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8

The Dubbing Ceremony Revisited: Object Naming and Categorization in Infancy and Early Childhood

Sandra R. Waxman

This Chapter is dedicated to Roger Brown for his profound influence.

An Itzaj infant rests on his mother's back as she walks through a village in Guatemala's Petén region. A North American infant sits in his stroller as his father walks past a pet store on his way to rent a video. Each infant will grow up in a world that the other cannot imagine, amid objects and events that the other has not experienced, and with words that the other cannot understand. And yet there will be striking similarities in the most fundamental aspects of their conceptual and language development. Within the first year of life, each of these infants will form categories to capture both the similarities and differences among the various objects they encounter. Most of these early object categories will be at an intermediate level of abstraction (i.e., dog,[1] rather than the more inclusive animal or the more specific terrier), known as the basic, or folk-generic, level in psychology and anthropology, respectively. These early categories will serve as an inductive base, permitting the infants to make inferences about the behaviors and properties of new objects. In addition to these conceptual advances, each infant will acquire his native language naturally, at a remarkable pace. By 12 months of age, each will begin to produce words, and included among these will be names for important people, for salient relations (e.g., hot, uh-oh), and for the basic level categories of objects that capture their interest. Each will add new words, and by 24 months of age, each will have productive command of hundreds of words and will begin to combine these to produce short, well-formed phrases.

This vignette reveals that although infants across the world's communities are exposed to widely varying types of experiences, they follow strikingly similar paths in cognitive and language development. Early cognitive and language development unfold naturally in humans, but these advances are also shaped in important ways by the people, the objects, and the events that the infant encounters. Therefore developmental theories must take into account both the natural endowments of the human infant and the shaping role of the environment.

To meet this challenge, I have woven together several lines of interdisciplinary work to cast light on the evolution of object categorization and object naming in infants and young children. This research has led me to the conclusion that object categorization and naming are tightly linked in human development. From the onset of acquisition, there are powerful, implicit links between these two uniquely human capacities. For infants who are on threshold of object naming, novel words highlight commonalities among objects and, in this way, foster the formation of object categories. This initial expectation is powerful. It guides infants in their first efforts to map words to their meanings. It also guides the acquisition of stable conceptual systems. However, this initial expectation is modified as a result of infants' experience with the range of objects and the structure of the native language they encounter (Waxman 1998).

8.1 Categorization, Naming, and the Establishment of Hierarchical Systems: Some Central Issues

Hierarchical Systems Established Universally

Extensive research in cognitive psychology, anthropology, and linguistics has revealed that people across the world establish hierarchical systems or taxonomies to capture important relations among objects (Atran, 1990; 1995; Berlin 1992; C. Brown 1977; Coley Medin Atran 1997; Frake 1962; Keil 1995; Lopez Atran Coley Medin, and Smith 1997; but see Burling 1964; Dupre 1981, and Lancy 1983 for arguments against this universalist position). Some of the most compelling evidence comes from detailed examinations of folkbiological knowledge from such disparate cultures and locales as the American Southwest (Hage and Miller 1976; Wyman and Bailey 1964), Guatemala (Atran 1990), Mexico

(Berlin, Breedlove, and Raven 1974; Berlin 1992; Hunn 1977), China (Anderson 1967), the New Guinea highlands (Bulmer and Tyler 1968), and college-educated North American adults (see Medin and Heit 1995; Smith and Medin 1981; Rosch, Mervis, Gray, Johnson, and Boyes-Braem 1976). Findings like these are intriguing, for they suggest that people immersed in vastly different cultures, living in vastly different locales, and exposed to vastly different amounts of formal schooling settle on a similar solution to the cognitive problem of organizing information efficiently. And because the categories within such systems support inductive inference, they motivate us to extend existing knowledge beyond that which we may have observed directly (S. Gelman and Medin 1993; Lopez et al. 1997.).

Privileged Status of the Basic, or Folk-Generic, Level

There is also strong evidence that across cultures, categories at an intermediate level of abstraction—known as the basic level in psychology (Rosch et al. 1976) and the folk-generic level in anthropology (Atran 1990; Berlin, 1992)—enjoy a privileged status. Descriptively this privileged level occupies a middle position within a hierarchical system (e.g., dog, rather than the more specific terrier, or the more inclusive mammal or animal; see Rosch et al. 1976 for a detailed description of the evidence). Briefly stated, under most circumstances, adults prefer to categorize and label objects at this level, and they are quickest to identify objects at this level. In addition these mid-level categories appear to have greater inductive potential than higher- and lower-order object categories (S. Gelman 1988; Coley et al. 1997).

Beyond such descriptions, precise formal characterizations of the privileged status of these mid-level categories have been difficult to achieve. Also at issue is the precise location of this privileged level within a given object hierarchy. Atran (1990) and Medin et al. (1997) have documented that there are "shifts" as a function of expertise. For example, for tree experts, the category oak may be privileged with regard to naming and induction, while for novices, the more inclusive category tree may serve this function (Atran 1990; Medin et al. 1997; Johnson and Mervis 1994; Mervis Johnson, and Mervis 1994). These controversies notwithstanding, the construct of a basic level has proved useful as a description or

heuristic in research with adults and children alike (see Berlin 1992; Armstrong, Gleitman, and Gleitman 1983; Medin and Heit 1995; Waxman 1990).

Developmental Primacy of the Basic, or Folk-Generic, Level

Of particular interest is the developmental evidence for a basic level advantage in object categorization, object naming, and induction. Developmentally, object categorization and naming at the basic level precedes that at higher- and lower-order levels within a hierarchy. Basic level object categories are formed early in infancy (Quinn, Eimas, and Rosenkrantz 1993); basic level categories and their names are acquired long before those at nonbasic levels (Rosch et al. 1976; Waxman 1990; Markman 1989; Mervis and Crisafi 1982; Anglin 1977; Brown 1958; Dougherty 1979; Mervis 1987; Stross 1973; Waxman and Hatch 1992); basic level names provide criteria for object individuation and object identity (Hall and Waxman 1993; Hall 1993; Macnamara 1986). Moreover basic level object categories serve as children's first and strongest basis for inductive inference (S. Gelman 1988; Waxman et al. 1997).

This is not to say that early category knowledge is limited to the basic level. This is clearly not the case. Infants and children also appreciate more abstract (e.g., animal) and more specific (e.g., collie, Thompson (green) grapes) object categories (Mandler 1992; Waxman 1990; Waxman and Markow 1995). Findings like these are testimony to the richness and flexibility of infants' early perceptual and conceptual abilities, and their ability to recruit these abilities in the service of object categorization. However, there are several indications that these nonbasic level categories do not enjoy the privileged status accorded to those at the basic level. Nonbasic level object categories are named later in development than those at the basic level, and they do not serve as the primary basis for inductive inference (Waxman et al. 1997; Gelman 1988). Thus the ability to form nonbasic level categories does not, in itself, preclude the argument for the developmental primacy of the basic level. On the contrary, the weight of the evidence (from a psychological, linguistic, philosophical, and anthropological perspective) supports the developmental primacy of the basic level in object categorization, naming, and induction (Waxman 1998).

Systematic Relation between Hierarchical Level and Linguistic Form

Further support for both universality of hierarchical systems and the privileged status of the basic level comes from cross-linguistic analyses of object naming and categorization. Berlin (1992) and his colleagues (C. Brown 1977; Hunn 1977) have discovered a systematic relation between the hierarchical level of an object category and the linguistic form of its label. This striking relation has been documented in adult speakers of diverse languages (see Berlin 1973). According to Berlin (1973; 1992), there are two important cross-linguistic observations regarding the basic or folk-generic level. First, across languages, categories at the basic level are named. Indeed Berlin (1973) has argued that classes at this level are so salient that they are "... crying out to be named." A second observation is that across languages, names for basic level categories have a consistent linguistic form. They tend to be simple (monomorphemic) count nouns. Examples from American English folkbiology are nondecomposable count nouns such as *grape, orchid*, and *whale*.

There are two key distinctions between the nomenclatural patterns associated with basic versus nonbasic level categories (Berlin 1973; 1992). First, unlike basic level categories, many nonbasic level categories remain unnamed. For example, in several folkbiological systems, the categories plant and animal are not lexicalized. (The psychological status of these covert categories will be discussed in the final section of this chapter.) Second, when nonbasic level categories are named, the linguistic form of their names differs systematically from those at the basic level. In contrast to the basic level, nonbasic level categories tend to be named with more complex, polymorphemic forms. For example, categories at the more abstract levels (e.g., the family, life form, and unique beginner ranks in ethnobiology, or the superordinate and global level categories in psychology) are typically named with count nouns, that are more complex morphologically than those at the basic level. This complexity appears to be a consequence of linguistic constructions such as compounding (see Lyons 1977 or Marchand 1969 for a full discussion of morphological complexity and other derivational forms). Names associated with the more specific levels (e.g., the specific and varietal ranks, or the subordinate level) exhibit a different nomenclatural pattern en-

tirely. These tend to be marked with phrases in which a modifier is used in conjunction with a simple count noun to denote a specific type of the basic level category marked by the noun alone. Examples from American English folk biology include names such as *Concord grape*, *humpback whale*, or *cymbidium orchid*.

In brief, this ethnobiological program of research has revealed striking uniformity across diverse languages regarding (1) the categories that are most likely to be lexicalized, and (2) the linguistic form of the names associated with categories at each hierarchical level. Evidence from American sign language (ASL) suggests that these convergences between nomenclatural patterns and object categorization are not a consequence of the particular modalities (visuomotor or auditory-vocal) through which a language is transmitted but are instead a more general feature of language and conceptual organization (Newport and Bellugi 1976; Waxman 1990).

Identifying Sources of Uniformities in Classification and Naming

What are the sources underlying these uniformities in folk classification and naming? Do these uniformities reflect the structural regularities among objects found within the natural world (see Berlin 1973; 1992; Rosch et al. 1976)? Do they arise as a consequence of the organizational tendencies (or constraints) imposed by the human mind? Although we do not yet have an answer to these questions, it is apparent that these sources are not mutually exclusive. Therefore several different research strategies have been mined to gain insights into the relative contributions of each.

One strategy has been to identify similarities and differences among hierarchical systems that have been established by adults *across* diverse cultures. Thanks to the painstaking and extensive research conducted by primarily by ethnobiologists, we now have elaborate descriptions of folktaxonomic knowledge across cultures. These comprehensive analyses of entire folkbiological systems have made it possible to speculate about factors within a given environment that may contribute to cross-cultural differences.

Another productive research strategy has been to compare, *within* a particular culture, the knowledge systems of groups of individuals with

different kinds of expertise. Chi (1983), Medin (Medin et al. 1997; Coley et al. 1997), and Mervis (Johnson and Mervis 1994; Mervis et al. 1994) have each pioneered this approach within the psychological literature. They have shown that experts and novices differ in the amount of knowledge that they have acquired within a domain. As a consequence the taxonomies constructed by experts have greater detail than those of novices. In addition the inductive force of their knowledge within that expert domain also differs. Further the precise location of the privileged level may shift as a function of expertise (Coley et al. 1997; Medin et al. 1997). Nonetheless, the similarities between experts and novices appear to outstrip their differences. Both groups form hierarchical systems and use categories within these systems as an inductive base. For both groups, mid-level object categories within these hierarchical systems appear to be privileged with respect to object naming, categorization and induction.

Necessity of Adopting a Developmental Approach

The research strategies described thus far amplify the uniformities and also reveal fascinating divergences across cultures or groups of individuals. However, there is an inherent limitation in these approaches that can only be overcome by adopting a developmental approach. For no matter how carefully an ethnobiological record is constructed and analyzed, or how elegantly an experiment is designed, evidence from adults cannot reveal the origins of knowledge or the mechanisms responsible for its unfolding. It is impossible to discern the initial state of a system from an examination of its mature state. To understand the origins and emergence of a system, one must begin at the beginning.

The power and necessity of adopting a developmental approach to questions of acquisition has been recognized across disciplines. See, for example, the elegant work of Marler (1991) on the acquisition of song in the white-crowned sparrow, Held and Hein (1963) on the acquisition of depth perception in kittens, Baillargeon (1993) and Spelke (1993) on infants' acquisition of physical knowledge about objects, and R. Gelman (1991) on the acquisition of number concepts in humans. Although these programs of research focus on different topics, they share with each other, and with research on folkbiology, a commitment to characterizing the rapid acquisition of complex, sophisticated systems. They also share

a commitment to considering carefully the relative contributions both of the amount and type of information present in the environment and of the structure imposed by the learner. (See Gallistel et al. 1991 for an extended discussion of this topic.)

In my research program I have adopted a similar approach to examine the origin and emergence of the relation between object categorization and naming. I argue for an integrative account that embraces at once the importance of *constraints* or *expectations* inherent in the child and *learning* on the basis of the child's experience.

Clarifying the Notion of Constraints within the Child

The interplay between constraints and learning is essential. Children raised in different communities and cultures will encounter different objects, will acquire different languages, and will be presented with different types of instruction and training (Cole et al. 1971; Laboratory of Comparative Human Cognition 1983; Lave 1991; Rogoff 1990). Acquisition must be sufficiently constrained to permit the child to form fundamental categories of objects and to acquire their native language, yet sufficiently flexible to accommodate the systematic variations that occur across cultures and languages.

Therefore an argument for constraints on acquisition is not a polarized argument that locates the engine of acquisition solely within the mind of the child. Neither does it preclude the indisputable fact that the kinds of input that children receive will shape their knowledge. Rather, the argument is that these constraints or expectations direct infants' attention toward precisely the sort of information and regularities in the environment that will make possible the rapid acquisition of complex systems of knowledge, including the acquisition of word meaning and the establishment of object categories (Gelman and Williams 1998; Waxman 1998). Notice also that this is a dynamic account: the initial constraints that we observe in infants at the outset of acquisition are not rigidly fixed. They do not exert a uniform influence throughout development. On the contrary, the infants' expectations regarding the specific relations between word meaning and conceptual organization become modified over the course of development. Thus any thorough account of acquisition will consider both factors within the child and factors within the child's environment (including the objects the child encounters, the native language under acquisition, and the people transmitting knowledge from one individual to another, from one generation to another).

The Dubbing Ceremony

This essential interaction between constraints within the child and learning comes into sharp focus when viewed through the lens of a simple and culturally widespread naming ritual known as the Original Word Game (Brown 1958) or the Dubbing Ceremony (Putnam 1975). This is a natural interchange involving a young child and a caretaker (an adult, or an older child). Typically one individual (e.g., an adult) points to an object (e.g., a tapir) and provides its name ("Ila' a' tzimin~che' je'lo'" [in Itzaj] or "Look, a tapir" [in English]). This simple ceremony is nothing more (or less) than an ostensive definition, embedded within a social exchange.

Considered from a social and cultural vantage point, the dubbing ceremony reveals the status accorded to naming across human society and the role that adults naturally assume in transmitting knowledge. The ceremony also captures the strong intuition that naming and categorization are not independent. By providing distinct names for two objects (e.g., "This is a *horse*; that is a *tapir*"), we highlight the conceptual distinctions between them. By providing a common name for these objects (e.g., "These are *animals*"), we highlight the conceptual commonalities among them. Thus names offer tacit information about relevant commonalities and distinctions among objects. Naming, then, is itself an act of categorization. Adults' naming practices help to shape the boundaries of children's object categories and their names. In this way the dubbing ceremony illustrates the vital contribution of parents and other caretakers in the child's acquisition of object categories and their names.

A thorough consideration of this ceremony also underscores the contribution of factors within the child. Despite wide variations in cultural practices associated with early naming, there is remarkable cross-cultural consistency in the timing and in the composition of the early lexicon. For example, in some cultures (e.g., middle- to upper-class communities in North America), caretakers begin naming objects for their infants well before the infants themselves can speak. In other communities (Kahluli; see Ochs and Schieffelin 1984), caretakers speak directly to infants only

once the infants themselves have begun to speak. Another source of variation comes from the structure of the language presented to infants. Infants as young as eight months of age are especially attentive to novel words, particularly those that occur at the end of a sentence or phrase boundary, such as "See the *tapir*?" (Fernald 1992; Jusczyk and Aslin 1995; Newsome and Jusczyk 1994). In many languages (e.g., English, Spanish, French), names of objects typically occupy this privileged phrase–final position. However, in other languages such as Mandarin Chinese (Tardif 1996), Korean (Au, Dapretto, and Song 1994; Choi and Gopnik 1996), and apparently Itzaj, this is less often the case.

Despite these cross-linguistic variations in the prevalence of naming routines and the linguistic structure in which names are embedded, infants acquire words for objects and categories of objects rapidly (Gentner 1982; Gleitman 1990; Goldin-Meadow, Seligman, and Gelman 1976; Huttenlocher and Smiley 1987; Macnamara 1982; Nelson 1973; Saah, Waxman, and Johnson 1996). This consistency in the timing and the composition of the early lexicon suggests that there are also strong factors within the child that support the acquisition of object categories and their names (Newport 1991; Gentner 1982; Waxman and Markow 1995).

Mapping Problem Perhaps the most compelling evidence of the child's contribution to acquisition comes from an analysis of the "mapping problem" (Gleitman and Wanner 1982). Consider, once again, the infant who hears "Ila' a' tzimin~che' je'lo'" as a tapir disappears behind a knoll. If the dubbing ceremony is to be informative at all, the infant must solve a difficult three-part task. First, the infant must parse the relevant word (*tzimin~che* or *tapir*) from the continuous speech stream; second, the infant must identify the relevant entity(ies) (the tapir) in the scenario; third, the infant must establish a word-to-object mapping between the two. In essence infants must discover the relevant linguistic units, the relevant conceptual units, and the precise mappings between them.

It is remarkable that by 12 months of age, infants are able to accomplish this task, keeping track of numerous new words and mapping them correctly to the objects upon which they were introduced. (See Carey 1978; Dromi 1987; Goldfield and Reznick 1990; Heibeck and Markman 1987; Waxman and Hall 1993; Woodward, Markman, and Fitzsimmons 1994 for discussions of fast mapping and the rapid acquisition of a lexicon.) But even more remarkable is the fact that infants, like adults, readily and spontaneously extend words beyond the instances upon which they were taught, and that they do so in a systematic and principled fashion.

From Word-to-Object to Word-to-Object Category Mappings When a child applies the name *tapir* to a new and (as yet) unlabeled object, that child has made an inference regarding the extension of that name to other novel objects.[2] Such spontaneous and principled extensions indicate that infants go well beyond word-to-object mappings to establish word-to-object category mappings. This is an impressive feat, particularly because there is a crucial distinction between an individual object and an object category. An individual object is a perceptually salient entity that can be partitioned amid the ongoing stream of activity. This perceptual salience of objects is likely a factor in infants' rapid acquisition of names for individual objects (as compared to words for actions and other relations; Gentner 1982). But this observation about individual objects cannot account for the acquisition of names for object categories. This is because an object category, unlike an individual object, is not a perceptually salient whole. On the contrary, members of object categories are distinct, and often disparate, individuals that tend to appear at different times and places. Moreover, it would be logically impossible for caretakers to assemble together all members of an object category to model explicitly the extension of the category name. Therefore, infants' spontaneous and principled extension of a novel word to an object category must reflect, in large part, their implicit expectations regarding a relation between object naming and categorization.

Induction Problem: Extension, Intension, and Indeterminacy of Meaning This discussion exposes an essential dialectic between extension (roughly, the entities included in a given category, or subsumed under a given category name) and intension (roughly, the meaning or concept underlying a category or its name). The extension of the concept or word *tapir* includes all members of the concept *tapir* and excludes all other individ-

uals; the intension of the concept or word *tapir* incorporates the criteria for inclusion in the lexical or conceptual category. But neither intension nor extension is revealed explicitly in the dubbing ceremony or in any other overt act of naming. Such acts do nothing more than indicate, via ostension, a name for an individual object. How then does the child discover the proper extension or intension for a novel word?

We know that the perceptual and conceptual repertoires of infants and young children permit them to appreciate many different kinds of properties of objects and relations among them. In principle, infants' rich and flexible repertoires should complicate the task of mapping a word to its meaning. How do infants select among the various kinds of properties and relations when seeking to determine the intension and extension of a word? How do they so rapidly learn that a given word (e.g., *tapir*) will apply to a particular whole object and can be extended to other members of its kind (e.g., other tapirs; perhaps other quadrupeds), but not to salient parts or properties of the object (e.g., it's long snout or lackluster color), to salient actions in which it may be engaged (e.g., foraging in the ferns), or to other salient thematic or associative relations involving the named object? If infants had to rule out these (and countless other) candidate meanings, word learning would be a laborious task, and would likely proceed at a sluggish pace. Yet this description does not fit. Infants and toddlers acquire words, especially words for objects and object categories, at a remarkably brisk pace.

Solving the Induction Problem: Contribution of the Child To reconcile the disparity between the logical difficulty of this task and infants' seemingly effortless solution, several scholars have proposed that infants are guided by certain constraints, or expectations, that lead them to favor some types of conceptual relations over others in mapping words to their meanings (Chomsky 1986; Landau and Gleitman 1985; Pinker 1984; Markman 1989; Waxman 1990 1991). There is now substantial evidence for this position. For example, infants and toddlers reveal a strong expectation that the *first* word applied to an object will refer to that whole object and will be extended to other members of the same object category (Markman and Wachtel 1988; Taylor and Gelman 1988; Hall, Waxman, and Hurwitz 1993; Markman 1989; Waxman and Hall 1993).

For the most part their extensions are roughly equivalent to basic level categories. To be sure, adults and other caretakers shape the extension and intension of children's categories an names. But in their first efforts, children typically map names to categories at a mid-level category (Mervis and Mervis 1988; Waxman and Senghas 1992). This suggests that there is a strong priority for establishing names for basic level kinds.

The bias to extend novel words to (roughly) basic level categories appears to reflect both the infants' appreciation of the perceptual and conceptual salience of groupings at the basic or folk-generic level, and the naming strategies of the adult community. (Recall that across languages, adults prefer to label objects at the basic level.) Thus the priority for establishing basic level names likely reflects a coordination between parental input and the child's interpretive biases in the acquisition of object categories and their names.

Moreover English-speaking children as young as two and a half years of age consistently use the grammatical form of a novel word as a clue to its meaning. For example, preschool-aged English speakers expect that count nouns will refer to objects and object categories (e.g., tapir, mammal, animal), that proper nouns will refer only to the named individual and not to other members of its kind (Hall 1991; 1994; Katz, Baker and Macnamara 1974; Gelman and Taylor 1984), and that adjectives (and other modifiers) will mark object properties or distinctions within a basic level kind (Markman and Hutchinson 1984; Taylor and Gelman 1988; Waxman 1990).

One important caveat bears mention: Children will use syntactic form as a cue to meaning only if they are already familiar with a basic level name for the object(s) under consideration (Au 1990; Au and Markman 1987; Hall 1991; Hall et al. 1993; Markman and Wachtel 1988; Taylor and Gelman 1988). When children hear a new word (be it a count noun, mass noun, proper noun, or adjective) applied to a familiar object (e.g., a horse), their interpretation varies appropriately as a function of its grammatical form, as described above. But when a new word is applied to an unfamiliar object (e.g., an armadillo), preschoolers reveal a strong tendency to interpret the novel word, independent of its grammatical form, as referring to the basic level object kind. Thus children's interpretation of a novel word applied ostensively to an object is mediated by

their familiarity with a basic level name for that object. This is consistent with the claim that there is a strong *conceptual priority* for establishing names for basic level kinds. It supports the argument that basic level names provide principles of object individuation and object identity (Hall 1993; Hall and Waxman 1993; Macnamara 1982) and set the stage for the acquisition of higher- and lower-order category names.

In sum, evidence from several different laboratories using several different experimental techniques converges on a common conclusion: Children have implicit expectations regarding the relation between object naming and categorization. They focus their attention differently when an object is named than when it is not named. Moreover their expectations concerning the extensions of novel words are guided, at least in part, by grammatical form (Brown 1957).

These expectations or linkages between particular types of words (count nouns, proper nouns, adjectives) and particular types of conceptual relations (object categories, individual objects, object properties) are impressive. And they have often been invoked to help explain how children so rapidly map novel words to their meanings and so successfully construct hierarchical systems of knowledge. What is the empirical evidence for this view?

8.2 Relation between Object Categorization and Naming in Development: Empirical Evidence

This section illustrates, primarily with examples from my research program, the nature of the empirical evidence regarding the origin and emergence of a relation between object categorization and naming in the developing mind. I discuss three series of experiments, each of which draws on different experimental methods and different subject populations. Several common threads tie these experiments together. All of the experiments are essentially object categorization tasks, tailored to the particular population under investigation. In each experiment I observe the relation between object naming and categorization by comparing subjects' object categorization in "neutral" conditions involving no object names with their performance when they are introduced to names for the object categories under consideration. Performance in the neutral conditions permits an assessment of how readily infants and children establish categories at various levels within a hierarchy; performance in the naming context permits an assessment of the role of naming in this important endeavor.

In the first series of experiments, I describe some foundational research with preschool-aged children acquiring English as their native language. These experiments reveal that novel count nouns support the establishment of object categories at the basic and superordinate levels, and that novel adjectives support the establishment of object categories at the more specific subordinate levels.

Constructive Influence of Naming: Evidence from English-speaking Preschoolers

In an early study R. Gelman and I took as our starting point the well-documented finding that young children succeed in categorizing objects at the basic level before they do so at nonbasic levels. We were especially intrigued at their difficulty in forming superordinate level categories. According to most traditional developmental accounts (e.g., Inhelder and Piaget 1964; Bruner, Goodnow, and Austin 1956; Vygotsky 1962), this was interpreted as evidence of young children's general inability to appreciate abstract relations. However, a more thorough consideration of preschoolers' behavior casts doubt on this strong conclusion.

Consider children's behavior in naming. It is not uncommon for a toddler to overextend the word *doggie* to refer to a horse, or for a preschooler to overextend the word *squirrel* to refer to a lemur. These overextensions, which permit the child to remark on an object for which they do not have an existing name, are revealing because they often respect the boundaries of object categories at a superordinate level. More recent evidence, gleaned from directed interviews as well as from object categorization tasks, offers direct support for the intuition that preschoolers do appreciate such abstract distinctions as that between animate and inanimate objects (R. Gelman 1990; S. Gelman 1988; Keil 1989; Mandler 1993). This suggests that although preschoolers appreciate nonbasic level object categories, they have difficulty recruiting this knowledge in the standard classification tasks.

To test this hypothesis, we designed a highly structured classification task (Waxman and Gelman 1986) in which an experimenter introduced preschool children to some "very picky" puppets who "only wanted a certain kind of thing." To indicate the type of thing that each puppet wanted, the experimenter displayed three typical instances (e.g., a dog, a horse, a duck) of a superordinate level category (e.g., animal), and then asked children to sort additional items for each puppet. To examine the influence of novel words, we compared performance in a Novel Noun and No Word (control) condition. Children in the No Word condition were introduced to the instances and were told, "Look at these." Children in the Novel Noun condition were introduced to the same instances but were told, "These are *dobutsus*."

Despite the fact that this task was so highly structured, children in the No Word condition still had difficulty forming superordinate level categories. This result is consistent with the traditional accounts of preschoolers' conceptual difficulties forming object categories at the superordinate level (Inhelder and Piaget 1964; Rosch et al. 1976). In sharp contrast, children in the Novel Noun condition were extremely successful. They classified objects consistently into superordinate level categories. In fact children in the Novel Noun condition were as successful as another group of children who had been provided with the familiar English superordinate labels for the classes (e.g., "These are *animals*").

Thus providing a name (even a novel one) effectively oriented preschool children toward commonalities among the objects and licensed the induction of superordinate level categories. Markman and Hutchinson (1984) have reported a similar pattern of findings, indicating that novel count nouns also augmented basic level object categorization in preschool-aged children. These findings indicate that preschoolers do indeed appreciate superordinate level object categories, but that superordinate relations are heightened in the context of learning a novel word (Waxman 1994).

In a subsequent series of experiments, I examined the *specificity* of this linkage between object categorization and naming. First, we asked whether novel count nouns draw attention to object categories at all hierarchical levels. Second, we asked whether object categorization is

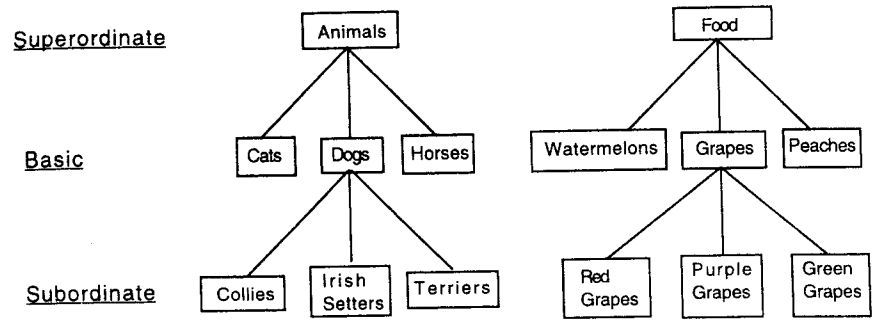


Figure 8.1
Representation of an object hierarchy

facilitated by novel words in general, or whether this focus is specific to learning novel nouns.

To address these questions, we systematically compared the effect of introducing novel words in a multiple-level classification task (Waxman 1990). Children were asked to sort pictures of objects at three different hierarchical levels (subordinate, basic and superordinate) within two different natural kind hierarchies (animals and food). See figure 8.1. As in the previous experiment (Waxman and Gelman 1986), the experimenter introduced three "very picky" puppets along with three typical members of each category. Children in the No Word condition sorted with no further instructions. To examine the influence of naming on object categorization, children in the Novel Noun condition heard a novel noun in conjunction with the photographs from each category (e.g., "These are the *dobus*"). To examine the specificity of these naming effects, we also examined the influence of introducing novel adjectives. Children in the Novel Adjective condition heard novel words that were presented in syntactic frames appropriate for adjectives (e.g., "These are the *dob-ish ones*").

The results of this experiment revealed (1) the facility with which children form basic level categories, (2) the important role of naming in the formation of nonbasic level object categories, and (3) the specificity of children's expectations about the relation between object categorization

and naming. Children in all three conditions formed the basic level categories successfully. At nonbasic levels, performance varied as a function of condition, and the influence of novel words on object categorization became apparent. The children were highly sensitive to the linguistic form in which a novel word is introduced. Novel nouns facilitated categorization at the superordinate, but not the subordinate, level. This pattern was completely reversed for children hearing novel adjectives. Unlike nouns, novel adjectives facilitated categorization at the subordinate, but not superordinate, level.

Preschool-aged children thus have both the *linguistic* capacity to distinguish among the relevant syntactic forms (count noun vs. adjective) and the *conceptual* or *perceptual* ability to appreciate both superordinate and subordinate level relations object categories. Further they have a tacit expectation that these linguistic and conceptual abilities are interwoven. They expect that novel count nouns will refer to object categories at the superordinate level and that novel adjectival phrases will refer to object categories at subordinate levels.

This clear pattern bears a striking resemblance to the systematic relation between object classification and naming that has been documented in the ethnobiological record (Berlin, 1992). In fact the convergences between the developmental and ethnobiological work suggest at least one way in which the labelling practices of the adult community will shape the semantic and conceptual categories formed by children: particular linguistic forms (count nouns vs. adjectives) will focus children's attention on object categories at particular hierarchical levels (superordinate vs. subordinate).

However, neither the ethnobiological nor the developmental research described thus far can reveal the origins, emergence, and universality of these linkages between object naming and categorization. Because the developmental evidence is derived almost exclusively from preschool-aged children, and because these individuals have already made significant linguistic and conceptual advances, it is unclear how and when these precise linkages between object naming and categorization emerge in the developing child. (See Nelson 1988 for an extended discussion of this point.) Therefore, to ascertain which linkages (if any) guide acquisition from the outset, and how these are shaped by experience, it is important

to examine infants on the threshold of language acquisition. Second, because very little work in ethnobiology has involved children (but see Dougherty 1979 and Stross 1973 for two noteworthy exceptions), and very little work in developmental psychology has involved children acquiring languages other than English, the extant evidence is based almost exclusively on children acquiring English. This is a serious limitation. It is therefore unclear which (if any) of these linkages are universal features of human development, which are specific to the English language, and how these linkages are shaped by language-specific learning. It is crucial that we examine children acquiring languages other than English. A developmental, cross-linguistic program will permit us to trace the origins of this phenomenon and to examine the constructive role of the native language under acquisition.

Developmental, Crosslinguistic Proposal

A précis of the Crosslinguistic and Developmental Literatures A review of the crosslinguistic and developmental literatures offered some signposts for our investigations. Briefly stated, this review suggested that the expectation linking count nouns and object categories was stable across languages and across development. There are universal features inherent in the design of language that appear to support this expectation. The grammatical category noun is unique for its stability across languages and across development. All known human languages have fully developed grammatical category noun, and across languages, this grammatical category includes the names for object categories (Dixon 1982; Gentner 1981; 1982; Greenberg 1963; Macnamara 1982; Maratsos 1991; Wierzbicka 1986; Gleitman 1990; Jackendoff 1990). There is also developmental stability for this grammatical category. Infants appear to have a special talent for mapping words to object categories, particularly those at the basic level. As a result names for object categories tend to be the most prevalent form in the early lexicon (Au et al. 1994; Gentner 1982; Saah et al. 1996; but see Bloom, Tinker and Margulis 1993; Gopnik and Choi 1991 and Tardif 1996 for a different view). In addition the mappings between count nouns and object categories can be established independently of the other grammatical categories. Other grammatical

categories (e.g., adjectives, verbs) appear to be semantically, morphologically, and syntactically dependent on nouns (Fisher 1996; Gleitman 1990; Hall et al. 1993; Maratsos 1991; Waxman and Markow, 1996).

In contrast to this stability of the grammatical category *noun*, there is substantially more variation across languages and across development associated with the grammatical category *adjective* (Bowerman 1985; Choi and Bowerman 1991; Gentner 1981; 1982; Maratsos 1991; Maratsos and Chalkley 1980; Talmy 1985; Wierzbicka 1986). Languages vary in the extent to which a grammatical category adjective is developed. Although many languages (like English) have a richly developed open-class adjective system, other languages have only a sparse set of adjectives. For example, most Bantu languages include between 10 and 50 adjectives. This is related to the crosslinguistic variability associated with this grammatical form. The meanings conveyed with an adjective in one language may be conveyed with a different grammatical form in another. There is also developmental variation in the adjective system. Adjectives tend to be acquired later than nouns (Bloom et al. 1993; Fenson et al. 1994; Gentner 1982; Waxman and Markow 1996). Early in acquisition, children tend to interpret adjectives (erroneously) as referring to object categories. For example, anecdotal evidence suggests that infants extend novel adjectives (e.g., "hot!") as referring to an object or object category (e.g., cup or stove) rather than to a salient property of the named object (e.g., its temperature). Observations like these are consistent with experimental evidence. There is a systematic bias to interpret the first word applied to an object as referring to the object category rather than to an object property (Hall et al. 1993; Waxman and Markow, 1996).

A Developmental, Crosslinguistic Proposal The developmental and crosslinguistic evidence suggests that all children, independent of the language under acquisition, will find support for an expectation that a novel noun (applied to an object) will refer to that object and will be extended to other members of its kind. As a result the expectation that count nouns refer to object categories is likely to play an instrumental role across development and across languages (Gleitman 1990; Maratsos 1991; Pinker 1994; Waxman 1994; Waxman and Markow 1996). In contrast, the crosslinguistic variability associated with the adjective system suggests that the mappings between adjectives and their associated meanings will neither be uniform across development nor across languages. Instead, the specific expectations regarding the types of meaning associated with adjectives should emerge later in development, should rely on an existing base of linguistic and conceptual knowledge, and should vary according to the particulars of the language under acquisition (Dixon 1982; Waxman and Markow 1998; Wierzbicka 1986).

Based on these patterns, I have proposed that (1) infants commence the process of acquisition equipped with an initially general expectation linking words to object categories, and (2) more finely tuned expectations linking specific linguistic forms (e.g., count nouns, proper nouns, adjectives) with specific types of meaning (e.g., object categories, individual objects, object properties, respectively) will emerge later, shaped by the infant's language-specific experience (Waxman 1994; Waxman and Markow 1995; Waxman, Senghas et al. 1997). One strength of this proposal is that an initially general expectation guides infants in their first efforts to map words to their meanings, supporting the ability to establish reference and setting the stage for the more specific linkages. Another strength is that it accommodates the fact that infants will acquire the particular syntactic distinctions drawn in their native language and will learn the range of meanings associated with each grammatical form. Finally this proposal embraces at once the notion of constraints within the child and learning on the basis of experience.

8.3 Empirical Evidence for the Proposal

Characterizing the Initial Expectations: Evidence from Infants Acquiring English

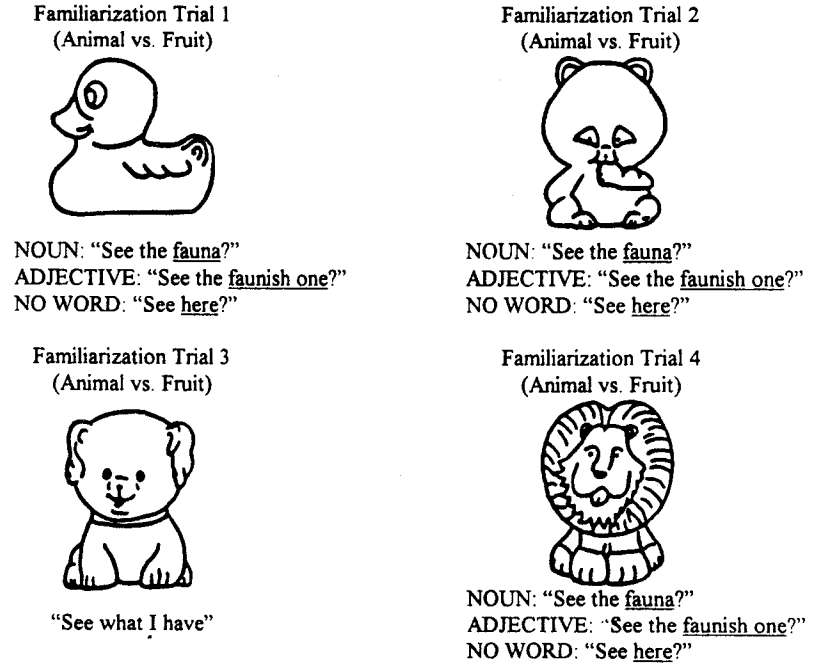
According to the proposal, infants on the brink of language acquisition should reveal evidence of an initial, general expectation that novel words (both count nouns and adjectives), applied to individual objects, will refer to object categories. To test this proposal, we therefore designed a procedure for infants (ranging from 12 to 14 months of age) who were just beginning to produce their first words (Waxman and Markow 1995).

To discover whether infants at this early point in acquisition would be guided by a general expectation that words refer to object categories, we adapted an object manipulation task, analogous to the more standard novelty-preference paradigms used in infancy research (see Waxman and Markow 1995 for a complete description of the method and results). The task involved two phases. See figure 8.2. In the *familiarization* phase an experimenter offered an infant four different toys from a given category (e.g., four different animals), one at a time in random order. This was immediately followed by a *test phase* in which the experimenter presented both a new member of the given category (e.g., another animal) and an object from a novel contrasting category (e.g., a fruit). Each infant completed the task with four different sets of objects: two involved categorization at the basic level (e.g., cars vs. airplanes; horses vs. cats) and two involved categorization at the superordinate level (e.g., animals vs. fruit; tools vs. vehicles). Infants manipulated the toys freely during this procedure, and their manipulation served as the dependent measure in our analyses.

If the infant detects the commonality or shared category relation among the objects presented during the familiarization phase, then the infant's attention during this phase will wane. At test, when two objects are presented simultaneously, if the infant notices that one object is a member of the now-familiar category, attention to that object should remain relatively low. In contrast, if the infant notices that one object is from a novel category, then attention to that object should be relatively high. Therefore, if an infant has formed an object category, that infant should reveal a decrease in attention during the familiarization phase, and a preference for the novel object at test.

To test the proposed influence of novel words on object categorization, we randomly assigned infants to one of three conditions, which differed only in the experimenter's comments about the objects presented during the *familiarization phase*. In the No Word condition (control), she said, "See here?" as she introduced the objects; in the Novel Noun condition, she said, "See the *daxin*?"; In the Novel Adjective condition, she said, "See the *dax-ish* one?" In the test phase, infants in all conditions heard precisely the same phrase ("See what I have?").

Familiarization Phase



Test Phase

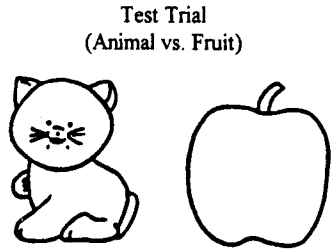


Figure 8.2
Design of experiment fromWaxman and Markow (1995)

If infants begin the process of lexical acquisition with no expectations regarding the extension of object names to object categories, then novel words should exert no influence on categorization: performance in all three conditions should be comparable. However, if novel words direct infants' attention to object categories, then infants who hear novel words in conjunction with the objects presented during familiarization should be more likely than those in the No Word condition to form object categories. Including both a Novel Noun and Novel Adjective condition permits us to test the specificity of this initial expectation. If, as I have proposed, the expectation is general, then infants in both the Noun and Adjective conditions should be more likely to form object categories than should those in the No Word control condition.

The data were entirely consistent with this proposal. Infants hearing novel words were more likely to form object categories than were their age-mates in the No Word control condition. Consider first the results from the *familiarization phase* (figure 8.3). On basic level trials, infants in all three conditions exhibited a significant decrease in attention. On superordinate level trials, the facilitative effect of the novel words became apparent: infants in the Novel Noun and Novel Adjective conditions showed a decrease in attention. Only infants in the No Word condition failed to exhibit such a trend. In the test phase (figure 8.4), the influence of novel words on object categorization was also evident. On basic level trials, infants in both the Novel Noun and Novel Adjective conditions showed reliable preference for the novel object. Infants in the No Word condition showed only a weak novelty preference. At the superordinate level, infants in the Novel Noun condition revealed a clear novelty preference, while those in the Novel Adjective condition revealed a trend in this direction. In contrast, infants in the No Word condition revealed no preference for the novel test object. To amplify these results, which are based on summaries over groups of subjects, we also examined the patterns displayed by each individual subject included in the experiment. We found that this phenomenon held up consistently across subjects.

In a series of subsequent experiments, we have begun to examine the influence of novel words on object categorization in infants as young as 9 months of age (Balaban and Waxman 1996; Waxman and Balaban 1996). In a procedure very much like the one described above, we find

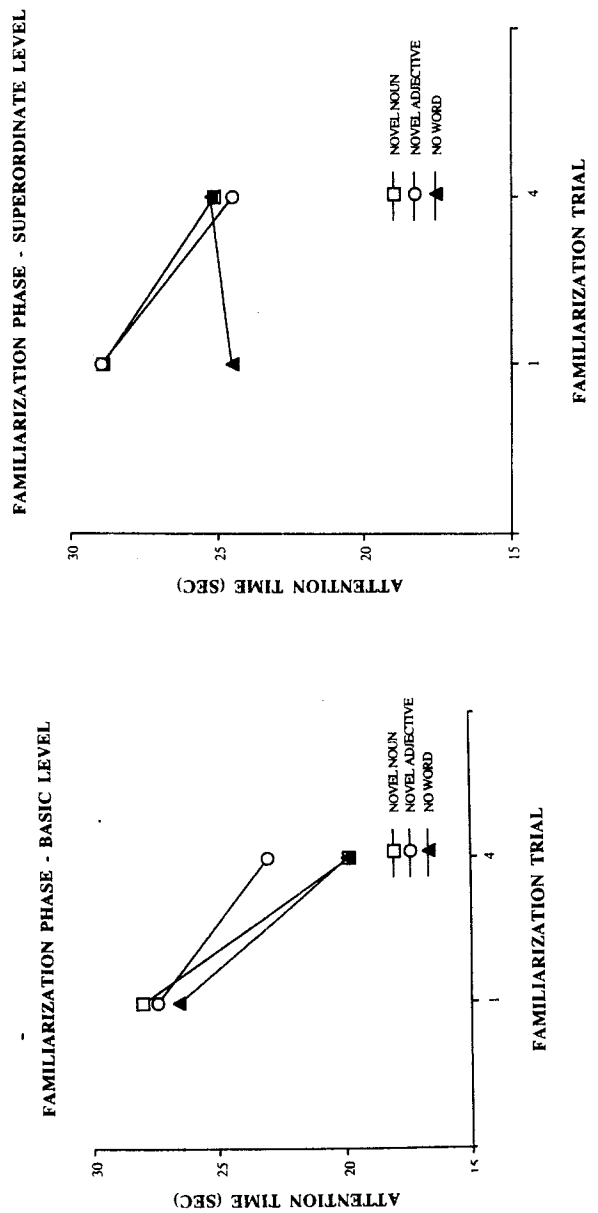


Figure 8.3
Familiarization phase from Waxman and Markow (1995)

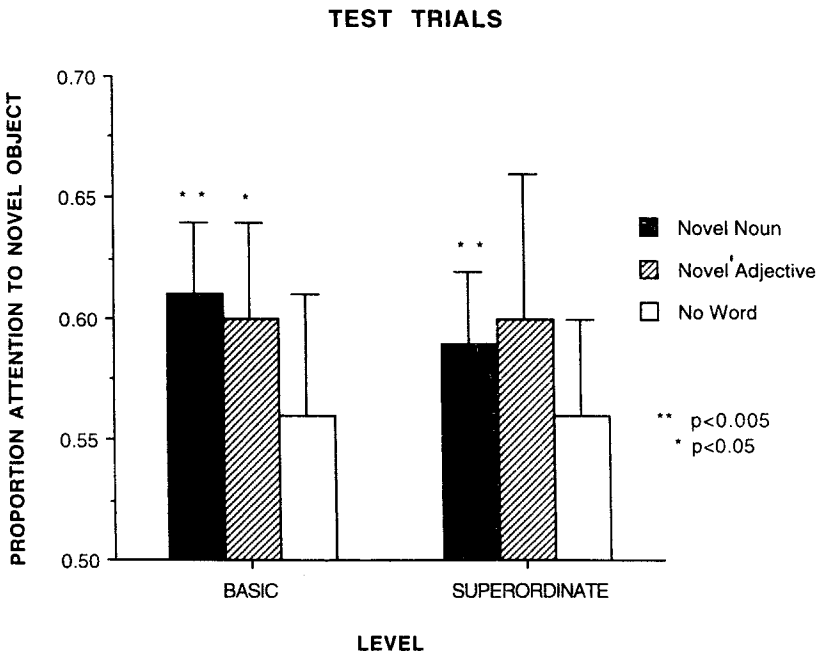


Figure 8.4
Test phase from Waxman and Markow (1995)

that novel nouns facilitate the formation of object categories at the basic and superordinate level, relative to performance in a No Word control condition. And in another series of experiments, using a forced-choice procedure, we have demonstrated that novel nouns focus attention on object categories for infants ranging from 16 to 30 months of age as well (Waxman and Hall 1993; Waxman, Stote and Philippe 1996).

In sum, the data from these experiments reveal that infants on the threshold of producing language harbor a broad, initial expectation that words (presented either as nouns or as adjectives) applied to objects will refer to those individual objects and will be extended to refer to other members of the same category. This developmental pattern illustrates three complementary points.

First, these results are relevant to the question concerning the early acquisition of basic level categories. Recall that at 12 months infants in

all conditions formed basic level categories successfully. That is, novel words did not influence performance at this level. In contrast, novel words exerted a clear facilitative effect on object categorization at the more abstract superordinate levels. This result suggests that object names serve as a catalyst for object categorization, particularly when the perceptual or conceptual support for a category is not as compelling as at the basic level. This is consistent with the prevalent psychological and anthropological notion that basic level categories are especially salient groupings, for infants and adults alike.

Second, these results support the proposal that acquisition is guided by an initial, general expectation on the part of the learner. It is unlikely that this initial expectation could have been learned or induced by the infant on the basis of observations of their existing word-meaning mappings (as suggested by Nelson 1988), for very few such mappings (if any) have been established by 9 months of age. From the outset, then, novel words direct infants' attention to object categories. The power of the dubbing ceremony derives, in large part, from the infants' a priori expectation that novel words, applied to individual objects, will refer to those objects and to other members of the same category. This initial rudimentary linkage between words and object categories serves a crucial function: it guides infants in their earliest efforts to map words to categories of objects, and it sets the stage for the emergence of a more specific set of expectations regarding particular types of words (e.g., nouns, adjectives, verbs) and particular types of conceptual relations (e.g., object categories, object properties, events).

Third, these findings with infants reveal a substantial role for learning and experience. For although infants treat novel words presented as nouns or adjectives identically with respect to object categorization, by two and a half years of age, this pattern changes. Toddlers and preschoolers acquiring English distinguish novel nouns from adjectives, and assign each particular types of meanings (e.g., Taylor and Gelman 1988; Waxman 1990). Clearly, then, between infancy and the preschool years, there is a burgeoning sensitivity to using linguistic form as a cue to word meaning. The more specific expectations linking novel adjectives to their associated meanings appear to emerge later, once the process of lexical acquisition is underway.

Modification of Initial Expectations: Evidence from Toddlers Acquiring English

To begin to understand how the infants' initial broad expectation becomes fine-tuned over the course of development, we have initiated a series of cross-sectional experiments to determine when, and under what circumstances, English-speaking subjects develop the more specific expectation that count nouns, but not adjectives, refer to object categories. I selected a group of 21- and 30-month-olds, suspecting that both their lexical and syntactic advances would permit them to tease apart the distinction between words presented as nouns and adjectives. We predicted that during this developmental period, count nouns would continue to promote object categorization, but that novel adjectives would no longer be expected to serve this function. And we expected that this distinction between novel nouns and adjectives vis-à-vis object categorization would be more apparent with familiar than with unfamiliar objects.

My colleagues and I tested this hypothesis using a forced-choice task in which an experimenter presented subjects with a target object (e.g., a horse) and two alternatives—one from the same object category as the target (e.g., another horse) and other from a contrasting object category (e.g., a bear; Waxman, Stote, and Philippe 1996). Each subject completed this task on eight different sets of objects, four involving categorization at the basic level and four involving categorization at the superordinate level. At each level two sets included familiar objects, and two included unfamiliar objects (for which the children had no existing category name).

We compared toddlers' performance in a Novel Noun, Novel Adjective, and No Word condition. In the Novel Noun condition, the experimenter introduced the target saying, "This one is a *daxin*." She introduced the choices, saying, "Can you find another *daxin*?" In the Novel Adjective condition, she said, "This one is *dakish*. Can you find another *dakish* one?" In the No Word condition, she said, "Look at this one. Can you find another one?"

Our results indicated that the specific expectation that novel nouns (but not adjectives) refer to categories of objects begins to emerge at about 21 months of age in children acquiring English and becomes more entrained with age. At both 21 and 30 months, subjects in the Novel Noun condition were more likely than those in either the Novel Adjective or No Word conditions to consistently select the alternative from the same object category as the target. This provides the earliest documentation to date of infants' emerging ability to distinguish the grammatical category *noun* from *adjective*, and to assign each distinct types of meaning. (See Bowerman 1996a, and Waxman and Markow 1996 for evidence of other related semantic-syntactic distinctions that emerge at this developmental moment.)

In sum, this developmental program of research begins to document the manner in which an initial and general linkage between words and object categories can give way to a more specific set of expectations regarding the particular types of meaning associated with novel words from different syntactic categories in English. These experiments permit us to test the hypothesis that language-specific learning is essential in the modification of the initially broad expectation linking words and object categories. However, to fully understand whether and how these expectations are shaped by the structure of the language under acquisition, it is crucial that we examine children acquiring languages other than English. Therefore my colleagues and I have asked whether the linkages that we have observed in infants and children acquiring English are evident in children acquiring other languages as well.

Constructive Role of Language: Cross-linguistic Evidence from Children Acquiring English, French, or Spanish

If the proposal that I have articulated is correct, then children's expectations regarding count nouns and object categories should be consistent across languages. In contrast, their expectations concerning the types of meaning associated with adjectives should vary as a function of the language under acquisition. To test this proposal, we have compared the influence of novel words presented as nouns or as adjectives on object categorization in young monolingual children acquiring either English, French (from Montreal, Canada) or Spanish (from Buenos Aires, Argentina) as their native language.

Although these three languages are closely related to one another, they provide an interesting set of cross-linguistic comparisons, primarily because of differences in the grammatical use and referential status asso-

ciated with the grammatical category adjective (see Waxman, Senghas et al. 1997 for a more detailed account of this difference and for a more thorough discussion of the cross-linguistic studies). In Spanish, nouns are omitted when the grammatical subject of a sentence is evident from the context. To get a flavor of this phenomenon, consider a scenario in which there are several different baskets lying in a corner of a room. In English, speakers distinguish these linguistically by modifying a noun (or pronoun) with an adjective (e.g., "the *smooth* basket" or "the *smooth* one"). In Spanish, the head noun in the phrase is omitted, leaving the determiner and adjective (e.g., "el *suave*") alone to refer to the intended basket. This results in a determiner-adjective (det + A) construction. In Spanish, det + A constructions are ubiquitous. In fact, if the head noun is not dropped under such circumstances, the sentence is judged to be awkward or ungrammatical by native adult speakers. Det – A constrictions are spontaneously productive in Spanish-speaking children as young as two and a half years of age. Of course, det – A constructions are sometimes permissible in English and, to a somewhat greater degree, in French.[3] However, in both English and French, det – A constructions occur only under restricted sets of circumstances; the this form is not spontaneously productive.

Therefore, in Spanish (more than in English or French), adjectives often appear in a syntactic frame that is identical to that for count nouns. Moreover, in these det + A constructions, adjectives are extended to members of the object categories denoted by a named property. As a result in Spanish there is considerable overlap in the syntactic privileges of occurrence and the extensions associated with count nouns and adjectives applied ostensively to objects.

We suspected that this difference might have consequences for children's interpretations of novel words applied to objects. In particular, we hypothesized that experience with these different native languages would lead to different outcomes in the expectations concerning the range of meanings associated with the grammatical form *adjective*. If this is the case children acquiring French (like those acquiring English) should learn that adjectives do not, as a rule, refer to object kinds. However, children acquiring Spanish should learn to use adjectives in a way that English- and French-speakers do not. In Spanish, where both nouns and adjectives

are permitted to convey information concerning object categories, children may learn that novel adjectives, like nouns, can be extended to refer to objects and categories of objects.

To test these predictions, we designed a five-item forced-choice procedure. We focused exclusively on the influence of introducing novel nouns and novel adjectives on children's tendency to form object categories at the superordinate level. We used essentially the same methodology for children acquiring English, French, and Spanish, but we modified the materials slightly in two ways. First, we selected objects that would be familiar to children growing up in each of the three locales. For example, we found that squirrels were familiar to children growing up in Boston, Chicago, and Montreal but not to those from Buenos Aires. Second, we selected objects that would permit us to assess the role of grammatical gender in French- and Spanish-speakers' performance. Briefly stated, there was no evidence that children's choices were influenced by grammatical gender.

In each experiment a child sat individually with an experimenter to "read" through a picture book that we had created. On each page there were five different pictures, including a target object (e.g., a cow), two objects from the same superordinate category as the target (e.g., a fox and a zebra), and two objects that were thematically related to the target (e.g., a barn and milk). Children participated in one of three conditions, which differed only in the way the experimenter introduced the target object. 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 show me another one that is 'fopish'?" In the No Word (control) condition, the experimenter pointed to the target and said, "See this? Can you find another one?" The child and experimenter went through the book two times. On the second reading, the experimenter reminded the children of their first choices and asked them to select another from the remaining (3) alternatives.

The results of these experiments were consistent with the previously presented proposal. See figure 8.5. Performance in the Novel Noun condition was uniform across all three languages. Children hearing a target labeled with a novel noun revealed a strong inclination to select the

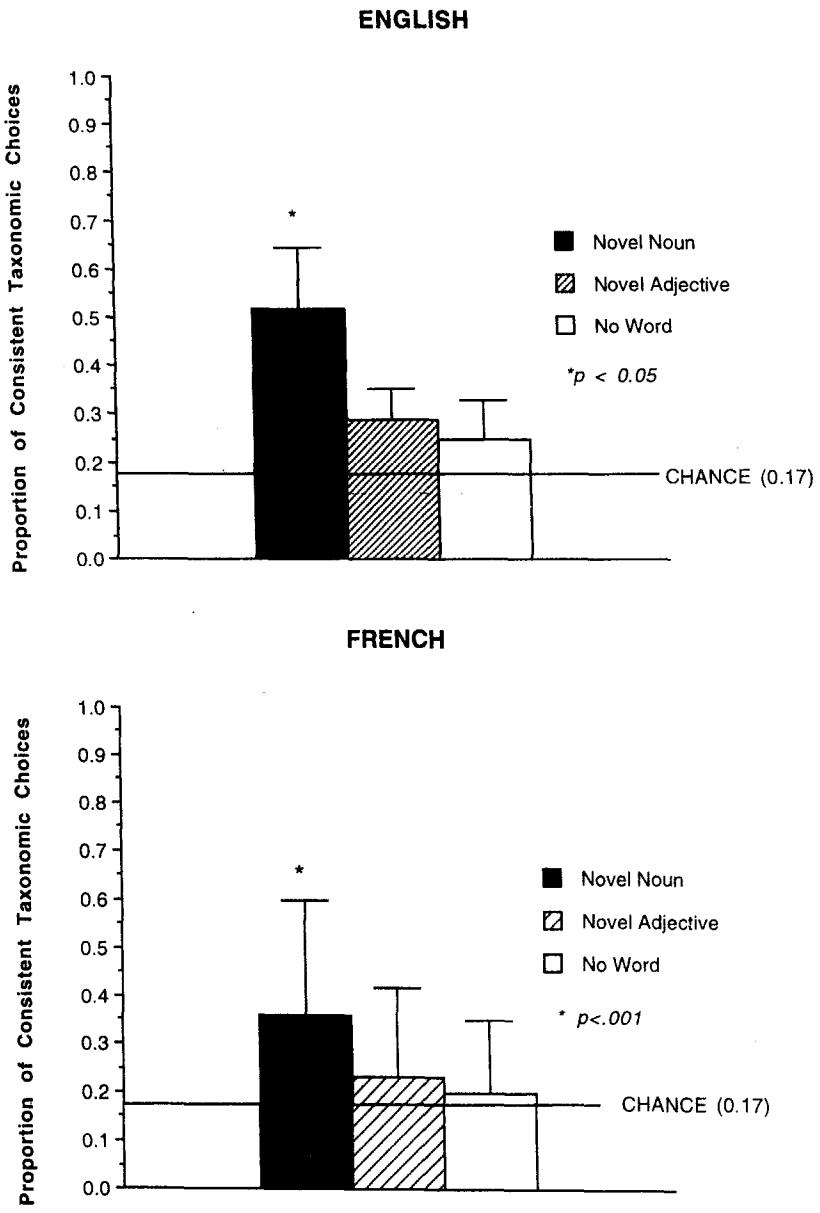


Figure 8.5
Proportion of consistently taxonomic selections is performance in (5a) English, (5b) French, and (5c) Spanish. From Waxman, Senghas, and Benveniste (1996)

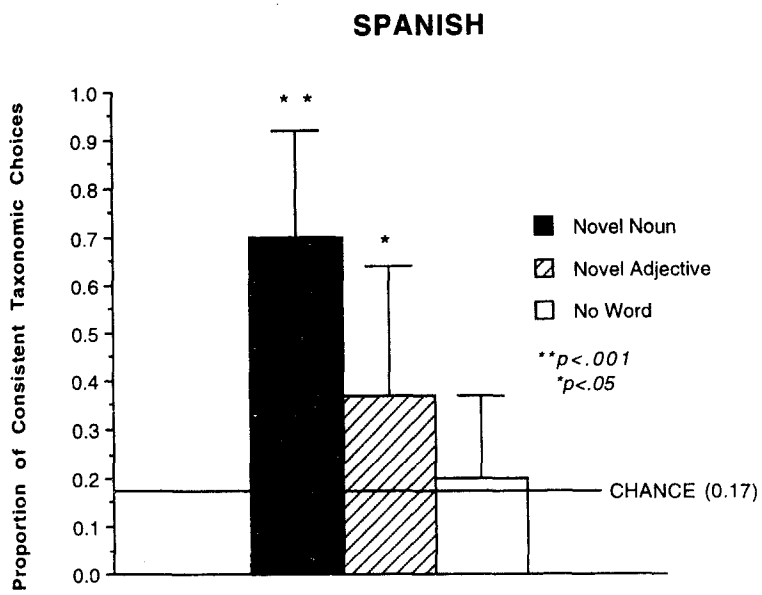


Figure 8.5 (continued)

alternatives that were from the same object category as the target. Performance in the No Word condition was also uniform across languages. Children in this control condition revealed no preference for either the taxonomic or thematic alternatives.

However, performance in the Novel Adjective condition varied systematically as a function of the language under acquisition. Children acquiring French (like those acquiring English) performed at chance in the Novel Adjective condition, revealing no preference for either the taxonomic or thematic alternatives. This indicates that they had learned that adjectives do not, as a rule, refer to object kinds. In contrast, Spanish-speaking children displayed a strong inclination to extend novel adjectives (like a novel nouns) to other members of the same superordinate level object category. This inclination to extend novel adjectives to object categories was apparent whether the novel adjectives were presented within det + A phrases or whether they were presented in conjunction with an overt noun or pronoun. This pattern of performance, which we have now replicated in four different studies, suggests that

Spanish-speaking children have learned that both count nouns and adjectives, applied ostensively to an individual object, can be extended to other members of a superordinate level object category.

Integrating the Developmental and Cross-linguistic Evidence Together, the developmental and cross-linguistic findings support the proposal that (1) early conceptual and language development unfold under the guidance of an initial set of broad constraints or expectations that are inherent in the child, (2) these initial constraints are themselves modified as a result of experience with both the range of objects and the structure of the native language that the infant encounters, and (3) throughout the course of development, there are strong but implicit linkages between object categorization and naming, and these foster the establishment of increasingly sophisticated hierarchical systems of knowledge.

Let us consider each aspect of this proposal in turn. First, our results support the argument that infants begin the process of lexical acquisition with an initially general expectation linking words to objects and categories. The fact this expectation is evident at 9 and 12 months of age reveals that it is available to guide infants in their early efforts to map words to their meanings (Balaban and Waxman 1996; Waxman and Markow 1995; Waxman and Hall 1993). This challenges directly the claim that this linkage is unavailable at the onset of lexical acquisition, that it is learned or constructed as a consequence or by-product of word learning (Bloom et al. 1993; Nelson 1988; Smith 1995). In addition the fact that this expectation is initially general (evident with novel words presented either as nouns or as adjectives) is consistent with developmental work. At 12 months of age, infants have probably not yet identified the relevant surface cues to permit them to distinguish among the particular grammatical categories (e.g., nouns, adjectives) as they are presented in the stream of language. Our results are also consistent with the crosslinguistic fact that languages converge in the mappings between nouns and categories of objects.

In fact it may be to infants' advantage to begin with an initially general expectation—an expectation that will guide them in establishing early word-meaning mappings and that can then be tailored to suit the particular variations encountered in their native language. In other words, this account is flexible enough to accommodate the fact that infants naturally acquire languages that differ among themselves in the ways in which they recruit particular grammatical categories to convey particular types of meaning.

The second aspect of our proposal focused on the manner in which this broad initial expectation would be modified or refined. We argued that the more specific linkages between particular types of words (e.g., nouns, adjectives) and particular types of meaning (e.g., object categories, object properties) would emerge as a function of infants' experience with the particular grammatical distinctions drawn in their language and their familiarity with labels for object kinds. The evidence is consistent with this position. We proposed that the linkage between count nouns and object categories would be uniform across development and across languages. Consistent with this proposal, we discovered that the expectation that a novel word (presented as a count noun and applied to an individual object) will be extended to include that object and other members of its superordinate level kind was evident in French- and Spanish-speaking children, just as it has been evident in English-speaking children (Markman and Hutchinson 1984; Waxman 1990; Waxman and Kosowski 1990) and in infants in an English-speaking environment (Waxman and Balaban 1992; Waxman and Hall 1993; Waxman and Markow 1995). There is consistency across development and across languages in children's expectations concerning the type of meaning associated with novel count nouns.

We also suggested that the more specific mappings between adjectives and their associated meanings would emerge later in development and would vary according to the structure of the native language under acquisition. Consistent with this proposal, we discovered children's expectations concerning the meaning associated with novel adjectives did change over early development (Waxman and Markow 1995; Waxman et al., 1996) and did vary across languages (Waxman et al. 1997). There is variation across development and across languages in children's expectations concerning the range of meanings associated with novel adjectives. Infants' initial expectations are subsequently shaped by the structure of the native language under acquisition and become more entrained with age.

The third aspect of our proposal asserts that throughout the course of development, linkages between object categorization and object naming will foster the establishment of increasingly sophisticated hierarchical systems of knowledge. The ethnobiological evidence suggested that across the world's languages, adults tend to label basic and superordinate level object categories with count nouns, and subordinate level object categories with modifier-noun phrases. The developmental data suggested that infants universally expect that count nouns, applied to individual objects, will refer to that whole object and to other members of the same basic or superordinate level object category. In addition, the developmental data indicate that once a basic level term has been acquired, infants interpret novel adjectives as referring to salient object properties, as opposed to object categories (Waxman and Markow 1996; Waxman et al. 1996). In this way adults' naming practices and infants' implicit expectations converge to support the establishment of rudimentary hierarchical systems.

Taken together, these developmental and crosslinguistic results advance substantially our theories of the acquisition. These results also illustrate the importance of considering carefully the interplay between constraints within the child and input from the language environment.

8.4 Further Considerations

Cognitive Consequences of Naming

I have argued that object naming plays an instrumental and specific role in establishing object categories within a hierarchical or taxonomic system. However, there is another aspect of the relation between object names and categories that I have not addressed directly. This is the notion that deep intuitions—sometimes known as essentialist beliefs—are conferred in the act of naming. Because this is the case, naming promotes not only the formation of an object category but also promotes the inductive potential of that category. Essentialist beliefs appear to be especially strong for natural kind terms (Keil 1989; Kripke 1972; Putnam 1975), particularly those referring to basic level categories (S. Gelman 1988; Waxman et al. 1996).

Words as Invitations to Form Categories These two important consequences of naming—that naming promotes the formation of object categories and that named categories serve as a powerful inductive base—have led me to argue that words serve as invitations to form categories (Waxman and Markow 1995). Words focus infants' attention on commonalities among objects, highlighting these especially in cases where the perceptual or conceptual similarities may not be as apparent as at the basic, or folk-generic, level. At superordinate levels, for example, the presence of a common word for a set of objects invites infants and children to assemble together objects that they might otherwise consider to be rather distinct entities. Naming, then, promotes comparison of objects in the child's mind (Gentner and Waxman 1994; Waxman and Markow 1996). This can have dramatic consequences, inviting the child to notice deeper and more subtle commonalities than those that served as the initial basis of the grouping. In this way, naming may itself help to advance the child beyond perceptible commonalities among objects, pointing them toward a richer appreciation of the deeper, nonperceptible commonalities that characterize human concepts (Gelman 1988; Gelman and Coley 1990; Gelman and Markman 1987; Shipley 1989).

I suspect that even at the basic level, where infants and children readily form object categories (even in the No Word conditions), naming will serve a crucial inductive role. Naming may engender a search for the nonobvious commonalities, and this may contribute to the acquisition of the elaborate information, richly interconnected theories, and inductive depth that are the hallmarks of this preferred level (Gentner and Waxman 1994; Keil 1987; Murphy and Medin 1985).

Words as an Obstacle in Forming Categories The argument that words serve as an invitation to form categories helps to account for the rapid establishment of hierarchical systems and for the inductive strength of the object categories within these systems. At the same time, however, naming may serve as a conservative force with respect to object categorization.

If naming leads to a search for commonalities and coherence among category members, then it may be difficult to change or modify those object categories that have been named. There is some evidence for this

conservative force in naming. Although novel nouns facilitate classification at the superordinate level, they put children at a disadvantage in classification at the subordinate level (Waxman 1990; Waxman, Shipley and Shepperson 1991). Children hearing novel nouns in the context of a classification task were less successful in forming subordinate level categories than were their peers hearing no novel words. Because the novel nouns drew children's attention toward the commonalities among objects at the basic level, they may have made children less likely to attend to the perceptible distinctions among subordinate level categories. From this observation, several points follow.

First, it may be difficult for children to partition an inductively rich named category. In particular, it may be difficult to partition basic level categories and to establish subordinate level categories as a basis for inductive inference. There are several indications that this may be the case. Although preschool-aged children notice the perceptual distinctions among subordinate level categories (e.g., terriers vs. collies; red grapes vs. green grapes; see Waxman 1990; Waxman et al. 1991), these perceptually based groupings do not support induction. Instead, the basic level categories (e.g., dog or grape) tend to serve as the basis for children's inductive inferences. Preschool-aged children require additional conceptual information about the subordinate level distinctions before they can use subordinate level categories as an inductive base (Waxman et al. 1997).

Another example of this conservative force comes from the observation that named categories may be resistant to change. The named categories tree and flower may serve as a case in point. Neither of these categories is actually a bona fide scientific category. But it is hard to convince people—especially people living in urban and suburban communities—that this is the case. For in addition to the perceptible commonalities among members of each of these categories, I suspect that the prevalence of a common name ensures a continued commitment to construing each as a unified grouping in categorization and in induction.

Mistaking the Map for the Territory: Issues of Measurement

At its best, research on folkbiology is a joint enterprise involving anthropology, cognitive and developmental psychology, linguistics, and philosophy. Each of these disciplines shares a commitment to understanding the same phenomenon, each brings a unique perspective to the issues. In addition to our common interests, researchers in these disciplines encounter common obstacles in interpreting the evidence before us. Because our subject matter cannot be observed directly, we must depend on overt behaviors (including e.g., object naming, object categorization, typicality judgments, induction tasks) to draw inferences about the underlying organization of object categories in the human mind. Although our research tools have become increasingly sophisticated and our hypotheses have become increasingly precise, the inferential nature of this joint endeavor remains a challenge.

When, and on what basis, can we credit subjects with an appreciation of a category or concept? This question has generated extensive debate. Generally, our decisions in such matters are based on subjects' overt behavior. For example, when a subject places objects together in a categorization task, or when a subject produces a common name for a group of different objects, we infer that the overt behavior reflects an appreciation of an underlying (covert) category. Notice that this logic applies to studies of infants as well as adults. At this stage in our interdisciplinary enterprise, many different kinds of measurements have been introduced, each of which enriches our approach to the task at hand. However, these various measures are all subject to many of the same critical interpretive problems.

What Constitutes Empirical Evidence for a Category? First, when a subject fails to provide a common response to a given set of objects, this does not in itself warrant the conclusion that the subject fails to represent the category in question. For example, an adult may appreciate the category animal but may fail to provide a common behavioral response to all members of that category. She may produce one overt behavior (e.g., running rapidly, or producing an elevated galvanic skin response) in response to some members (e.g., a leopard and a spider), but not to others (e.g., a cow and a ladybug). Similarly an infant or young child may appreciate the category animal but fail to group them together on some behavioral task. The point here is that failure to provide a common

r sponse does not license the conclusion that the subject (be it an adult or a child) fails to represent the category in question.

Conversely, when a subject succeeds in producing a common response (e.g., uttering a label, producing a physical grouping of objects), this does not constitute evidence that the subject represents the underlying category in question. For example, a subject may produce a common response (rapid running or elevated galvanic skin response) to a leopard and to a city bus that is about to drive away.

Likewise evidence of identical performance (e.g., in object categorization, object naming, induction) within two different individuals or within two different populations (e.g., infants vs. adults in a given culture; Itzaj Maya vs. U.S. adults; bird experts vs. novices) does not constitute evidence that the underlying structure of knowledge is the same in each. For example, although 12-month-olds may be capable of grouping instances of the category animal in precisely the same ways as adults, the underlying knowledge associated with that grouping is surely more elaborate in the adult. And although third graders and biologists may identify some of the same individuals as members of the category bird, the underlying knowledge is surely more detailed in the mind of the biologist.

Covert Categories Scholars from various disciplines have devoted considerable attention to studying the relation between object naming and categorization; most have converged on the idea that these capacities are inextricably linked in humans. Although it is not within the scope of this chapter to discuss this topic fully, it is important to point out some core interdisciplinary ideas that are relevant to issues of acquisition. One key idea that has been articulated within cognitive psychology and anthropology is the notion that performance on naming and categorization tasks provide converging measures of the same underlying conceptual structure (Medin et al. 1997; Rosch et al. 1976; Medin and Waxman 1998). But there is also evidence to suggest that these are not perfectly convergent.

Covert (or unnamed) categories serve as one especially intriguing example. If naming and categorization are perfectly converging measures, then there should be no cognitive difference between those categories that are named and those that remain unnamed. However, some have argued that only named categories have the status of a true category within a given culture (C. Brown 1977; Burling 1964; Hunn 1977). Others (Berlin 1978; Kay 1971; Taylor 1984) have asserted that this criterion is too restrictive, that "... although a name may be an unambiguous indicator of a category, the absence of a name does not necessarily imply the absence of a category" (Berlin 1978, p. 12).

To support this assertion that covert categories are not unrecognized, Berlin garnered additional evidence. For example, he argued that although there are no overt labels denoting the categories plant or animal in Tzeltal, there are other indexes that these categories are part of the conceptual repertoire of people in this Mayan language community. For example, all plants take the classifier *tehk*; all animals take the classifier *koht*. This type of evidence is persuasive, but it is not unimpeachable. There is no compelling reason to assume that a group of objects whose labels take a particular classifier term constitute the same sort of category as do a group of objects that share a common label. Lakoff (1988) provides a fascinating example. In Dyirbal (an aboriginal Australian language) the classifier *balan* accompanies the names referring to women, fire, scorpions, and other dangerous things. The mechanisms linking this diverse set of objects together must be quite different than those underlying taxonomic categories (e.g., plant, animal). As a consequence the argument that objects denoted by a common classifier term have the same conceptual status as those denoted by a common label seems to be a vulnerable one. This is an argument that is certainly worth testing.

Covert categories provide a fascinating example of problems with measurement and inference. Although covert categories have been discussed primarily in the anthropological literature, they have important implications in cognitive and developmental psychology as well. Of particular interest is the fact that early in lexical development, most nonbasic level categories remain unnamed (Anglin 1977; Brown 1957; Mervis and Crisafi 1982; Waxman and Hatch 1992). We have argued that there are many other behavioral indexes (e.g., semantic overextensions, novelty-preference tasks, semantic clustering techniques) that suggest that children's failure to label an object category does not necessarily constitute a failure to appreciate that category. However, it is very much an open

question whether these (as yet) unnamed categories share the same status as labeled categories.

8.5 Conclusions

The recent renewal of interdisciplinary interest in the relation between naming and categorization provides us with exciting opportunities and difficult challenges. The most recent evidence comes from diverse populations; it is gathered using diverse research tools. One challenge is to integrate these diverse findings and to use them as a basis upon which to generate additional theoretical and empirical work. A related challenge is to avoid the more general debates of the past, in favor of articulating more precise hypotheses regarding the relation between language and categorization. The current mandate is not to decide whether language influences categorization or whether categorization influences language. Rather, it is to specify how, when, and under what specific circumstances language and categorization exert their influences in acquisition.

In this chapter, I have focused primarily on the role of specific linguistic forms (e.g., count nouns, adjectives) in the establishment of object categories at specific levels within a taxonomy (e.g., subordinate, basic, superordinate). I have argued that from the onset of acquisition, there are precise and powerful relations linking linguistic and conceptual development and that these support the establishment of hierarchical systems of knowledge. I have asserted that although it has been difficult to formalize our notions of the basic level, categories at this level form the core of object categorization. I have demonstrated that language plays a constructive role, particularly in the acquisition of nonbasic levels, and that count nouns and adjectives support the acquisition of categories at the superordinate and subordinate level, respectively.

The objects that an infant encounters may differ across cultures. There will be tapirs and kinkajous in the rain forest, and squirrels and bluejays in North American backyards. And the names for objects will differ across languages. But the fundamental process of mapping words to their meaning is similar across cultures and languages. Infants systematically and naturally extend words, applied to individual objects, to other members of an object category, and these named categories go on to support inference and induction. From infancy, then, the dubbing ceremony serves as a powerful catalyst in object naming, object categorization and object induction.

Notes

1. I use underlining to refer to an object category and *italics* to refer to the category name.

2. Of course the young word learners' extensions do not always converge precisely with those of the adult community. For example, both over- and underextensions are observed in child language (Merriman 1986; Mervis and Mervis 1982, 1988; Waxman and Senghas 1992). In overextensions, the infant extends a word more widely than in the adult language (e.g., an infant may use the word *doggie* to refer to most furry four-legged creatures); in underextensions, the infant is more restricted than the adult in extension (e.g., an infant may apply the word *doggie* to some instances of the adult category dog but not others). These extensions will be shaped over time as the infants' learn the range or boundaries of a name. Notice, however, that the very fact that infants readily extend words beyond the referents upon which they were taught is important, for to accomplish this task, infants must use some sense of the word's meaning or its intension.

3. I am excluding for present discussion, phrases that are interpretable with an elliptical context as well as those that become acceptable only when they are produced with contrastive stress. See Waxman et al. (1996) for a more thorough discussion.

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