

# Perspectives on language and thought

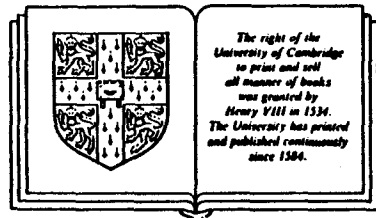
Interrelations in development

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## 4. Convergences between semantic and conceptual organization in the preschool years

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The gentleman who is discriminating about his wine . . . can consistently apply nouns to the different fluids of a class and he can apply adjectives to the differences between the fluids.  
Gibson and Gibson (1955, p. 35)

Our enduring fascination with issues concerning language and thought may derive from our sense that these are uniquely human capacities. Despite years of devoted tutoring, even our closest genealogical relatives have yet to acquire the complex and creative linguistic systems that human infants master within the first few years of life (Petitto & Seidenberg, 1979; Premack, 1971). And although members of other species surely manifest sophisticated conceptual and representational capacities, these appear to be accessible to them only under restricted conditions (Rozin, 1976). Findings like these lend substance to the intuition that humans are uniquely endowed with the capacity to build complex, flexible, and creative linguistic and conceptual systems.

Recent research has documented the remarkable rate at which very young children naturally acquire language and develop rich conceptual systems. Researchers estimate that by the time children reach 2 years of age, they learn an average of six new words each day (Templin, 1957). They also have at their command a rich variety of

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conceptual relations (e.g., taxonomic, thematic, and associative relations) with which they organize and categorize the objects and events they encounter in their lives.

It is conceivable that these concurrent linguistic and conceptual advances are more than coincidental. After all, there is an essential conceptual component in even the simplest act of naming. Whenever we apply a single common label (e.g., *animal*) to a set of disparate instances (e.g., a dog, a horse, and a flamingo) we have, in fact, classified these together. And when we use different labels for each of these instances (e.g., *dog*, *horse*), we reveal our appreciation of their conceptual distinctions as well.

Moreover, the mastery of new words and new concepts appears to go hand in hand. Oftentimes, hearing an unfamiliar word launches a search for the concept to which it refers. For example, I recently read an article that made passing mention of Frances Wright's discovery of the *spherule*. The new word piqued my curiosity and led me to inquire into its meaning. Conversely, it is possible for an idea to germinate before its linguistic realization. This was undoubtedly the case for Professor Wright, who envisioned the concept of the spherule first and only later gave it a name to communicate the concept to others.

Observations like these fuel the intuition that human language and conceptual organization are essentially linked, but they leave open many questions concerning the nature of this relation (see R. Brown, 1986, for an excellent overview of research programs addressing language-thought questions). It is vital that we articulate our research questions precisely if we are to find satisfying answers regarding the complex relations between language and thought.

My approach has been to focus on questions concerning the relation between word learning and conceptual organization in one specific area of development. In my research program, I have been concerned primarily with the early establishment of object categories at various hierarchical levels (e.g., flamingo, bird, animal) and the labels we use to describe them. On the basis of evidence obtained from several different experimental paradigms and gleaned from several different cultures and language communities, I have taken the position that there are powerful, yet precise, relations that link language with conceptual development and promote the formation of conceptual hierarchies. More specifically, I have argued that in the process of word learning, children are guided by implicit

biases that direct their attention to taxonomic relations among objects and classes of objects.

In this chapter, I bring together psychological, linguistic, and eth-nobiological evidence to support this position. I begin by describing several characteristics of hierarchical systems of organization. I then amplify this psychological perspective by integrating it within the larger context of cross-cultural and cross-linguistic work. Here, I draw primarily on the work of ethnobiologists to argue that cross-cultural and cross-linguistic data can inform our current views on the relations between linguistic and conceptual organization. Turning next to developmental issues, I argue that early in development, linguistic and conceptual organization are wedded and that children use syntactic form class (e.g., noun, adjective) to help them determine the meaning of novel nouns. Nouns highlight higher-order taxonomic relations (e.g., animal, furniture) and adjectives highlight specific lower-order distinctions (e.g., Siamese cats vs. tabby cats). In this way, linguistic information guides the establishment of conceptual hierarchies. Finally, I articulate more precisely the claim that certain aspects of human development may unfold under the influence of constraints or biases.

### Hierarchical systems of organization

A hallmark of human conceptual organization is its flexibility. We readily place objects in different kinds of classes, depending on the task at hand. For example, I may group a flamingo taxonomically with an oriole (because both are birds); I may also classify a flamingo taxonomically with a bear (because both are animals). Alternatively, I may group that same flamingo with a kumquat (because both thrive in warm climates) or even with the sunset (because both are pink). Amidst this conceptual flexibility, one type of organization – hierarchical systems of taxonomic classes – has been consistently singled out by scholars from diverse disciplines for its power and efficiency.

Hierarchical systems are composed of a series of taxonomic classes that vary in their scope (e.g., flamingo, bird, and animal) and together form a hierarchy in which lower-order classes are nested within higher-order classes. Hierarchical systems are governed by two organizing principles, the *hierarchical* and *contrastive* principles (Inhelder & Piaget, 1964; Miller & Johnson-Laird, 1976).

The hierarchical principle is concerned with logical inclusion relations among classes at various levels of abstraction and is based on the logical principles of *transitivity* and *asymmetry*. Transitivity captures the fact that if the members of Class C are a subset of Class B, and if the members of Class B are a subset of Class A, then the members of Class C are necessarily included in Class A. Asymmetry captures the fact that the inferences licensed by hierarchical systems are unidirectional. Inferences regarding class membership are licensed in ascending order within a hierarchy. Any member of a lower-order class (e.g., a flamingo) is, by definition, included in each of its higher-order classes (e.g., *birds*, *animals*). In this way, the principle of asymmetry ensures that higher-order classes are larger than any of their constituent subsets. The direction of the asymmetry is reversed when one considers class properties, as opposed to class membership. Properties are "inherited" in descending order within a hierarchy; any property that can be predicated of a higher-order class can also be predicated of its constituent subclasses. For instance, because we know that all fruits have seeds, we can infer that a papaya has seeds.

The hierarchical principle governs vertical relations among classes at different levels of abstraction; the contrastive principle maintains horizontal relations among classes at any given level of abstraction. Considered horizontally, the classes within a hierarchy are contrastive or mutually exclusive. This relation is sometimes known as "direct contrast," and the entire collection of classes immediately included within a single higher-order class constitutes a contrast set. For example, *tulip*, *rose*, and *daisy* comprise a portion of the contrast set immediately included in the higher-order class *flower*.

The hierarchical and contrastive principles provide the structural framework for hierarchical systems and make possible a rich set of inferences, both inductive and deductive. For example, if we encounter a novel item and learn that it is an animal, we can deduce that it eats. If we encounter a novel item and learn that it is, say, a dog, we can induce that it is an animal and shares other properties with members of that class (Blewitt, 1990). Further, when we discover a new property of a single item (e.g., that Fido has a heart rate that is much faster than that of a human), we tend to attribute that property to other class members as well (Gelman, 1988; Gelman & Coley, Chapter 5, this volume).

Therefore, by placing an object within a hierarchical system, we

open up "a whole vista of possibilities for 'going beyond' the category by virtue of the . . . relationships linking one category to the others" (Bruner, Goodnow, & Austin, 1956, p. 13). As a consequence, hierarchical systems serve as the natural domain of induction (Gelman, 1988; Miller & Johnson-Laird, 1976; Shipley, 1989) and "give us the greatest command of our knowledge already acquired and lead most directly to the acquisition of more" (Mill, 1843, p. 432).

#### *Conceptual modifications within hierarchical systems*

Hierarchical systems are structured and powerful, but they are not carved in stone. On the contrary, they are supple enough to be revised as we incorporate new knowledge (Quine, 1969). As a result, our conceptual hierarchies are productive, flexible constructions that evolve throughout the course of development. Indeed, there is a fluid relationship between our systems of knowledge and our theories within a given domain (see Murphy & Medin, 1985, for a discussion of the relationship between theories and conceptual structure; see Carey, 1985, for an example of the development of theories and classification of the concept *animal*).

In this section, I describe three types of modifications that bear directly on the construction of hierarchical systems: new distinctions, new generalizations, and reorganizations. First, throughout development, we learn to make new distinctions within existing classes. For example, many adults who have little expertise with flowers distinguish one broad class of *roses*. With increasing experience, they may come to appreciate distinctions within this broad class and to capture these by creating categorical subclasses (e.g., tea roses vs. climbing roses). Similarly, at one time astronomers considered *stars* to be a homogeneous class, but with increasing experience, they discerned several distinct kinds, including single, double, and pulsing stars. Notice that neither flower novices nor early astronomers failed to establish hierarchical systems of organization. The point here is that earlier, more elementary hierarchies are often simply less elaborate than those established later on the basis of additional knowledge and experience.

Second, we often generalize to create new higher-order classes and, in so doing, establish increasingly elaborate hierarchies. Many examples of this phenomenon come from the field of biology. For

example, biologists group shrimps, moths, and spiders together as members of the class *arthropod*; nonbiologists may not appreciate this higher-order relation. Other examples come from studies of folk biology (e.g., Berlin, Breedlove, & Raven, 1973). For example, in most cultures, two kingdoms (corresponding roughly to our plant and animal kingdoms) are recognized. As a result of extensive and detailed examinations, some Western biosystematists now discern five biological kingdoms. Note that although the precise number of classes within a contrast set (here, the number of kingdoms) may differ, both biosystematists and folk biologists have constructed hierarchical systems of organization.

Conceptual reorganizations represent a third type of modification within hierarchical systems. In conceptual reorganizations, no new classes (be they higher- or lower-order) are established. Instead, it is the relations among existing classes that are modified. One class (e.g., *whales*), previously classified in one way (e.g., as fish), may later (and perhaps more accurately) be classified in a different way (e.g., as mammals). Following the logical principles of class inclusion, the discovery that a particular whale is a mammal (because it shares properties characteristic of mammals) motivates a systematic reorganization in which all whales are reclassified as mammals.

These three kinds of conceptual modification illustrate the dynamic and creative nature of human classification. In some cases, modifications have only a local effect. In others, the modifications are more dramatic and may lead to a radical restructuring of the conceptual hierarchy for an entire domain (Carey, 1985; Kuhn, 1962). In general, this discussion of conceptual modification illustrates some possible routes by which young children's rudimentary classification systems may change or become more detailed over time (also see Chi, 1983; Waxman & Shipley, 1987; Waxman, Shipley, & Shepperson, 1990). By virtue of conceptual modifications, we incorporate new information, clarify relations among classes, and strive to fashion increasingly accurate bases for logical reasoning throughout development.

#### *Some caveats concerning conceptual hierarchies*

Although there is little doubt that hierarchical systems play a very important role in human cognition, two controversial points bear mention. The first is that precisely because human conceptual or-

ganization is so flexible, identifying any one type of conceptual organization (e.g., taxonomic hierarchies) is not tantamount to discovering the sole means of conceptual representation underlying the organization of the human mind. A rapidly accumulating body of research has revealed the importance of non-taxonomic systems of organization. These include script-based, or contextual, categories (Hunn, 1985; Mandler, Fivush, & Reznick, 1987; Nelson, 1987; Nelson & Gruendel, 1981), "taskonomies" (Dougherty & Keller, 1985), part-whole organizations (Tversky & Hemenway, 1984), kinship groupings (Casson, 1975), and ad hoc or utilitarian groupings (Barsalou, 1983; Dougherty & Keller, 1985; Hunn, 1985).

Evidence for these alternative systems of organization may be interpreted in one of two ways. If one takes the view that taxonomic hierarchies represent *the* structure of the mind, the considerable evidence for alternative forms of conceptual organization is damning. However, the existence of such alternative organizations is completely compatible with the position that hierarchies, although powerful and ubiquitous, are not the only system of organization in the repertoire of human conceptual representation.

The second controversial point concerns not the hierarchical relations among classes, but the internal structure of the constituent classes. The shortcomings of the classical theory of concepts, in which class membership is presumed to be determined by simple perceptual features, are now well known. Although criticisms have come from many quarters for many different reasons, no comprehensive description of the internal structure and representation of classes has yet taken its place (see Smith & Medin, 1981, for a thorough review of these issues, including discussions of feature-based, prototype-based, and exemplar-based representations). For the purposes of this chapter, I restrict my focus to the hierarchical relations among classes; issues concerning internal structure are not treated here.

These controversies notwithstanding, the psychological evidence attests to the prominent position of hierarchical systems in the repertoire of human cognition. This position is firmly grounded in converging results from many different experimental sources, including classification, reaction time, multidimensional scaling, labeling, habituation, and memory procedures (see Smith & Medin, 1981, for a representative sample of this work). Yet this body of work derives almost exclusively from research in Western cultures (for some no-

table exceptions see Luria, 1976; Saxe, 1982; Saxe, Gearhart, & Guberman, 1984; Wagner, 1974). If hierarchical systems are fundamental to human cognition, and not an artifact of Western culture, they should be evident universally.

I therefore turn now to a comprehensive body of anthropological research aimed at elucidating the classification schemes of Western and non-Western peoples alike. In this field, as in psychology, there is ample debate surrounding the subject of hierarchical systems, but the weight of the evidence supports the view that hierarchies are established universally (e.g., Frake, 1962; for arguments to the contrary, see Burling, 1964, Dupré, 1981, and Lancy, 1983). Moreover, the anthropological record reveals striking convergences between the hierarchical systems we create and the linguistic conventions we use to describe them.

### Ethnobiological evidence

The field of ethnobiology, a formal discipline within cultural anthropology, is devoted to the study of the linguistic and conceptual systems created by people from diverse cultures to describe the organisms and classes of organisms that occupy the natural world. Scientific interest in "folk biology" was ignited by Berlin and his colleagues (Berlin, 1973; Berlin et al., 1973, 1974; Hunn, 1975). Ethnobiologists have since focused on specific segments of classification systems (e.g., Hage & Miller's, 1976, description of the Shoshoni's nomenclature for birds), as well as more exhaustive, large-scale studies of entire biological classification systems (e.g., Berlin et al., 1973). Consequently, there is now a body of research documenting the existence of hierarchical systems in such disparate cultures and surroundings as the American Southwest (Wyman & Bailey, 1964), Mexico (Berlin et al., 1974; Hunn, 1977), Thailand (Stanlaw & Yoddumnern, 1985), the Phillipines (Conklin, 1954), China (Anderson, 1967), and the New Guinea highlands (Bulmer & Tyler, 1968).

In ethnobiology, directed interviews with adult native informants have served as the primary research tool. The traditional approach has been to construct that part of the lexicon in a given language community that is devoted to describing the natural world and to use this lexicon as a window onto the underlying conceptual framework. Notice that in this field of research, language is accorded a

special status, for it is assumed to provide the most direct observable access to underlying cognitive phenomena.<sup>1</sup>

On the basis of his seminal work with the Tzeltal Indians, Berlin abstracted two basic patterns concerning the nature of folk biological knowledge (Berlin et al., 1973). The first concerns the derivation of the basic principles of folk taxonomic classification from our perceptions of the morphological properties of objects in the natural world.<sup>2</sup> The second concerns the hierarchical organization of folk biological knowledge. Berlin's characterization of hierarchical systems embraces the hierarchical and contrastive principles described earlier (e.g., Miller & Johnson-Laird, 1976) and provides a point of contact between anthropology and psychology.

### *Ethnobiological rank*

In an effort to interpret and compare the many different observed systems of folk knowledge, Berlin created a model, or idealized, folk taxonomy. This archetypical taxonomy, which is designed to include all of the categories of natural objects recognized in a given culture, incorporates a maximum of six, and a minimum of three, hierarchical levels or ranks. Beginning at the most inclusive level, these include the Unique Beginner, Life Form, Intermediate, Generic, Specific, and Varietal ranks.

This six-tiered schema does not match perfectly the three levels of abstraction (i.e., superordinate, basic, subordinate) that figure prominently in the psychological literature (Rosch, Mervis, Gray, Johnson, & Boyes-Braem, 1976). However, this mismatch is merely superficial, for there is a fundamental correspondence at one particular hierarchical level that unites the findings in psychology with those in anthropology.

*Basic level.* In both disciplines, one level has received special attention. This level, known as the basic or generic level (in psychology and anthropology, respectively), occupies a midlevel position within a hierarchical system and corresponds roughly to our notion of a biological species. The basic level appears to be privileged in several regards. First, according to Berlin (1966), classes at this level "cry out to be named." In all cultures examined to date, no matter how primitive or advanced, there are labels for basic-level classes. Oftentimes, higher- and lower-order classes remain unnamed. Moreover,

children's earliest vocabularies contain predominantly object terms, and of these, most are at the basic level (Anglin, 1977; Mervis & Crisafi, 1982; Nelson, 1974).

Furthermore, the classes at the basic level tend to be stable over time and fairly consistent across cultures (but see Dougherty, 1978, for a critique of this view).<sup>3</sup> In contrast, researchers in anthropology and psychology share the view that the number and composition of higher- and lower-order classes are a function of the experience and familiarity of the people doing the classifying and may well vary across cultures (Dougherty, 1978; Randall, 1976; Rosch, 1975). Finally, even when a linguistic community (like our own) has established labels for higher- and lower-order classes, the basic-level label maintains its special status: Basic-level labels are the ones most readily supplied by adults in identification and labeling tasks (Callanan, 1985; Chapter 12, this volume; Shipley, Kuhn, & Madden, 1983; Smith & Medin, 1981). Thus, although many names may apply to a given object, the basic-level name seems truest.

R. Brown (1958) suggested that this privileged position may reflect the psychological utility of the basic level. Rosch and her colleagues (Rosch, 1975; Rosch et al., 1976) built on this line of reasoning to operationalize the notion of the basic level and to demonstrate its psychological utility.

One caution is in order here: The "basic-level advantage" is a robust empirical phenomenon. However, although many theoretical explanations have been advanced, none of these alone has proved sufficient (see Armstrong, Gleitman, & Gleitman, 1983; Mervis, 1987; Murphy & Medin, 1985; Smith & Medin, 1981).

#### *Convergences between classification and nomenclature*

From the vantage point of psychology, Berlin's signal contribution was his insight concerning the intricate and systematic relations between classes at various levels and their labels. In brief, Berlin asserted that each level within a taxonomy is associated with a particular linguistic form.

Central to Berlin's analysis is his discussion of the *lexeme*, or lexical item, of which he distinguishes two types: primary and secondary. Classes at the basic or generic level tend to be labeled with morphologically simple primary lexemes. Primary lexemes are "unique, single word expressions which . . . are semantically uni-

tary and linguistically distinct" (Berlin et al., 1973). Examples from American English folk biology are nondecomposable nouns such as *orchid* and *whale*.

In many folk biological systems, the more abstract classes (e.g., those at the Unique Beginner and Intermediate levels) are not linguistically encoded. The psychological status of these unnamed classes, or *covert categories*, will be discussed later. If any linguistic pattern can be detected at these higher-order levels, it is that nouns tend to serve as labels. But in contrast to the nouns that typify the basic-level labels, the nouns for higher-order classes tend to have a more complex morphology. In part, this complexity is an inevitable consequence of linguistic constructions such as compounding (for a full discussion of morphological complexity and derivations see Lyons, 1977; Marchand, 1969).

Classes at the less inclusive levels (the Specific and Varietal ranks, or subordinate level) are labeled with secondary lexemes (Berlin et al., 1973; Brown, Kolar, Torrey, Truong-Quang, & Volkman, 1976), which typically include a modifier used in conjunction with a primary lexeme to denote a particular type of the category described by the primary lexeme. Modifier-noun phrases like *cymbidium orchid* and *humpback whale* are secondary lexemes in American English folk biology.

Further, these parallels between linguistic form and hierarchical level are in evidence in signed, as well as in spoken, languages. In American Sign Language (ASL), many superordinate-level terms are created by compounding basic-level terms in such a way as to create a new, morphologically complex noun. For example, the sign for *musical instrument* is a compound noun composed of the basic-level signs *guitar*, *piano*, *violin*. Like spoken languages, ASL employs different linguistic devices to mark subordinate-level classes. Here, the basic-level terms are typically modified by "size and shape specifiers" (SASSes) to denote a distinct subtype (Newport & Bellugi, 1978).

One difference between spoken and signed languages is relevant to our discussion here. In ASL, modifiers like the SASSes are signed simultaneously with the basic-level form. However, in spoken language, the modifier and noun are distinct lexical items. Over time, as a new subcategory gains utility in a given language community, the original modifier-noun phrase typically becomes nominalized. In essence, the phrase is replaced with a single lexical item. For this

reason, it is interesting to chart the etymology of subordinate-level terms. For example, *terrier* is derived from the Latin *terra* because this dog was known specifically for its ability to search underground for small game.

Although these correlations between classification and nomenclature are not perfect, they certainly fuel the intuition that language and thought are interrelated in hierarchical systems of organization. The data from ASL are especially intriguing, because sign languages employ an entirely different perceptual modality (visuomotor) than do spoken languages (auditory-vocal). Thus, these convergences between linguistic form and category level appear to be inherent in the design of human language and are not due simply to the particular modality through which a given language is conveyed.

Does this interrelation contribute to the development of semantic and conceptual organization? Unfortunately, very little ethnobiological work has adopted a developmental perspective (for two exceptions see Dougherty, 1979; Stross, 1973). We therefore return to the psychological literature, this time focusing on early word learning and the development of hierarchical systems. More specifically, we ask whether *particular* linguistic forms expedite the acquisition of taxonomic classes at *particular* hierarchical levels.

### Development of hierarchical systems

Young children acquire a wealth of information in their first few years, and conceptual hierarchies are especially tailored for this enterprise. It therefore stands to reason that children might begin to build hierarchical systems early in development and use them in the service of learning. However, this is emphatically not the position embraced by traditional developmental theorists, who based their work on the assumption that preschool children lack the requisite cognitive capacity to construct hierarchical systems (Bruner et al., 1956; Inhelder & Piaget, 1964; Vygotsky, 1962). Yet in recent years, it has become increasingly clear that children do establish hierarchies early in development and that language plays a decisive role in this development. What is the evidence for this view? There is no doubt that children appreciate at least some taxonomic classes, notably those at the *basic* level (Anglin, 1977; Mervis & Crisafi, 1982; Rosch et al., 1976). Children make their first forays into labeling and classifying objects at just the taxonomic level that adults, across cul-

tures, find most salient. Across languages, children acquire basic-level terms with remarkable speed and proficiency, well before they master higher- and lower-order category terms (Anglin, 1977). And one of the most robust findings in the literature on cognitive development is that children succeed in classifying objects at the basic level long before they do so at nonbasic levels. Thus, for adults as well as for children, the basic level appears to occupy a psychologically privileged position.

However, children's early successes at the basic level stand in sharp contrast to their difficulty in imposing taxonomic relations at nonbasic levels under most circumstances (Anglin, 1977; Mervis & Crisafi, 1982). Therefore, the most intriguing developmental questions are those concerning development beyond the basic level.

In my research program, I accept as a given the "primacy" of the basic level and go on to ask how children advance beyond it to form the higher- and lower-order classes that comprise hierarchical systems. And it is precisely here, at nonbasic levels, that subtle yet powerful biases linking word learning and conceptual development have become evident.

### Theoretical motivations

Before describing the empirical work related to these biases, it is worthwhile outlining briefly the theoretical motivation for proposing that such biases exist. Recall that within the first few years of their lives, young children demonstrate an appreciation of a variety of conceptual relations, including taxonomic, thematic, event-related, and ad hoc groupings. Concurrent with these conceptual advances, they make equally impressive gains in language acquisition. These simultaneous achievements have presented something of a puzzle to developmental psychologists, for although conceptual flexibility affords remarkable creativity, it could, in principle, complicate the task of word learning.

Given their appreciation of myriad possible relations among objects, how do children single out the taxonomic relations central to the construction of conceptual hierarchies? This question is particularly engaging when it is posed in light of the developmental research suggesting that young children actually prefer thematic and associative relations over taxonomic relations (Inhelder & Piaget, 1964; Smiley & Brown, 1979; Vygotsky, 1962). How, then, do

children learn that a given word (e.g., *flamingo*) may apply to a particular object and may be extended to other members of that class (e.g., other flamingos), but not to thematic relations (e.g., a flamingo and sand), salient properties of the object (e.g., its long neck or unusual color), or an action in which it is engaged (e.g., feeding its young)?

Children's seemingly effortless solution to the logically difficult problem of mapping words to their appropriate meanings has led to the hypothesis that when learning the meaning of a novel word, children do not sample randomly from among all the possible interpretations. Instead, the data suggest that children restrict their focus to a circumscribed set of possible meanings. In particular, children's expectations about a new word's meaning appear to be guided by the syntactic status of the word itself.

Several different research laboratories have provided evidence that young children appreciate formal distinctions among syntactic categories (e.g., noun, adjective, determiner) and use these distinctions to help them discern the *semantic* content of novel words (R. Brown, 1957; Clark, Gelman, & Lane, 1985; Gelman & Markman, 1985; Gelman & Taylor, 1984; Hall & Waxman, 1990; Katz, Baker, & Macnamara, 1974; Naigles, Gleitman, & Gleitman, in press; Taylor & Gelman, 1988; Waxman, 1990). That is, children's expectations about a novel word's meaning are guided by the syntactic environment in which that word is introduced.

To understand how children's expectations about word meaning support the establishment of taxonomic relations and conceptual hierarchies, we will first consider the evidence pertaining to the superordinate level (e.g., animals, clothing, food).

#### **Establishing superordinate relations: the role of nouns**

Under most circumstances, preschool children have difficulty sorting objects at the superordinate level (Gelman & Baillargeon, 1983; Inhelder & Piaget, 1964). In fact, they seem to view superordinate classification tasks as an invitation to create stories and scenes rather than to impose a taxonomic classification. However, when children are introduced to novel words for superordinate-level classes, their performance changes dramatically.

To illustrate this phenomenon, R. Gelman and I compared preschoolers' superordinate-level classification with, and without, novel

labels (Waxman & Gelman, 1986). First, we introduced children to three handpuppets who were "very picky and only liked a certain kind of thing" and enlisted the children's assistance in finding items for each puppet. To get the children started, we displayed three typical members (e.g., a dog, a horse, and a cat) of each superordinate-level class under investigation (e.g., *animal*) to give them an idea of the "kinds of things" each puppet favored.

In one condition, the *instance* condition, children were left to sort the remaining pictures (these were various members of the classes *animals*, *clothing*, and *food*) with no further instructions. As one might expect on the basis of traditional developmental literature, 3-year-old children had difficulty forming superordinate-level classes when they were presented with the instances alone. In fact, children in the instance condition performed only slightly better than we would have expected if they had distributed the items to the puppets randomly.

In the *novel-label* condition, the children encountered the same typical instances, but in addition the experimenter introduced the Japanese label for each superordinate class (e.g., "These are 'dobutsus,' these are 'gohans,' and these are 'kimonos'"). Although these Japanese terms were completely unfamiliar to our children, they had a dramatic effect: Children in the novel-label condition formed superordinate classes readily.

As a control, we asked another group of children to classify the same sets of objects, but we gave these children the familiar English superordinate labels (e.g., "These are animals, these are clothes, and these are food"). Performance in the *English label* and novel-label conditions was indistinguishable. Therefore, we can conclude that introducing preschool children to novel nouns motivates them to classify as successfully as children who have been prompted with the English labels for these superordinate-level classes.

Clearly, the introduction of a novel label effectively alerted preschool children to the taxonomic relations among items and licensed the induction of superordinate-level categories. This phenomenon, which has been referred to alternatively as the *noun-category bias* (Waxman, 1989; Waxman & Kosowski, 1990) or the *taxonomic assumption* (Clark, Chapter 2, this volume; Markman, 1989; Chapter 3, this volume), has now been demonstrated using both triad tasks (Markman & Hutchinson, 1984) and classification procedures (Waxman & Gelman, 1986). Taken together, these findings support the

claim that when interpreting the meaning of novel nouns, children focus on categorical relations.

This intriguing result has generated several further questions. The first concerns the age at which children evidence this affinity between nouns and superordinate-level relations. The second concerns the specificity of the taxonomic bias. Are taxonomic relations highlighted in the context of word learning in general, or is the taxonomic focus reserved for novel nouns in particular?

To begin to answer these questions, T. Kosowski and I designed an experimental procedure specifically for research with 2-year-old children (Waxman & Kosowski, in press). This was essential because 2-year-old children often become sidetracked and falter in most classification tasks (Sugarman, 1982; Waxman, 1987). And although triad tasks, like those designed by Markman and Hutchinson, are simple enough to be applied to 2-year-olds, these toddlers, unlike older children, are virtually unable to articulate *why* they have chosen one particular item as opposed to another. Without such justifications, the data from these tasks are difficult to interpret unambiguously. (Because Markman & Hutchinson's experiments included older preschool children, this did not present an obstacle in their work.)

To circumvent these procedural difficulties, we developed a five-item match-to-sample task in which we supplemented children's first choices with second choices rather than with justifications. We created a picture book in which each page constituted a trial (Waxman & Kosowski, in press). On each page, there were five pictures, a target (e.g., a cow) and four alternatives. Two of these alternatives were members of the same superordinate-level class as the target (e.g., a fox and a zebra); the remaining two alternatives were thematically related to the target (e.g., a barn and milk).

The experimenter sat with each child individually to read the book. In the *no-word* condition, she pointed to the target and said, "See this? Can you find another one?" In the *novel-noun* and *novel-adjective* conditions, in addition to pointing to the target, she labeled it with a novel word. These conditions differed from one another only in the syntactic context in which the novel words were presented. In the novel-noun condition, she said, for example, "See this 'fopin'? Can you find another 'fopin'?" In the novel-adjective condition, she said, for example, "See this 'fopish one'? Can you find another one that is 'fopish'?"

After they had gone through the book once, the experimenter encouraged the children to read it a second time. On each page, she reminded the children of their first choice and asked them to select another of the remaining alternatives. In this way, despite the fact that 2-year-olds are unable to justify their selections, we were able to supplement their first choices with second choices.

If children select both of the superordinate category members and none of the thematic alternatives, it is likely that they have established a taxonomic criterion and have applied it consistently. If novel nouns highlight superordinate category relations in 2-year-old children, we would expect children in the novel-noun condition to prefer the taxonomically related alternatives. If this bias is specific to novel nouns, children in the novel-adjective condition, like those in the no-word condition, should demonstrate no such preference.

The results of this experiment were straightforward. Performance in the novel-adjective and no-word conditions were indistinguishable from one another and from the pattern expected if children had selected items randomly. Only in the novel-noun condition did children consistently favor category relations. Thus, it is not word learning, per se, that highlights superordinate relations. Instead, superordinate relations gain priority only in the context of learning novel nouns.

For the purpose of charting the development of the noun-category bias across the preschool years, we conducted companion studies with 3-year-old children and found a pattern of results that was virtually identical to that obtained with the 2-year-olds. Therefore, whatever the origin of the noun-category bias, it is clearly in place by the time children are 2 years of age.

We interpreted the consistent difference between performance in the novel-noun and other conditions as evidence for an abstract bias that leads children to focus their attention on category relations when learning the meaning of novel nouns. To make this argument compelling, we had to rule out a competing hypothesis: that children "translated" the novel nouns into known category terms (e.g., *dog*) and the novel adjectives into known attributes or descriptive phrases (e.g., *furry thing* or *brownish one*) and then used these translations to guide their item selections.

To rule out the possibility that the powerful effect of the nouns was the result of children's "translations," we showed another group of 2- and 3-year-old children our picture book and explicitly asked

them to translate our novel terms into English. We explained that although our puppet had "his own special language," he wanted to learn to speak English. In the novel-noun condition, the experimenter pointed to the target item on each page and said, for example, "See this? Zupe [the puppet] calls this a 'dobin.' What do you think 'dobin' means?" In the novel-adjective condition, she asked, for example, "See this? Zupe calls this a 'dobish' one. What do you think 'dobish' means?" As a control, we asked another group to label the targets, but did not provide them with novel words. For example, the experimenter asked, "See this? Tell Zupe what we call this."

Children in all three experimental conditions translated the novel terms (whether nouns or adjectives) into familiar basic-level nouns. Clearly, when they are explicitly asked to translate, preschool children treat novel nouns and adjectives similarly. Note that if the children had relied on these translations in the preceding experiments, their performance in all three conditions would have been indistinguishable. But this was not the case. The children made systematic and reliable distinctions between these syntactic categories. We therefore conclude that the children's item selections were not mediated by direct translation of the novel terms into English.

The experiments described thus far reveal that children as young as 2 years are sensitive to the syntactic environment in which novel words are introduced. They expect novel nouns, but not novel adjectives, to highlight superordinate-level relations, even in the presence of thematic alternatives. Moreover, the effect of the novel noun is powerful enough to guide both a first and a second set of choices.

Notice, however, that these findings are based solely on English-speaking children. This is a serious limitation, for if these phenomena reflect a fundamental relation between language and conceptual development, they should be evident in all children, independent of the language they are learning. Therefore, to ascertain whether the systematic patterns we have observed in our English-speaking preschoolers are evident in other languages as well, we have recently embarked on a series of cross-linguistic developmental experiments (Waxman, Senghas, Ross, & Benveniste, 1990).

#### *Cross-linguistic developmental studies*

Our aim in this series is to detect developmental universals in the relation between word learning and conceptual development and,

at the same time, to document any differences due to the particulars of the language being acquired. To date, our sample includes preschool children from two different language communities. Our unilingual French speakers are from Montreal, Canada, and our unilingual Spanish speakers are from Buenos Aires, Argentina. We are limited, at this early stage in our research program, to languages that are closely related to one another. However, despite their commonalities, there are also variations in the grammars of English, French, and Spanish that may bear on the questions at hand.

There is, for example, a linguistic difference between English, on the one hand, and French and Spanish, on the other. In the latter languages, because categories have associated with them a particular gender, the words (nouns, adjectives, determiners, etc.) that refer to these categories carry gender markings as well. It is possible that the gender markings associated with the various object terms influence young children's interpretations of novel words.

Moreover, in Spanish and French, nouns are typically dropped if the subject is recoverable from the context. Under such circumstances, adjectives essentially stand in for the noun and convey nominal information. Consider, for example, a scenario in which there are six coffee mugs, each of a different size. In English, we would distinguish these linguistically by pairing the noun *mug* with an adjective. That is, to request the largest mug, we might ask for *the big mug* or *the big one*. In Spanish, such constructions are ungrammatical. Instead, the noun is dropped, leaving the determiner and adjective to refer to the intended mug. For example, we might request *la grande*, where *grande* is the adjective. Likewise, in French, we might indicate the smallest mug by asking for *la petite*.

We wondered if as a result of this aspect of French and Spanish grammar, novel adjectives might produce a different effect in these languages that they had in our English-speaking sample. In particular, we wondered whether in French and Spanish, nouns and adjectives might produce very similar results.

To address these possibilities, we adapted the five-item match to the sample procedure developed by Waxman and Kosowski (1990) to accommodate the particular requirements of our different populations and their structurally different languages. To examine the possible influence of gender markings in these languages, we took two distinctly different routes. On half of the pages (trials), we included only items that shared a common gender designation. For

example, a representative page in French included the following items (all masculine): a squirrel (target), a cat, a fox, an acorn, and a tree. On these pages, because we eliminated the possibility that children could select items on the basis of gender, the French and Spanish speakers' task was wholly comparable to the task confronting their English-speaking age-mates.

On the remaining trials, however, we varied the gender composition of the items in the following manner: We selected one thematic and one taxonomic alternative that matched the target in gender, and one taxonomic and one thematic alternative that conflicted with the target's gender. For example, a representative Spanish trial included a banana (target, feminine), an apple (feminine), a lemon (masculine), a girl (feminine), and monkey (masculine). On these trials, it was possible for children to select items on the basis of gender agreement. In the current example, one gender-matched choice is related taxonomically to the target (the apple); the other gender-matched choice is related thematically to the target (the girl). If, however, children were to select on the basis of taxonomic relations, they would have to overlook gender agreement to do so. In the current example, one taxonomically related choice (the apple) matches the target in gender; the other taxonomically related choice (the lemon) does not match. Thus, these mixed-gender trials allowed us to examine whether children in a novel-noun condition would override gender agreement to select both taxonomically related items.

*The French-speaking preschoolers.* With the French-speaking preschoolers, our results were identical to those obtained with our English-speaking sample. Children in the novel-adjective and no-word conditions demonstrated no particular preference for taxonomically, thematically, or gender-related items. However, as we predicted, French-speaking children in the novel-noun condition chose predominantly taxonomically related items. This effect seemed to be stronger for the 2- and 3-year-olds than for the 4-year-olds. Furthermore, there was no evidence that children relied on gender matching in making their selections.

*The Spanish-speaking preschoolers.* Our preliminary results with the Spanish-speaking children have been very interesting. Like their English- and French-speaking age-mates, Spanish-speaking pre-

schoolers in the novel-noun condition demonstrated a strong noun-category bias. They exhibited a strong preference for the taxonomically related items on both their first and their second trials. The Spanish-speaking children in the no-word condition showed no particular preference for thematic, taxonomic, or gender-matched stimuli. The essentially random performance in this condition replicates the results obtained with our other two language samples. However, unlike our French- and English-speaking children, the Spanish-speaking children in the novel-adjective conditions did display a systematic inclination toward the taxonomically related items.

Before concluding that this inclination reflects a linguistic difference in the status of adjectives in Spanish, we address two alternative hypotheses. First, we must determine whether this effect could have been due to the particular items used in the study with the Argentine children. To examine this hypothesis, we conducted a companion experiment, using the stimuli designed for the Spanish speakers with a new group of English-speaking children. Our results are very much like those obtained earlier with our English-speaking sample. Namely, children in the novel-adjective condition did not show a strong inclination toward taxonomic relations. Like children in the no-word condition, English-speaking children hearing novel adjectives appeared to show no preference for taxonomic or thematic relations.

The second hypothesis concerns the wording of the instructions to the Argentine children. Perhaps there was some ambiguity regarding the introduction of the adjectives that could account for these very preliminary cross-linguistic differences. We are currently testing this hypothesis. Therefore, any firm conclusions regarding this issue must await additional data.

Although our cross-linguistic developmental program of research is only in its infancy, it has already begun to reveal some very strong similarities as well as some compelling differences in development. The noun-category bias is evident as early as 2 years of age in all three languages we have studied. And on the basis of Gentner's (1982) extensive review of the noun and predicate systems across languages, I suspect that this may be a universal phenomenon that guides development from the very onset of language acquisition.

Across languages, children's earliest words are predominantly nouns (see Gentner, 1982, for a review). Further, nouns function in a similar fashion across these languages, picking out primarily ob-

jects and classes of objects. Finally, there is linguistic evidence that nouns are organized differently in the lexicon than are other syntactic classes (Huttenlocher & Lui, 1979).

The members of the predicate system (e.g., adjectives, verbs, adverbs) seem to have a more fluid status, and there is considerable cross-linguistic variation as to what information is conveyed as part of one predicate and what is conveyed as part of another (Gentner, 1982; Talmy, 1975, 1985). Unlike those of nouns, the syntactic status and semantic role of these predicates are much less distinct. I suspect that the noun-category bias is evident very early in development, but that the role of adjectives (and other predicates) may emerge later in development and may vary according to the language being acquired.

The preceding experiments with English-, French-, and Spanish-speaking children provide strong empirical support for the claim that by the age of 2, there is a close affiliation between nouns and superordinate category relations. Does this linkage extend to other hierarchical levels, or is it specific to the superordinate level? The psychological as well as ethnographic literature gives us reason to suspect that nouns exert different influences at different hierarchical levels. This is because the "cognitive processes" involved in forming superordinate-level generalizations among basic-level classes are genuinely different from those involved in generating subordinate-level distinctions within a basic-level class.

#### **Establishing subordinate relations: The role of adjectives**

Psychologists have appealed to different explanations for the relative difficulties encountered in forming superordinate- as opposed to subordinate-level classes (e.g., Rosch, 1973). At the superordinate level, where class members vary widely in appearance and function, classes have little internal coherence, or *within-category similarity*. Nouns may augment the internal coherence of abstract superordinate-level classes by drawing together the disparate members. The ethnographic record is compatible with this line of reasoning. Recall that the linguistic labels for basic and higher-order classes tend to be primary lexemes. Single nouns may amplify the commonalities and internal coherence among the distinct members and, in this way, facilitate the establishment of superordinate-level classes.

However, highlighting commonalities is not likely to promote the

establishment of subordinate distinctions. At subordinate levels, where members of different classes closely resemble one another, class membership is easily confused. For example, Clydesdale and Palamino horses have a great deal in common, both in appearance and in function. Thus, to foster the formation of distinct subordinate-level classes, one must highlight not the commonalities within a particular class, but the categorical distinctions between classes.

The fact that different cognitive mechanisms may be required to establish superordinate- as opposed to subordinate-level classes may have a direct bearing on the types of linguistic labels that will highlight each. It is possible that although nouns facilitate the establishment of superordinate-level classes, they may fail to do so at subordinate levels. At the subordinate level, where categorical distinctions, not commonalities, must be amplified, adjectives may play a crucial role.

Once again, this prediction accords well with the ethnographic data. Here we find a strong tendency for subordinate-level classes (or Varietal and Specific ranks) to be marked by secondary lexemes, which are composed of a head noun referring to the basic (or Generic) level and a modifier to distinguish a salient characteristic of the subtype.

To examine the possibility that particular linguistic constructions (e.g., nouns vs. adjectives) expedite the establishment of taxonomic classes at particular levels within a hierarchy (superordinate vs. subordinate), we conducted a series of experiments to compare in a systematic way the effect of introducing either novel nouns or novel adjectives at multiple hierarchical levels (Waxman, 1990). We asked each child to classify pictures of objects at all three hierarchical levels (subordinate, basic, and superordinate) within the two different natural object hierarchies (animals and food) depicted in Figure 4.1.<sup>4</sup> Notice that these classes conform to the hierarchical and contrastive principles. Considered vertically, the lower-order classes are nested within subsequently higher-order classes; considered horizontally, the classes are mutually exclusive.

The experimental procedure was similar to the one utilized in the superordinate-level classification task described earlier in this chapter (Waxman & Gelman, 1986). Once again, to ensure that the children understood that they were to sort the items into classes, the experimenter first set out three small dolls and explained that they were "very picky and only liked a certain kind of thing." She then

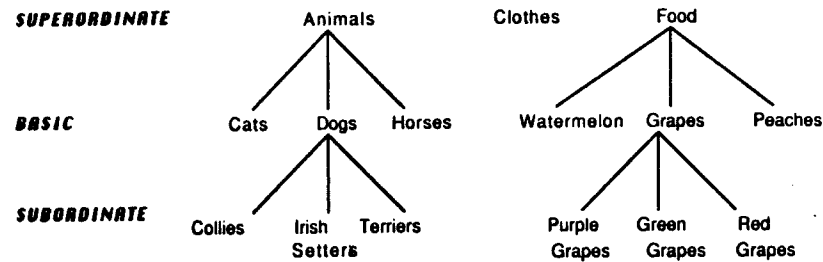


Figure 4.1. A hierarchical system of natural object categories.

revealed three typical members of each contrastive class to indicate the "kinds of things each puppet would like," leaving these clue photographs in full view during the experiment proper.

We assigned 3- and 4-year-old subjects to one of three experimental conditions (no word, novel noun, novel adjective). In the no-word condition, the experimenter simply drew attention to these clue photographs as she set them out, saying, "This doll likes this, and this, and this, and other things like that," as she placed the appropriate clue photographs beneath each doll. The instructions in the novel-noun and novel-adjective conditions were identical to those in the no-word condition, with only one exception: Here the experimenter provided a novel label in conjunction with the clue photographs. For example, in the novel-noun condition, she said, "This doll likes this, and this, and this, and other things like that. She calls these 'akas.' But this doll [indicating a second doll] likes this, and this, and this, and other things like that. She calls these 'dobus.'" In the novel-adjective condition, the novel words were presented in an adjectival context. For example, the experimenter labeled the classes as "These are the 'akish ones,' these are the 'dobish ones,' and these are the ones that are 'kimish.'"

The most interesting results to emerge from this series concerned the specific effects of the novel labels. As we had expected, we found very different effects at the different hierarchical levels. Let us first consider the influence of the novel nouns. At the superordinate level, the novel nouns facilitated taxonomic classification. This, of course, was expected on the basis of the work described earlier in this chapter (Markman & Hutchinson, 1984; Waxman & Gelman, 1986; Waxman & Kosowski, 1990). At the subordinate level, where we expected the nouns to have very little influence, they actually made

taxonomic classification more difficult. Children in the novel-noun condition classified less well at the subordinate level than did their peers in the no-word condition.

Of course, this is not to say that labels have no effect on the establishment of subordinate classes. Recall that the findings from ethnobiology as well as those from American Sign Language revealed a tendency across languages for subordinate classes to be marked with modifier-noun phrases or secondary lexemes. On the basis of these findings, we suspected that novel adjectives would facilitate the establishment of subordinate-level classes.

Our predictions concerning the role of novel adjectives at the subordinate level were borne out by the data. Unlike novel nouns, novel adjectives supported subordinate, but not superordinate, classification. Children in the novel-adjective condition classified very successfully at the subordinate level. Yet novel adjectives exerted no demonstrable effect at either the basic or superordinate level. Thus, novel adjectives produced a systematic pattern of results, but one that was quite distinct from the pattern engendered by the novel nouns.

In this series, we found that the 3-year-old children were swayed to a greater extent by the novel words than were the 4-year-olds. This is consistent with the view that children may be most sensitive to the influence of novel words early in development, before they have established elaborate hierarchical systems. It would certainly be worthwhile pursuing this intuition by examining these phenomena in children younger than 3 years of age.

*Fostering subordinate-level classification: The joint contributions of word-learning biases and existing knowledge*

One unexpected result of the preceding experiment was particularly puzzling. We had expected the novel nouns to have very little influence at the subordinate level, but they actually interfered with subordinate classification. That is, children in the novel-noun condition had more difficulty forming subordinate-level classes than did their age-mates in the no-word condition. This enigmatic finding, which has since been replicated (Waxman & Shipley, 1987), underscores the complexity of relations linking language and conceptual organization; for although novel nouns promote the establishment of some classes (notably, those at the superordinate level), they hinder

the formation of others (those at the subordinate level). But why should novel nouns promote some taxonomic relations and obscure others?

E. Shipley and I designed a series of experiments to address this question (Waxman, Shipley, & Shepperson, 1990).<sup>5</sup> We suspected that the detrimental effect of introducing novel nouns at the subordinate level was related to children's lack of knowledge concerning subordinate-level distinctions (Chi, 1983). Our reasoning was as follows: If children have not yet established categorical subclasses, novel nouns should highlight taxonomic relations at the basic level and, as a consequence, interfere with the establishment of new subclasses. But if children *have* begun to establish subclasses, novel nouns might be taken to refer to the emerging subclasses. In this case, novel nouns should no longer interfere with subordinate-level classification.

To test this hypothesis, we supplied 3-year-old subjects with factual information concerning the subordinate-level distinctions. For example, pointing to an angelfish, the experimenter explained that "this kind of fish changes color to hide from enemies, and has fused teeth." She offered different facts about salmon and trunkfish. All of the facts were true, but could not be detected perceptually by studying the stimuli themselves. We then observed the effect of introducing novel nouns, by comparing children in a novel-noun condition with others in a no-word condition. In the novel-noun condition, the experimenter labeled each target with a novel noun. In the no-word condition, she supplied the facts, but no labels, for the subclasses.

As we had predicted, when we provided children with specific information to distinguish the relevant subclasses, novel nouns no longer presented an obstacle in subordinate classification. In this experiment, we detected no difference between performance in the no-word and the novel-noun conditions. Because the specific information emphasized the categorical distinctions among the subclasses, it reduced children's tendency to interpret the novel nouns at the basic level. As a result, the children no longer encountered difficulty when novel nouns were introduced at the subordinate level.

However, parents and teachers do not always accompany novel subordinate-level terms with such substantial distinguishing information. How, then, do children learn to make subordinate-level distinctions and to label them appropriately? To answer this question,

we drew on the literature on parental labeling strategies. Parents employ a systematic strategy known as *anchoring at the basic level* when they introduce young children to subordinate-level distinctions (Adams & Bullock, 1986; Callanan, 1985, 1989; Chapter 12, this volume). They use the novel nouns (e.g., *salmon*) in conjunction with the familiar basic-level term (e.g., "This is a salmon. It's a fish").

In the next experiment, we followed the parents' lead. We explicitly mentioned the basic-level labels. In addition, we provided children with information about general properties shared by members of the basic-level classes. We then observed the effect of introducing novel nouns for the subordinate-level classes. In the no-word condition, the experimenter pointed to three targets (one from each contrastive class), saying, "We've got three fish here. This one, this one, and this one. Fish breathe by taking water into their mouths [etc.]." In the novel-noun condition, she introduced the same basic-level labels and information, but in addition labeled each target with a novel noun. For example, she said, "We've got three fish here. This is a 'tosa,' this is an 'aka,' and this a 'kita' [pointing to each target]. Fish breathe by taking water into their mouths [etc.]"

Once the novel nouns were introduced together with the known basic-level terms and basic-level information, they no longer interfered with subordinate-level classification. In fact, in this experiment, children in the novel-noun condition sorted more items correctly than did their age-mates in the no-word condition. We suspect that by anchoring the novel terms at the basic level, we effectively ruled out the possibility that the children would try to interpret the novel nouns at the basic level.

These experiments illustrate an important point: Children's bias to interpret novel nouns as referring to taxonomic relations does not operate in a vacuum. Rather, their interpretation of novel nouns depends crucially on the status of their existing knowledge regarding the classes under consideration, their existing vocabularies, and the conditions under which the words are introduced (see also Callanan, Chapter 12, this volume). Either by providing new information about distinct kinds or by ruling out basic-level interpretations of the novel nouns, we can focus children's attention on subordinate-level distinctions within a known basic-level class. And once they are so focused, children are able to take novel nouns as referring to these emergent subordinate-level classes.

### Parallels in ethnobiology and developmental psychology

Taken together, the findings from developmental psychology and ethnobiology provide support for the claim that there is a precise link between linguistic and conceptual systems of organization. This link appears to be evident throughout development and across a wide range of object categories. Across diverse cultures and languages, there is a strong tendency to use nouns to refer to higher-order classes and adjectival phrases, with the head noun referring to the familiar basic-level class, to refer to subordinate-level classes.

In addition to their common interests and findings, researchers in ethnobiology and developmental psychology also encounter common obstacles when it comes to interpreting data. In large part, this is because neither conceptual organization nor linguistic structure is amenable to direct observation. As a consequence, researchers in both fields must depend on overt behaviors (such as intrinsic common responses, labeling, or classification) to draw inferences concerning the covert organization of the mind. Although we now have sophisticated and precise tools of measurement, inferences of this sort are as much a challenge to modern cognitive scientists as they were to our predecessors. Therefore, we must take care not to mistake the map (here, the measurements) for the territory itself (the mind).

#### *Problems of measurement and inference*

In both ethnobiology and psychology, our assessment of the presence or absence of a particular category is based on subjects' behavior when they are faced with a variety of discriminable stimuli. For example, when subjects group objects together in a classification task, or when they produce or accept a common label for a group of different objects, we infer that their common response reflects an underlying conceptual category. This inferential logic is also evident in the behavioral techniques and physiological measures that have gained wide acceptance in infancy research (see Reznick, 1989, for a current review of methods employed in infancy research). For example, Mervis (1985) systematically charted one particular observable behavior (bringing an object to the mouth and blowing) to describe one infant's category, *horn*.

To be sure, these measures have yielded important insights into

categories and their development. However, they also raise some critical problems of interpretation. First, a subject's failure to provide a common response toward a given set of objects does not necessarily warrant the conclusion that the subject fails to appreciate the category in question. For example, although I appreciate the category *animal*, I may not provide a common behavioral response to all members of the class. I may run from a tiger, but not from a lamb. Or, to take a more physiological measure, I may produce an elevated galvanic skin response when faced with a tiger, but not with a lamb.

Conversely, the fact that a subject does produce a common response (be it a verbal label, a physical grouping of objects, or an observable behavior such as blowing) does not necessarily warrant the conclusion that the subject appreciates the category in question. For example, I may produce a common response (rapid running) to a tiger and to a bus that is about to depart without me.

The question of when, and on what basis, to credit subjects with an appreciation of a category, particularly an unnamed category, has generated extensive debate, particularly in ethnobiological circles. On one side of the debate are those who insist that only if a category is named by native informants can it be said to have the status of a conceptual category within a culture (C. H. Brown, 1977; Burling, 1964; Hunn, 1977). Others (Berlin, 1978; Kay, 1971; Taylor, 1984) maintain that this interpretation is too restrictive and that "although a name may be an unambiguous indicator of a category, the absence of a label does not necessarily imply the absence of a category" (Berlin, 1978, p. 12).

To support the position that a category, though unnamed, is not unrecognized requires other sources of evidence. Berlin provided such evidence in his study of Tzeltal. Although there are no overt labels for the Unique Beginner rank *plant* or *animal* in Tzeltal, other linguistic indices suggest that these conceptual categories are indeed recognized by members of this Mayan Indian language community. For example, Tzeltal speakers consistently describe the plant domain phrasally as "those things that don't move, don't walk, possess roots, and are planted in the earth." Further, all plants take the Tzeltal classifier *tehk*; all animals take the classifier *koht* (Berlin et al., 1973; see Allan, 1977, for a thorough discussion of classifiers).

Although this argument is persuasive, it is not unimpeachable. There is no compelling reason to accept the premise that a group

of objects whose labels occur with a particular classifier term constitute the same sort of class as do a group of objects that take a common label. For example, in Dyirbal (an aboriginal Australian language), a common classifier, *balan*, accompanies the labels referring to women, fire, scorpions, and other dangerous things (Lakoff, 1988). Yet the mechanisms or principles linking this diverse set of items together appear to be quite different from those linking taxonomic classes such as *plant* and *animal*. Therefore, the argument that groups of objects denoted by common classifiers have the same status as those picked out by common labels stands on tenuous ground.

The issue of covert categories has been discussed primarily in the ethnobiological literature, but it has implications in developmental psychology as well. For example, it is a well-documented finding that children acquire basic-level labels before they acquire superordinate- and subordinate-level labels (Anglin, 1977; Mervis & Crisafi, 1982; Waxman, 1990). Thus, early in development, the non-basic levels often remain unnamed. Most developmental psychologists appear to accept tacitly the premise that a failure to label does not necessarily constitute a failure to appreciate a conceptual grouping.

In fact, there is an interesting parallel between ethnobiologists' treatment of classifier terms and developmental psychologists' treatment of children's overextensions. Early in semantic development, children typically fail to label superordinate-level classes such as *animal*, *clothing*, and *vehicle*. Yet they tend to extend a basic-level term (e.g., *car*) to other objects within the same superordinate-level class (e.g., *vehicle*) (Rescorla, 1980). These apparently rule-governed overextensions have sometimes been taken as hints that children are cognizant of such superordinate categories, despite their failure to label them. Additional support for this position has come from preschoolers' performance on other behavioral measures (including oddity tasks, semantic clustering techniques, and habituation procedures). However, it remains an open question whether these early groupings share the same status as labeled classes.

### Biases in development

The focal point of this chapter has been the hypothesis that there are powerful convergences between hierarchical systems of orga-

nization and the linguistic devices we use to describe them. Languages encode the categories, relations, and ideas we deem salient and help us to transmit these to others. In brief, I have asserted that hierarchical systems are a universal and fundamental aspect of human cognition and that implicit biases in word learning foster their development.

The notion that certain aspects of human psychological development unfold under the influence of constraints or biases has generated considerable debate. For this debate to be constructive, it is crucial that the theoretical position itself and its attendant claims be made clear. The essential position is that children approach the task of learning and development equipped with certain biases or predispositions. Children find themselves immersed in an enormously rich and varied world. Each day they encounter a continual stream of new objects and witness new events. Biases serve as guideposts; they help children to organize these encounters into coherent systems.

Notice that the argument for biases or constraints is not meant to provide a complete account of human psychological development. This theoretical approach does not, in any sense, preclude the examination of other important sources and mechanisms of development. Researchers working from this theoretical perspective do not envision human development as an inflexible procession toward a single, predetermined goal. Nor are they committed to the view that discovering a particular bias in development (e.g., the noun-category bias) is tantamount to discovering that a mature system is "there" from the start. On the contrary, central to this approach is the conviction that children are active learners who seek out information from the world around them. Biases provide direction for development, but leave ample opportunity for the elaboration and variation that comes with children's important interactions with the people, objects, and events that constitute their world.

These other sources of development are essential, for the categories we construct are not rigidly fixed by innate predispositions, by linguistic structures, or by objective reality. They vary with experience and evolve over time. For example, although the noun-category bias highlights taxonomic relations and facilitates the early development of hierarchical systems, it does not dictate precisely which categories a given child will establish. This will be a function of that child's perceptual endowments, her existing knowledge and

theories, and the particular constellation of objects she encounters.

Further, there are fundamental questions concerning the nature and origins of these biases in development. It is important that we determine whether the biases we have discussed are learned during the process of language development, or whether they are part of a child's innate endowment. Infants do not appear to use syntactic context to affix meaning to a new word at the very onset of language acquisition. Before the "naming explosion" (at approximately 17 to 24 months), they appear to interpret most words, independent of their syntactic status, as referring to objects and categories of objects.

An anecdote may illustrate this point: A 15-month-old repeatedly tried to get a hold of a broom (an item for which she had no label) while her mother was sweeping the floor. Frustrated in her domestic efforts, the mother offered the toddler her "own broom" (actually, a hand-sized fireplace sweeper), placing emphasis on the word *own*. The toddler repeated the stressed syllable *own* and, for six weeks thereafter, consistently labeled her small broom and all others *own*.

Later, as children begin to appreciate the formal distinctions among various syntactic form classes (Gordon, 1987; Valian, 1986), they begin to rely on syntactic information to determine the meaning of novel words. At this point, they begin to interpret nouns, but not adjectives and other predicates, as referring to category relations. On the basis of my research with children as young as 2 years of age learning English, French, and Spanish, I have speculated that the noun-category bias may be innate, but that children's interpretation of adjectives may arise at a later point in development, may vary across languages, and may be dependent on the particulars of the language being acquired.

Finally, this rapidly accumulating body of research has set the stage for a whole new line of inquiry concerning the interrelations among the various proposed biases (e.g., among the noun-category bias [Waxman, 1989; Waxman & Kosowski, 1990], the principle of mutual exclusivity [Markman, Chapter 3, this volume; Merriman & Bowman, 1989], and the principle of contrast [Clark, Chapter 2, this volume]). For example, there is evidence that children are constrained to interpret the first word for a novel object as referring to the basic-level kind (Markman, Mervis), but that the second word applied to an object is not so constrained. Once they have acquired a basic-level kind term, children are free to interpret words acquired

later in a host of ways. These may include higher- and lower-order terms (Taylor & Gelman, 1988, 1989; Waxman, 1990), property terms (Au, 1990), and various restricted terms (e.g., life-phase and context-restricted terms) (Hall & Waxman, 1990; Macnamara, 1986). How are the various proposed biases coordinated such that children rapidly derive the meanings of new words and, at the same time, work out the relations among new words? Further research on this important question is certainly warranted (see Waxman, 1990).

## Conclusions

Language exerts a strong influence in the early establishment of hierarchical systems. Basic-level classes emerge early in development, are remarkably consistent across cultures, and tend not to be affected by the introduction of novel terms, whether they be nouns or adjectives. However, at nonbasic levels, where categories vary considerably across cultures and throughout development, language exerts a definite and constructive influence. For very young children, nouns highlight higher-order category relations (e.g., animals, furniture) and adjectival phrases mark specific, lower-order distinctions (e.g., Ribier grapes, Thompson grapes). These implicit word-learning biases streamline the acquisition of word meaning and, at the same time, promote the establishment of hierarchical systems of organization.

## Notes

1. Within cultural anthropology, examinations of language still occupy a privileged position as overt indices of implicit cognitive activity. In recent years, there has been a growing trend toward developing other measures of cognitive activity (see Dougherty, 1985).
2. This entails three assumptions: (a) that there is structure in the natural world (a fact that biologists have long embraced), (b) that human perceptual abilities are sensitive to this structure (a position which psychologists since Rosch and Gibson have embraced but which is problematic; see Carey, 1983), and (c) that our underlying conceptual representations echo this perceptible, real-world structure (this third assumption is a most controversial one).
3. Determining which level is the *basic* level is, at least in part, a function of the salience, or cultural significance, attached to a particular domain by the members of the society. For example, taxa of the Generic rank may be most salient to people who interact frequently with their biological environment and whose subsistence depends on it. But for those

of us living in an urban, industrialized world, categories at the Life Form or Intermediate rank may be judged to be at the basic level. See Dougherty (1978) and Rosch (1978) for this position.

4. In one experiment, the children classified pictures of objects at four (rather than three) hierarchical levels. See Waxman (1990) for a complete account of this series of experiments.
5. To begin this series of experiments, we conducted an initial study, the purpose of which was to select stimuli that preschool children could recognize as individual members of their respective basic-level classes but that were not yet organized into distinct kinds or subclasses. In other words, we wanted to be sure that preschool children's existing knowledge regarding the subclasses we selected was indeed limited. On the basis of this preliminary study, we selected three subordinate-level contrast sets, including types of dogs (collies, terriers, and Irish setters), types of grapes (Ribier, Thompson, and Foch), and types of fish (angelfish, salmon, and trunkfish).

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