horse situation.

Example 7 shows Eva's use of *moon*. This was first applied to the real moon, then extended to a variety of objects that shared shape (circular, half-moon, or crescent) with the moon and that were also characterized by one or more of the following attributes of the moon or of the situation in which it is viewed: flatness, yellowness, shininess, having a broad expanse as a background, and being seen obliquely from below. This example is particularly interesting because it reveals that the child may assign different weights or values to the attributes she associates with a category. *Shape* was obviously criterial for Eva's use of *moon*, since no matter how flat, shiny, yellow, etc. an object might have been she never called it *moon* unless it was also shaped like the real moon in one of its phases. Unlike shape, attributes like flatness, shininess, and so on were only probabilistically associated with the category labeled *moon*. The differential weighting of attributes according to their relative degree of criteriality for a category is a central part of a model of prototype structure (for adult categories) outlined by Smith *et al.* (1974).

To summarize, the preceding discussion of the structure of semantic categories in the early period of word acquisition reveals little discontinuity between childhood and adulthood in the structural processes used in categorizing. While data from only two children have been presented here, there

is no reason to suppose they are unrepresentative. To the contrary, there is at least preliminary evidence to suggest that the phenomenon of extending a word on the basis of similarities that new referents bear to prototypical referents is quite general in the early period of word acquisition. For example, Labov and Labov (1974) describe such a usage for *cat*, one of their daughter's first two words, and Clark (1975) reanalyzes examples of word use from the early diary literature in a way that is quite compatible with the present model.

The argument that children are capable of using essentially the same principles in categorizing objects and events as adults do supports Rosch *et al.*'s (1976) contention that the structural principles of category formation are universal. In addition, it is in keeping with the more inclusive hypothesis that is currently enjoying much popularity, that man's biologically given propensities for organizing experiences in certain ways will, because they are so basic, manifest themselves early in childhood (as well as in other domains such as universals of linguistic structure and constraints on the way languages change over time; see Rosch, 1975; Slobin, 1975, for general discussions). This approach to the child's abilities regards maturation as a process consisting largely of acquiring an overlay of detail, much of it culture-specific, on an underlying universal cognitive base that is common to both children and adults. In this emphasis, it differs from accounts of child development (including those of Vygotsky and other theorists who have written about complexive thought processes) that stress ways in which children are both different from and deficient with respect to adults.

On the Origins of Children's Categories

Old and New Hypotheses

The current theoretical emphasis on the extent of man's inherent cognitive capacities stands in striking contrast not only to the different-and-deficient view of children referred to above but also to the view, widely accepted earlier in this century, that cognitive development is heavily dependent on language acquisition. According to this latter position, embodied most strongly in the Sapir-Whorf hypothesis, the categorization schemes adopted by different cultures are essentially arbitrary, there being nothing in either man's make-up or in the real world that calls for experiences to be divided up one way rather than another. The growing child, in this view, is socialized into the locally prevailing system of categorizing largely through his acquisition of language. Thus, language acquisition precedes and guides cognitive development.

This hypothesis has been turned upside down in the last few years, with many researchers now arguing for the opposite view, that cognitive devel-

opment precedes, paces, and guides language development. An important early determinant of this shift was the recognition in the early 1970s that children's early sentences everywhere are largely limited to the expression of a small set of putatively universal operations and semantic relationships,³ coupled with the realization that Piaget's theory of cognitive development in the sensory-motor period (birth to 24 months) provides a compelling account of how children arrive at these concepts independently of language input (Brown, 1973). The cognition-precedes-language hypothesis has gained additional strength from studies showing that children employ many non-linguistic strategies in trying to process and interpret linguistic structures (see, for example, Slobin, 1973; Clark, 1975), from the generally negative outcomes of attempts to test the hypothesis that language structure influences cognitive structure or processing (Lenneberg, 1967), and from the recently adduced evidence that certain categorization schemes are far less arbitrary and variable from language to language than has been supposed (Berlin and Kay, 1969; Rosch, 1975; Rosch *et al.*, 1976).

According to the currently prevalent view of the relationship between linguistic and cognitive development, the prelinguistic child is engaged in building up a repertoire of basic concepts and ways of organizing his experiences on the basis of his own dealings with the world and in accordance with biologically given constraints on the possible form that human concepts can take. The task of acquiring language, in this view, is to learn the linguistic devices with which the local language *encodes* concepts that the child has already formulated independently of language. In other words, learning to talk involves learning a system for mapping or translating from one representational system (cognition) into another (language) (see, for example, Clark, 1973; Nelson, 1974; Slobin, 1973). No one would deny that language at some point becomes instrumental in introducing the child to new concepts or in refining his existing concepts so they conform to adult norms, but this is typically seen as a phenomenon of later language acquisition—say, beyond the period of early sentences at about 18 to 30 months. During the early period of acquisition, the child is thought not to acquire linguistic forms—perhaps not even to notice them—until he has already arrived, on his own, at an understanding of the meanings they express. Then he will actively start searching for the needed expressive devices.

In the following discussion, I will argue that this account is far too extreme. In our enthusiasm to acknowledge the many ways in which language acquisition depends on prior cognitive growth, we should not be so easily

³ These include the predication of existence, nonexistence or disappearance, and recurrence of objects and events by words such as *that*, *there*, *no more*, *allgone*, and *more*, and the expression of relations among agents, actions, and objects acted upon, between locations and objects located, between possessors and possessions, and between objects and their attributes (see Bloom, 1970; Bowerman, 1973; and Brown, 1973).

persuaded that linguistic forms are always mapped onto preformulated concepts, and never concepts built to account for received linguistic forms.

Some Relevant Data

Speculation on the role of language in early cognitive development has generally been hampered by a lack of specific and detailed information on the contexts in which children learn particular words and the ways in which they use them. The following analyses of data from my two subjects are brief, but I think they are sufficient to suggest that the relationship between language and cognition in early development is more complex than either the current cognition-precedes-language theory or the earlier language-precedes-cognition theory can account for. There seem to be complex interactions in word learning among such factors as the child's own prelinguistic conceptual activity in a particular semantic domain, the nature of the input provided, and the child's attempts to make sense of this input.

The relative contribution of linguistic input and autonomous cognitive development in the child's acquisition of the concept underlying her use of a particular word can be roughly inferred from several types of evidence. A first consideration is whether the word is one the child has been exposed to, or instead is idiosyncratic. Children sometimes appear to make up words; Nelson (1974) suggests that this occurs when they have formulated concepts independently of language and cannot find suitable words in the speech they hear with which to express them. A second consideration is whether the range of situations across which a child applies a recognizable word of the adult language is similar to the semantic range across which it has been applied in the input to her, or whether she uses it in a consistent but deviant way—for example, either for only a subset of the situations in which the adult uses it (underextension) or for those situations plus many more besides (overextension). Gross deviations from the input in terms of the size and make-up of the child's semantic category suggest a relatively strong role for the child's independent conceptual activity. A third consideration is whether the concept underlying a child's word, as inferred from the situations in which she uses it, is at all likely to have originated completely autonomously, or whether, instead, there has been a specific kind of verbal input to which the concept can more plausibly be traced.

When these admittedly somewhat rough criteria are applied in analyzing Christy's and Eva's early words, at least two general patterns emerge (probably these are merely opposite ends of a continuum representing the relative contribution of language-independent cognition and linguistic input in the genesis of the child's semantic categories). In one pattern, the underlying concept seems to have originated with minimal or no assistance from adult linguistic input; this, of course, is exactly and *only* what one should expect to find according to the current hypothesis that early language learning con-

sists of mapping linguistic forms onto preformulated concepts. In the second pattern, in contrast, considerable influence of adult linguistic input is apparent.

Some examples of the first pattern include Christy's *offlon*, Eva's *off* (Examples 2 and 3, respectively, in Table 1) and Eva's [bidi] (Example 1 in Table 3). As noted earlier, Christy's *offlon* was applied over a much broader semantic domain than in adult speech. It apparently referred to almost any kind of separation or joining of two objects or parts of the same object. Eva's use of *off* contrasts strikingly in that its range of application was very restricted by adult standards (to objects being removed from the body). These patterns of word usage suggest that Christy regarded taking clothes and other objects off the body as similar, at some level of abstraction, to opening boxes, unfolding papers, and pulling pop beads apart—all could be referred to by the same word. Like Christy, Eva regarded manipulations

TABLE 3

Words Illustrating Differences in the Relative Contribution of Language-Independent Cognition and Linguistic Input to Concept Formation

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1. Eva, [bidi]. Concept: *pinching or touching someone, especially on leg, or unexpectedly bare skin.*

Selected examples. Seventeenth month: as pinches M's leg; as pinches her own leg; coming up to pinch leg of visitor; soon after, as pinches M's leg. Eighteenth mo.: looking at picture of boy on a swing, his shirt is pulled up so bare skin shows in back; approaching strange child in theater and touching his bare back; after father appears in unfamiliar shorts, E going up to touch bottom edge of the shorts.

2. Christy, *hi*. Concept: *things on or covering hands or feet.* (As a greeting, *hi* had already been known for several months.)

Selected examples. Nineteenth month: sticking hand inside snowsuit hood and holding it up; as washrag drifts across her foot in tub; as shows M tiny object balanced on end of her finger; as hold up finger with drop of milk from her bottle on the end of it; as looks at M's finger which is stuck in toy tube of straw; as slides her hands under her blanket and holds them up; as puts a mitten-shaped potholder over her hand; as sticks her hand down into silverware holder of dishdrainer; as holds up finger with wing-nut balanced on it; when shirt falls off side of crib and lands over her foot.

3. Eva, [gidi]. Concept: *physical displacement* of object, or anticipated potential displacement.

Selected examples. Nineteenth month: "gidi towel," as climbs on chair, brushing against towel hanging on stove; as climbs over father's legs on couch; as tries to squeeze past Christy in narrow hall; "gidi book," as clammers over magazine on couch. Twentieth mo.: "gidi Mommy," as tries to squeeze behind and past M in hallway; "gidi miao," as pushes aside a rabbit riding toy (which she calls "miao") so she can push doll carriage through; "gidi Mommy," pushing M's arm, which is over her head, away; "gidi Christy," trying to shove a chair in at kitchen counter beside chair C is standing on; "gidi beads," pushing toy car through pile of beads, shoving them aside. Twenty-first mo.: "Christy gidi!" distressed after C has encroached on her space in tub, trying to shove her back.

with pop beads, folded paper, boxes, and so on as similar enough to be referred to by the same word, although the word she used was *open* rather than *off*. But taking things off the body did not appear to share in this concept for Eva, since she always referred to this action by a different word, *off*.

It is difficult to account for these differences on the basis of the linguistic or other input to the children, since their linguistic and physical environments were quite similar at this age (same parent, babysitter, house, toys, etc., although of course Eva had an older sibling while Christy did not). An alternative and more persuasive hypothesis is that the children had, on the basis of their own dealings with the physical world, arrived at different ways of categorizing and organizing their experiences involving separations of various types. Different children may make the cuts in their experiences in different places. The things that one child sees as going together might not exactly coincide with what another child regards as similar, and—as in the case of the two *offs*—neither child may make the cuts in the places they might be expected to if they were relying primarily on linguistic input to instruct them on how to categorize things.

Eva's word [bidi] (Example 1, Table 3) reflects a concept that seems even more independent of adult input than Christy's *off/on* and Eva's *off*. Eva used this word extensively in her seventeenth and eighteenth months in connection with her act of pinching someone's leg or, later, touching someone wherever bare skin was somewhat surprisingly on view. As far as I can determine, both [bidi] and the concept it encoded originated with Eva; no plausible adult model suggests itself. We did not pinch or talk about pinching; we did tickle, but Eva had a separate word for this, *ticky*, which was associated with toes. The salience and interest value for Eva of "surprising" bare skin also seems to have been independent of any adult linguistic input. In short, [bidi] seems to have been a purely spontaneous invention on Eva's part, in both word and governing concept.

Now consider Christy's *hi* and Eva's [gidi] (Examples 2 and 3 in Table 3). Unlike *off/on*, *off*, and [bidi], these words were acquired and used in such a way as to suggest considerable influence of linguistic input on concept formation. That is, there is strong reason to infer that the children did *not* formulate the concepts independently of language and then look around for convenient labels with which to encode them. Rather, the concepts seem to have originated with the children's attempts to make sense of the way they heard certain words used to them. In both cases, the child's efforts to understand resulted in her construction of a concept that was not the same as the adult concept governing the use of the word. But it seems unlikely that her concept would have been formed and labeled at all unless she had been exposed to adult usage of the word and had attended to it without yet having a notion of what the word meant in those contexts. Notice that this kind of behavior is precisely what is *not* predicted by the hypothesis that

children initially learn language only to encode those concepts that they already have acquired on a nonlinguistic basis.

The first example shows that Christy at 18 months began to develop a peculiar use for *hi* (she had used it normally as a greeting for some time). The governing concept appears to have been 'situations in which something rests on or covers the hand or foot' (see examples in Table 3 from which this inference is made). What would cause a child to develop a concept like this? I think it is implausible to suppose that the concept was formulated independently of language, not only because it is such a peculiar one, but, more importantly, because there is an easily located linguistic source for it. When playing with Christy, I would sometimes put a finger puppet or object like the cap of a pen on my finger and pretend it was a little person, coming to say *hi*. Thus, she heard *hi* modeled in connection with seeing something stuck on the end of a finger. Rather than interpreting *hi* in its intended and known (to her) sense as a greeting, she apparently concentrated on making sense of the co-currence of *hi* with something on the finger, and from there constructed a rather ingenious and consistent hypothesis—albeit the wrong one—to account for the usage.

The concept governing Eva's use of [gidi] (Example 3, Table 3) seems to have involved the actual or anticipated physical displacement of objects. For example, starting in the nineteenth month, she produced the word as she brushed against a hanging towel, as she set a hairbrush to one side, as she shoved a toy car through a pile of beads, and as she pushed past people or objects in narrow hallways. It is not inconceivable that a child would formulate a category involving the physical displacement of objects and people on her own, and, not finding a suitable adult word to encode it, make up her own. But consider how much sense this concept makes if we identify Eva's [gidi] with adult '*scuse me*. [gidi] was a plausible rendition for '*scuse me* in Eva's phonology, and she had certainly been exposed to the phrase on many occasions in which someone was squeezing past her in the hall or moving her to one side. I would hypothesize that Eva's attention was drawn to 'physical displacement' because she had heard the same phrase used repeatedly across a variety of superficially diverse situations, most of which shared this abstract element. In other words, repeated exposure to the word served as a "lure to cognition" (Brown, 1958:206) and started her working on a concept she probably would not have formulated at that time in the absence of this specific kind of linguistic input.

The examples presented so far all involve categories for which there appear to be criterial attributes. Determining the source of such categories in the child's development involves making inferences about what brings a certain cross-situational invariance to a child's attention and/or sets a certain categorizational principle in motion at a particular time. What about categories revolving around prototypical exemplars? Determining the origin of

these involves making an additional type of inference: Why do certain objects or events, complete with all their attributes, take on central or core significance while others are relegated to more peripheral status?

Rosch (1973, 1975) suggests a number of principles by which prototypes might arise. In some of these, certain category exemplars take on prototype status as a result of the learner's experience with a variety of category instances. For example, the learner may become implicitly aware, through principles of information processing, that certain exemplars represent the central tendency of the category taken as a whole. The data presented in the preceding section indicate that early in children's development prototypes do not arise by this type of processing, but rather are salient from the beginning, constituting the growing points around which the categories are subsequently formed. Rosch postulates that there may be several ways in which certain stimuli take on special salience before the formation of their categories. For example, some items (e.g., certain colors, "good gestalt" shapes) appear to have prototype status universally due to the characteristics of man's perceptual apparatus. Other items might acquire special salience because they are the exemplars of their category that the learner hears identified first or most frequently.

The hypothesis that early word acquisition consists of mapping words onto preformulated concepts would predict that the child would be little influenced in his selection of prototypes by which items he hears labeled by a particular word first or most frequently. Rather, certain stimuli should assume special salience for the child on grounds quite independent of language. This is no doubt true in many cases. For example, consider Eva's *moon* (Example 7, Table 2). Because the real moon is unique and perceptually highly salient, its preeminence over hangnails, scraps of paper, and other more peripheral members of the category labeled by Eva's *moon* is easy to understand. It would seem implausible, in fact, for a child to form a category (such as, perhaps, *paper*) including scraps of paper as the prototype and the real moon as a peripheral member. In short, it is not necessary to suppose that linguistic input played a critical role in singling the moon out from other "similar" objects and giving it special status in Eva's eyes. It is quite plausible, to the contrary, that she conceptualized it for herself and only then adopted the word offered for it in parental speech.

However, now consider Eva's use of *kick*. Should we assume that there is also something highly salient about kicking a ball that would lead a child to elevate this event to prototype status on nonlinguistic grounds? It is not clear that kicking a ball has the necessary perceptual or functional salience over other similar events, such as kicking one's sister or throwing a ball, to make it the core of a concept that includes these other events as more peripheral members. An equally or more plausible explanation for the prototypical status of kicking a ball in the category labeled by Eva's *kick* is that the word *kick* was modeled to her in connection with this referent far more

frequently than with any other referent. This alone could have highlighted it and caused it to assume focal importance over all "similar" competing referents for *kick*.

Frequency probably also correlates with firstness. That is, the referents in connection with which parents model words most frequently would also tend to be the first or certainly among the first referents with which they introduce the word. Brown (1977) suggests that parents' choice of first referent when introducing a word is not random, but rather is dictated by their own (adult) knowledge of the internal structure of the category labeled by that word: "Given any choice at all . . . a parent will surely prefer to introduce a word with a highly prototypical instance. Indeed, I suspect there is a little law to the effect that words will be ostensibly introduced to children with the most prototypical or representative example available. For *vegetable*, peas or carrots, not mushrooms. For *furniture*, a chair or sofa, not a clock. And for *bird*, something like [a jay], rather than a penguin [pp. 6-7]."

If it is indeed true that when parents talk to children they select highly prototypical category members as first (and probably most frequent) referents for a given word, and if children use parental speech as a guide in selecting referents to serve as prototypes for their own incipient semantic categories, as the data discussed in the preceding suggest, then the core examples of children's semantic categories would tend to be the same as those of adult categories virtually from the start. In the case of categories whose prototypes are favored on grounds of universal cognitive-perceptual salience, the adult input would simply tend to affirm and reinforce children's inherent language-independent categorizational predispositions. But in the case of categories lacking biologically given prototypes, which no doubt constitute the majority of those to be learned, the road to adultlike knowledge would be considerably shortened if the child were attentive to adult linguistic input and willing to accept as his own prototypes the category members that adults label first and most frequently for him, rather than simply matching adult words to self-generated and presumably often rather idiosyncratic concepts.

The Role of Nonlinguistic Categorizational Biases in Human Symbolic Activity

According to the hypothesis that the initial stage of language acquisition involves a mapping of language forms onto concepts generated independently of language, the role of children's categorizational predispositions would be to provide the concepts—or prototypes for the concepts—that the child subsequently learns to encode linguistically. However, if early language acquisition involves an interaction rather than a one-way mapping

between cognition and language, as I have argued, then we can expect categorizational predilections to manifest themselves in additional ways: as characteristic biases in the way children learning the same and different languages try to make sense of words whose meanings they don't yet know (see also Clark, 1975) and in the way they assimilate novel referents to the prototypical category instances presented to them through language. Children's tendencies to attend to certain sorts of resemblances and not others among objects and events might be expected, on grounds that they are exceedingly basic, to show up in areas of human symbolic activity other than language acquisition. There is preliminary evidence that this is so.

Most work on nonlinguistic categorizational biases among children has been limited to the domain of object classification. A number of studies indicate that young children regardless of language tend to extend words for objects to novel referents most frequently on the basis of shared *perceptual characteristics*, especially of shape (Anglin, 1977; Bowerman, 1976, 1978; Clark, 1973). Clark (1977) suggests that children's reliance on visual perceptual similarities in extending words arises from universal nonlinguistic categorization processes that manifest themselves not only in children but also in the classifier systems of many natural languages. In both classifiers and children, "objects are categorized primarily on the basis of shape, and the same properties of shape appear to be relevant in acquisition and in classifier systems. Roundness and length . . . appear to be very salient [1977; p. 263 in 1979 reprint]." Similarity of overall contour is also an important basis upon which metaphors and other symbols are selected by both adults and children.

Little evidence is yet available on children's ways of recognizing similarities between actions or spatial relationships, as opposed to objects. But data from my two subjects suggest that universal cognitive predispositions may also operate in these domains to guide children's hypotheses about what words mean. It is intriguing to note that many of the ways in which Christy and Eva overextended nonobject words reflect classifications that, although "incorrect" in the English modeled to them, are found in other languages, in dialects or special uses of English, or in possible metaphorical extensions of English words. For example, one does not normally *open* or *close* the television, radio, or water faucet in standard English, but one can *shut* them off; and one routinely *opens* and *closes* the water in Spanish and the television or radio in Finnish. Similarly, although a foot is normally required for the application of English *kick* to be appropriate, one speaks metaphorically of the *kick* of a gun against a shoulder—a usage only trivially different from Eva's application of *kick* to situations in which she bumped her stomach or chest up against an object.

Even when word usage superficially seems whimsical or wildly unreasonable, a closer look often reveals a hidden logic. For example, Christy's extension of *hi* from situations involving things on the hand (as had been

modeled to her) to those involving things on the feet reflects an underlying equation of hands and feet. The same equation was demonstrated about a month later when she requested help in getting a tiny plastic doll's leg off with "awant open hand." A parallel equation of arms and legs was also shown in her frequent reference to pant legs as *sleeves*, in Eva's extension of *kick* to the throwing of a ball, and in Eva's one-time reference to her wrists as *ankles*. While these equations are not directly encoded in the English lexicon with which the children were familiar, they are routine in other languages (e.g., many languages use the same term for both fingers and toes; see Anderson, 1978:353-4).

A related example is Christy's extension of *night night* to normally vertical objects now horizontal. This reflects a sensitivity to spatial orientation that plays a relatively minor role in English (e.g., *stand* versus *lie [down]*), but that is of central importance in certain American Indian languages, in which the *position* (standing, sitting, or lying) of both animate and inanimate objects is obligatorily encoded in almost every sentence (Watkins, 1976).

These examples suggest that children's hypotheses about what might be relevant to the meanings of the words they are learning are not randomly generated, but are guided by universally shared categorizational propensities. The role of linguistic input in the very early stages of language development may thus not be primarily to instruct the child that she should become aware of certain similarities among stimuli, as in traditional language-precedes-cognition accounts (although this may become important later in development). Rather, the input may at first serve the more limited function of activating a search for the relevant classificational principle(s) from among a somewhat constrained set of candidates. When the child hits upon a certain principle to guide her extension of a word to novel referents, the correctness of her hypothesis will be to a large extent dependent on the language she is learning. A usage that is acceptable literally in one language may be either acceptable only by metaphorical extension in another or simply incorrect. Even when it is incorrect, however, the usage may reflect a classifying principle that is important in some other area of the lexicon or morphology of the child's language or other languages, or in a symbolic domain other than language. Ultimately, an important role of linguistic input must be to inform the child of how the classificational principles she favors are formally recognized in the culture in which she finds herself.

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