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Linking Language and Conceptual Development: Linguistic Cues and The Construction of Conceptual Hierarchies

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The establishment of class-inclusion hierarchies is the principal focus of this volume and, as a result, taxonomic classes and the hierarchical relations among them occupy center stage. However, there is very little reason to suspect that young children share this preoccupation. On the contrary, very young children, and perhaps even infants, appreciate a rich variety of different kinds of conceptual relations, including thematic, associative, and causal relations (e.g., Smiley & Brown, 1979; Sugarman, 1982; Mandler, Fivush, & Reznick, 1987; Cohen & Younger, 1983). In fact, several researchers have suggested that very young children prefer to direct their attention to these, as opposed to taxonomic, relations. How, then, do children come to focus on the taxonomic relations essential for building hierarchical systems?

In this article, I will examine the evidence and the implications of the recent claim that linguistic and conceptual development are intricately linked in such a way as to promote the early establishment of conceptual hierarchies. In particular, I will argue that very young children honor implicit biases in word-learning and that these biases highlight taxonomic relations among objects and classes of objects.

The notion that certain aspects of human psychological development may be guided by implicit biases or constraints within the child has recently received considerable attention. The "constraints approach," as it is sometimes called (e.g., R. Gelman, in press; Nelson, 1988), is fairly new to developmental psychology and although it has generated much discussion and empirical work, the theoretical position itself and its attendant claims are only now in the process of being clearly drawn.

The essential idea in a constraints approach is that the child brings to the task of learning and development tacit biases or tendencies that lead her to favor some interpretations of events and objects over others. While these interpretations are motivated by biases internal to the child, they propel the child to seek

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out information from the world around her. Therefore, positing constraints in development does not, in any sense, preclude the examination of other important sources in development. For central to a constraints approach is the conviction that the child is an active learner. Constraints are assumed to provide direction for development but to leave open ample opportunity for variation and elaboration. As a result, development is not presumed to be a rigid, predetermined procession toward a single fixed endpoint. On the contrary, development, even under the influence of constraints, is seen as crucially dependent upon interactions with the people, objects, and events that constitute the child's physical and social world. My aim in this article is to begin to articulate these fundamental assumptions of a constraints approach. To do so, I take the development of conceptual hierarchies as a case in point.

It appears that some aspects of development are more likely to be guided by tacit biases or constraints than others. One would expect to find constraints operating in the development of complex domains which, like language, are acquired universally and rapidly. Chomsky and his colleagues pioneered the argument that a priori constraints guide both language acquisition in the child (Wexler & Culicover, 1980) and language processing in the adult. In addition, there appear to be constraints on the acquisition of number (R. Gelman & Gallistel, 1978), object (Spelke, 1985), and causal (Massey & R. Gelman, 1988) concepts. Indeed, some have argued that young children honor an innate constraint to organize ontological categories (e.g., object vs. event; animate vs. inanimate object) in a strictly hierarchical fashion (Keil, 1979; but see Carey, 1983 for a critique of this view).

Although it is possible, at least in theory, that there are constraints on the early establishment of ontological hierarchies, as Keil (1979) has argued, such a constraint does not (indeed *could* not) operate for the classification of physical objects. This is because humans, both children and adults, are exceptionally flexible in object classification. We appreciate myriad kinds of conceptual relationships among objects, including taxonomic, thematic, associative, and idiosyncratic relations. While this unconstrained conceptual flexibility affords us creativity, it also brings with it a cost (Quine, 1960). Consider the problem of word learning. When an adult points to an object (say, a rabbit) and says "rabbit," how does the child determine that the word may refer to that particular object and to a class of similar objects (rabbits), but not to thematic groupings (e.g., the rabbit and its carrot), associated objects (e.g., the rabbit and an easter egg), isolated parts (e.g., rabbit ears), or actions in which the object is engaged (e.g., hopping)? If word-learning actually entailed ruling out these and countless other alternatives, it would be an overwhelmingly difficult task. Yet we know that children learn new words with remarkable speed.

Children's seemingly effortless solution to the logically difficult problem of matching words to their appropriate meanings has offered a challenge to developmental psychologists. Recent research in this area has led to the hypothesis that children may honor implicit biases in word-learning which lead

them to favor certain hypotheses over others when linking a particular novel word to its referent (Brown, 1957; Soja, 1987; Katz, Baker, & Macnamara, 1974; S. Gelman & Taylor, 1984). In particular, we have found that taxonomic relations become especially salient to young children when they are learning novel words. In this way, subtle, but powerful connections linking children's early linguistic and conceptual systems may promote the development of conceptual hierarchies (Waxman, in press).

What is the evidence for this view? There is no doubt that very young children easily form at least some taxonomic classes, notably those at the basic level. Basic level classes develop very early and are remarkably consistent across cultures. The same cannot be said for non-basic levels, where children have considerable difficulty imposing taxonomic relations and where there is notable fluctuation in the classes established across cultures (Rosch, Mervis, Gray, Johnson, and Boyes-Braehm, 1976; Berlin, Breedlove, & Raven, 1973). Therefore, the remaining questions for developmental psychologists are those regarding the development of non-basic level classes.

In my research program, I take as a starting point the "primacy" of the basic level. Because the logical power of hierarchical systems derives from the inclusion relations among classes at multiple hierarchical levels, I go on to ask how children go beyond the basic level to form the higher- and lower-order classes that comprise hierarchical systems. And it is here, at the non-basic levels, that researchers have begun recently to notice the influence of subtle, yet powerful, biases linking word-learning and conceptual development. To investigate these biases, I introduce preschool children to novel words for classes at various hierarchical levels and observe the effect of these novel labels in their object classification.

First, let us consider superordinate level classes (e.g., animals, food, clothing). Under most circumstances, preschool children have difficulty sorting objects into categories at this abstract level (see R. Gelman & Baillargeon, 1983, for a review). However, when children are introduced to novel words for these categories, their performance improves remarkably. To illustrate this phenomenon, we have compared children's superordinate level classification with, and without, novel labels. In one study (Waxman & R. Gelman, 1986), we introduced three- and four-year-old subjects to three puppets, explained that the puppets were very picky, and asked the children to help the puppets find the things they would like. To get the children started, we showed them three typical instances (e.g., a dog, a horse, and a cat) for each superordinate level category under investigation (e.g., ANIMAL).

We asked children in our Instance condition to sort the remaining objects (various members of the categories ANIMALS, CLOTHING, and FOOD) with no further instructions. The Novel Label condition differed from the Instance condition in only one respect. Children in the Novel Label condition saw the same typical instances as their age-mates in the Instance condition, but they were also introduced to a novel label for each superordinate class (e.g., "These

are *dobutsus*, these are *gohans*, and these are *kimonos*"). Three-year-old children in the Instance condition had difficulty forming superordinate level classes, and performed only slightly better than would be expected by chance. In contrast, children in the Novel Label condition formed the superordinate level classes readily. In fact, simply introducing children to novel nouns led them to classify as successfully as their age-mates who had been told the actual English superordinate labels for the classes (e.g., "These are the animals, these are the clothes, and these are the foods").

The introduction of novel nouns effectively alerted children as young as three years of age to the taxonomic relations among the objects and licensed the induction of superordinate level categories. This finding has been demonstrated in both forced choice (Markman & Hutchinson, 1984) and classification tasks (Waxman & Gelman, 1986), and with children as young as two years of age (Waxman, 1987; Waxman & Kosowski, 1989).

Do novel nouns promote taxonomic classification at all hierarchical levels or is this effect specific to the superordinate level? There is reason to suspect that nouns may not exert the same influence at all levels, for the "cognitive work" involved in forming superordinate level generalizations seems to be quite different from the work required to form subordinate level distinctions. Indeed, researchers have offered two distinct explanations for difficulties encountered in forming superordinate, as opposed to subordinate, level classes (Rosch, 1978). At the superordinate level, because class members vary widely in appearance and function, these classes lack internal coherence or "within-category similarity." I suspect that nouns augment the internal coherence by drawing together distinct members of superordinate classes. In contrast, at subordinate levels, because members of different classes closely resemble one another (e.g., Siamese and Tabby cats have a great deal in common, both perceptually and functionally), class membership is easily confused. Thus, to promote the establishment of subordinate classes, one must highlight not commonalities within a particular class, but distinctions between classes.

These cognitive distinctions between the superordinate and subordinate levels have a linguistic counterpart. Across languages, both spoken and signed, nouns tend to mark taxonomic classes, while adjectival phrases tend to mark distinctions within a known class (Marchand, 1969; Berlin, et. al., 1973; Brown, Kolar, Torrey, Truong-Quang, & Volkman, 1976; Newport & Bellugi, 1978). Furthermore, when preschoolers are asked to label subordinate level classes, they tend to use adjectival phrases (Waxman, in press). It is therefore possible that while nouns facilitate superordinate level taxonomic relations, they will fail to do so at subordinate levels. Adjectives may promote the establishment of subordinate level distinctions.

To address this possibility, I introduced some children to novel nouns (as described above) and other children to novel adjectives (e.g., "These are the *dobish ones*, these are the *gohish* ones, and these are the ones that are *kimish*"), and then examined the influence of these novel labels at multiple hierarchical

levels. As was the case in the earlier studies, nouns facilitated superordinate classification. However, nouns actually interfered with subordinate level classification. This result appears to reflect an interaction between children's existing knowledge and the role of a novel label. It seems that most preschoolers have not yet begun to differentiate their basic level classes into distinct subordinate level classes. For example, although they are familiar with several cats, and recognize them as members of a common basic level class (e.g., cats), they do not yet recognize each as a member of a distinct subclass (e.g., Siamese as opposed to Tabby cats). This would have a direct consequence for the interpretation of the novel nouns. It is most likely that the nouns highlighted the commonalities among the items and, in so doing, made the establishment of new, subordinate level distinctions more difficult.

The introduction of novel adjectives also promoted specific effects at various hierarchical levels, but these effects were quite different than those engendered by the novel nouns. Children in the Novel Adjective condition classified very successfully at subordinate levels. Unlike nouns, novel adjectives facilitated subordinate, but not superordinate level classification (Waxman, in press).

Clearly, preschool children are sensitive to the distinctions between formal grammatical categories such as "noun" and "adjective" and expect each grammatical form class to have a unique referring function. They expect that nouns refer to higher-order taxonomic relations and that adjectives refer to lower-order distinctions. Interestingly, these convergences between our linguistic and conceptual systems are not unique to young children of a particular developmental stage. A sensitivity to the different applications of nouns and adjectives appears to be evident throughout the course of development and across a wide range of object categories.

Let us examine how this pattern of results may be incorporated within a constraints approach to development. First, in the context of word-learning, children appear to honor tacit biases which lead them to favor some interpretations over others. When ascribing meaning to a novel word, children do not sample randomly among possible hypotheses. On the contrary, they are acutely sensitive to the linguistic context in which a novel word is introduced (e.g., adjective or noun). They are predisposed to interpret novel nouns as referring to higher-order taxonomic relations and to interpret novel adjectives as referring to lower-order distinctions. Notice that at the basic level, where taxonomic classes are consistent across cultures and change very little over the course of development, neither novel nouns nor novel adjectives influenced children's near-ceiling performance. The word-learning biases described here exert an influence at just those hierarchical levels (e.g., non-basic levels) where children have difficulty imposing taxonomic systems and where classification systems tend to vary across cultures.

What are the origins of these early biases? Unfortunately, we do not yet have sufficient data to answer this question. These biases may be part of the child's

"innate" knowledge-base and may guide linguistic and conceptual development at the outset. But is also possible that the biases are learned or induced during the process of language acquisition. Perhaps children actually notice convergences between types of object categories and the linguistic forms we use to describe them (e.g., Nelson, 1988). If this is this case, the developmental puzzle does not become any simpler, for we must then discover how children come to notice these untutored yet influential parallels linking their linguistic and conceptual systems. There is another possibility: Some aspects of the biases may be given and others may emerge later with subsequent experience.

Two types of evidence may help to reveal the origins of children's early biases in word learning. These include data from a) children who are just entering the process of language acquisition and b) children who are acquiring languages other than English. For if the biases described here are fundamental, they should be evident very early and across all human languages.

We have recently embarked upon a series of experiments with two- to four-year-old unilingual children learning either English, French, or Spanish. Our preliminary results suggest that the noun bias may be the strongest and the first to develop. As early as two years of age, novel nouns highlight superordinate level relations in English-speaking children (Waxman & Kosowski, 1989). Further, preliminary results from both French- and Spanish-speaking preschoolers suggest that nouns exert the same influence in these languages as well (Waxman, Ross, & Benveniste, in progress). In contrast, the adjective bias seems to emerge later and may be induced after experience with language. We detect no clear evidence that adjectives promote subordinate classification in children younger than three years of age. We therefore speculate that children's interpretation of novel nouns may be guided by a priori biases, while their interpretation of novel adjectives may emerge later, may vary across languages, and may be dependent upon exposure to the particulars of the language being acquired.

The early biases described here serve as an important guide in the establishment of conceptual hierarchies. But evidence that young children honor a particular bias is not evidence that a mature system is "there" from the start, for experience is an equally essential ingredient for human development. Experience serves to shape the initial blueprint and to advance a more mature system of knowledge. Therefore, to fully understand the development of conceptual hierarchies, we must continue to pinpoint the relevant constraints and simultaneously explore how children use input from teachers and parents (Callanan, this volume), how they incorporate new information, new items, and new labels into their existing hierarchies (Waxman & Shipley, 1987), how they integrate linguistic, perceptual, factual, and functional information (S. Gelman, 1985; Shipley, this volume), and how they begin to use hierarchies in abstract, logical reasoning (Blewitt, this volume).

In this program of research, we have begun to forge a precise link between two uniquely human capacities — language and thought. Our results add to a growing body of research suggesting that powerful principles or biases guide the

young child's development and make possible the rapid acquisition of complex systems of knowledge. We have described intricate relations linking children's early linguistic and conceptual systems of organization which insure that, in the context of word-learning, children pay particular attention to the taxonomic relations necessary for the construction of conceptual hierarchies.

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Categorical Hierarchies: Levels of Knowledge and Skill

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Inhelder and Piaget (1964) reported that young children have difficulty answering quantified class inclusion questions, so that when asked "Are there more dogs or more animals?" in a display of three dogs and two cats, children younger than about seven usually answer "More dogs." Although Inhelder and Piaget acknowledged that children as young as two years may be able to state that a dog is an animal, they argued that "true" knowledge of hierarchies is only reflected in accurate quantified class inclusion. That is, true knowledge requires the ability to compare class with subclass and to recognize that the whole class must be larger than the included subclass (assuming that there is more than one subclass in the class).

Implicit in the Piagetian view of children's knowledge of hierarchies is the notion that children can know something about hierarchies without knowing everything, although the description of quantified class inclusion as reflecting "true" hierarchical knowledge diverts attention from this implication. In fact, there is considerable evidence, short of good performance on quantified class inclusion tasks, that children know something about hierarchies in the preschool years. Much of this evidence comes from research focused on labeled categories of concrete objects, which will be the focus of the remainder of this paper. For example, young children are aided in their recall of subcategory labels, like "dog," when cued by a more general category label, like "animal" (Blewitt & Toppino, 1988). They can even generate lists of subcategories in familiar, general categories (Nelson, 1974). Such findings have often been construed as evidence that adult-like hierarchical knowledge is available to very young children. Failures on some tasks are seen as the result of task demands (e.g., linguistic requirements) that are unrelated to hierarchical knowledge (e.g., Smith, 1979; Steinberg & Anderson, 1975). From this perspective, hierarchical knowledge is a unitary phenomenon: either you have it or you don't.

An alternative approach is to view knowledge of categorical hierarchies as a series of levels of knowledge, with more advanced levels emerging from and dependent on the emergence of earlier levels. In this view, skills in hierarchical organization are based on one or another of these levels of knowledge. Thus, we could describe skill in hierarchical organization as composed of component skills. The simpler skills are based on lower levels of knowledge that are necessary for, but not sufficient to support, the more advanced skills. Higher levels of knowledge are needed for skills that are more developmentally advanced. From this perspective, quantified class inclusion ability may be an