

The development of an appreciation of specific linkages between linguistic and conceptual organization*

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Evidence from infants and toddlers, and from preschool children learning either English, French, or Spanish as their first language are summarized to reveal the emergence of specific linkages between linguistic and conceptual development. The data suggest that infants begin the process of word learning with a general expectation that words (independent of the linguistic form) refer to objects and object categories. This initial, rudimentary linkage gives way to more specific pairings between particular linguistic forms (e.g., nouns vs. adjectives) and particular types of meaning (e.g., object categories vs. properties of objects). These more specific linkages may depend upon language experience.

'When I make a word do a lot of work like that, I always pay it extra'
(Lewis Carroll 1895)

1. Introduction

Humans are uniquely endowed with the capacity to build complex, flexible, and creative *linguistic* and *conceptual* systems. Infants' and toddlers' remarkable achievements in each of these arenas have engaged researchers for decades. Yet in recent years, it is the relation between linguistic and conceptual development that has come to occupy center stage. Some of the most exciting current work has been designed to explore the relation between early linguistic and conceptual development in the young child's acquisition of the lexicon.

This new, integrative approach has brought into sharp focus a fascinating puzzle. We know that infants acquire their native language naturally at a

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remarkable pace (Carey 1978, Dromi 1987, Gopnik and Meltzoff 1987, Nelson 1983). We also know that even before learning the words to express them, infants appreciate many different kinds of conceptual relations among objects, including category relations, thematic relations, causal relations, and event-related or associative groupings (Bornstein 1984, Leslie and Keeble 1987, Mandler et al. 1987, Younger and Cohen 1986). These early linguistic and conceptual achievements set the stage for what has been described as 'the inductive problem of word learning' (Goodman 1983, Quine 1960, Carey 1990). The problem is that, in principle, the richness and flexibility of infants' conceptual abilities should complicate the task of mapping new words to their meanings.

To understand why this is the case, consider a typical word learning scenario, in which an adult introduces a child to a novel object (say, a flamingo) and offers a novel label ('a flamingo'). Let us assume that both the child and adult are focusing attention on the same object or scene (Baldwin and Markman 1989, Tomasello 1988). If children have the conceptual ability to appreciate so many different kinds of relations involving that object, and if each of these is a potential candidate for the new word's meaning, then how do infants select from among these many possible meanings when determining what the new word is intended to convey? How do infants so rapidly learn that a given word (e.g., *flamingo*) may apply to a particular whole object and may be extended to other members of that object category (e.g., other flamingos), but not to salient properties of the object (e.g., its long neck or unusual color), to salient actions in which it is engaged (e.g., feeding its young), or to salient thematic relations (e.g., a flamingo and sand)? If children had to rule out these and countless other logically possible candidate meanings, word learning would be a formidable task indeed.

1.1. Solving the inductive problem

Yet despite the logical difficulty of the task, young children rapidly and successfully map novel words and meanings. This observation has led several researchers, working from several different paradigms, to suggest that children come to the task of word learning equipped with certain implicit biases or expectations which lead them to favor some types of conceptual relations over others when ascribing meaning to a new word (Chomsky 1986, Landau and Gleitman 1985, Pinker 1984, Markman 1989, Waxman 1990, 1991). The claim is that these expectations reduce the logical difficulty of word learning

by narrowing the range of candidate meanings a child will consider for any given new word.

Several such implicit biases have been proposed. For example, research in several different laboratories has converged on the finding that children expect that the *first* word applied to a novel object will refer to the whole object and other members of its basic-level kind, rather than to its parts or other salient aspects (Markman and Wachtel 1988, Taylor and Gelman 1988, Hall et al. 1993, Markman 1989). Further evidence reveals that children, like adults, expect that different words will contrast in meaning (Clark 1987, Golinkoff et al. 1992, Markman 1984, 1989; Merriman and Bowman 1989, Waxman and Senghas 1992).

A third type of bias or predisposition will serve as the focal point of this article. There is now considerable evidence that children use the grammatical form of a novel word (e.g., count noun, proper noun, adjective) as a guide to determining its meaning (Brown 1957, Katz et al. 1974, Landau and Gleitman 1985, Naigles 1990, Gleitman et al. 1987, Hall and Waxman 1993). For example, by two to three years of age, English-speaking children expect objects and object categories (e.g., flamingos, birds, animals) to be marked by count nouns (Markman and Hutchinson 1984, Waxman and Gelman 1986, Waxman and Kosowski 1990, Waxman and Hall 1993); they expect substances (e.g., wood; gel) to be marked by mass nouns (Dickinson 1988, Soja et al. 1991); and they expect object properties (e.g., size, color) to be marked by modifiers (Gelman and Markman 1985, Hall et al. 1993, Taylor and Gelman 1988, Waxman 1990).

Notice that any linkage between grammatical form class and meaning requires that the word learner has (a) the *linguistic* capacity to distinguish among the relevant syntactic categories (e.g., count noun vs. mass noun vs. adjective) in her language, and (b) the *conceptual* or *perceptual* ability to appreciate the various kinds of relations among objects.

In sum, recent work has established that young children appreciate linkages between *particular* types of words (e.g., count nouns vs., adjectives) and *particular* types of conceptual relations. These linkages help to explain how children so rapidly map novel words appropriately to their meanings. For, although children appreciate myriad kinds of conceptual relations, only some of these relations become lexicalized. Children do not sample randomly among these many possible relations when determining the meaning of a new word. Instead, particular kinds of conceptual relations are favored in the context of learning particular kinds of words.

1.2. Overview of the article

In this article, I take as a starting point the general hypothesis that (a) young children are sensitive to precise relations linking linguistic with conceptual development, and that (b) these linkages promote rapid lexical acquisition and foster the establishment of powerful systems of conceptual organization. I begin by reviewing the evidence in support of this position with preschool-aged children, focusing primarily on the role of linguistic information (e.g., count nouns vs. adjectives) in the young child's ability to form categories of object kinds at various hierarchical levels (e.g. flamingo, bird, animal). See figure 1.

Next, I turn to theoretical questions concerning the origin or developmental status of these linkages between word learning and conceptual organization, asking *how* and *when* they emerge in the developing child. This discussion highlights some limitations in the existing literature and underscores the importance of two distinct, but complementary research approaches.

First, because so much of the existing literature is devoted to primarily preschool children who have already made significant linguistic advances, we are left with a very limited understanding of how the child acquires these important linkages early in development. Therefore, the goal of the first approach is to chart the emergence of these links in preverbal infants and in toddlers by examining the influence of language on their categorization abilities.

Second, because the existing research has been based almost exclusively on English-speaking subjects, it is unclear whether these linkages are universal features of human development or specific to English. Therefore, the goal of the second approach is to seek evidence for these linkages in children learning languages other than English.

Although these developmental and cross-linguistic research programs are still very much in progress, our initial results converge to suggest that the linkage between count nouns and object categories is evident even at the onset of language acquisition and may be a universal phenomenon. In contrast, the data suggest a very different development course for the linkage between adjectives and properties of objects. This linkage appears to emerge later in development and to vary across languages.

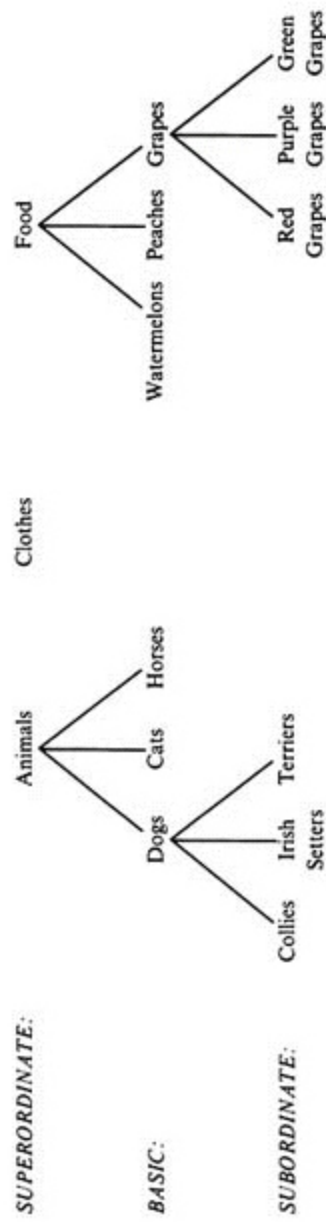


Fig. 1

2. Describing the phenomenon: The influence of linguistic form class information on object categorization in preschool children

An essential task in early development is to form categories that capture the commonalities among objects and to learn words that describe these categories. A considerable amount of scholarly attention has been devoted to examining the establishment of categories within hierarchical systems of organization. Hierarchical systems are exceptional for their efficiency in organizing existing information and for their power in generating new information; it therefore stands to reason that developmentalists would seek to understand when such systems are available to the young child.

Empirical work with both adults and children has singled out one particular hierarchical level — referred to as the basic level — as being most salient psychologically (Rosch et al. 1976). The basic level, which occupies a mid-level position within a hierarchy, has been shown to have a privileged status on a range of psychological tasks. (See Rosch et al. 1976 for details.) Although it has been difficult to account formally for this privileged psychological status, the construct of a basic level has proven useful as a summary description or heuristic in research with adults and children alike (cf., Gleitman et al. 1987). Although Mandler and her colleagues have argued against this position in favor of the view that infants initially conceptualize objects at a level more abstract than the basic level (Mandler 1988, Mandler and Bauer 1988, Mandler et al. 1991), the weight of the evidence overwhelmingly favors the developmental primacy of the basic level.

For example, one of the most robust findings in the developmental literature is that preschool children succeed in classifying and labeling objects at the *basic* level long before they do so at other hierarchical levels (Anglin 1977, Brown 1958, Mervis 1987, Mervis and Crisafi 1982, Rosch et al. 1976). However, because the inductive and organizational power of hierarchical systems derives from relations among categories at various levels of abstraction, developmentalists have also been concerned with children's acquisition of categories beyond the basic level. Although preschool children have considerable difficulty forming superordinate and subordinate level categories under most circumstances, their performance improves dramatically when they are introduced to novel words in the context of categorization tasks. Indeed, it is at the non-basic levels that the interplay between word learning and conceptual organization has become especially evident. To observe this interplay, we have compared children's ability to form object categories at various hierarchical levels with, and without, novel labels.

In an early study, we examined the impact of introducing novel nouns in a superordinate level categorization task (Waxman and Gelman 1986). The experimenter introduced preschool children to three 'very picky' puppets and then displayed three typical members (e.g., a dog, a horse, a cat) of a superordinate category (e.g., animal) to indicate the type of thing each puppet would like. She then asked children to sort additional items for each puppet.

Children in the *Instance* condition, who sorted the additional pictures (various members of the classes animals, clothing, and food) with no further instructions, performed only slightly better than would be expected by chance. This is consistent with traditional reports that children have difficulty establishing superordinate relations (Inhelder and Piaget 1964, Rosch et al. 1976). In contrast, children in the *Novel Label* condition, who encountered the same typical instances, but were also introduced to a novel Japanese label for each superordinate class (e.g., 'These are the *dobutsus*, these are the *gohans*) formed superordinate classes very successfully. Simply introducing them to novel labels led these children to classify as successfully as other children who had been given familiar English superordinate labels for the classes (e.g., 'These are animals, these are clothes'). Clearly, *novel* count nouns effectively oriented preschool children toward object categories and licensed the induction of superordinate level categories. Data from Markman and Hutchinson. (1984) have revealed that count nouns also highlight basic level object categories for 3- and 4-year-old children.

This result has linked one particular linguistic form class — count nouns — to object categories at the basic and superordinate levels. This intriguing finding raised two important questions, both of which concern the specificity of the linkage: First, do novel count nouns draw attention to object categories at all hierarchical levels, or is this effect specific to the basic and superordinate levels? Second, are object categories highlighted in the context of word learning in general, or is this focus specific to learning novel nouns?

To address these questions, I systematically compared the effect of introducing either novel nouns or novel adjectives in a multiple-level classification task (Waxman 1990). Each child in this study classified pictures of objects from three contrastive classes at three different hierarchical levels (subordinate, basic and superordinate) within the two different natural object hierarchies (animals and food) depicted in figure 1. As in Waxman and Gelman (1986), the experimenter introduced three 'very picky' puppets and revealed three typical members of each class to indicate the type of thing each puppet would like. Children in the *No Word* condition sorted with no further clues. Children in the *Novel Noun* condition were introduced to a novel noun in

conjunction with the photographs from each class (e.g., 'These are the *akas*; these are the *dobus*'). Children in the *Novel Adjective* condition also heard novel words, but the words were presented within an adjectival syntactic context (e.g., 'These are the *ak-ish* ones, these are the ones that are *dob-ish*').

The children in this experiment were very sensitive to the linguistic context in which the novel words were introduced. Novel nouns facilitated object categorization at the superordinate, but not the subordinate level.¹ In the *Novel Adjective* condition, this pattern was completely reversed. Unlike nouns, novel adjectives supported the formation of subordinate level object categories, but exerted no demonstrable effect at either the basic or superordinate levels. Thus, each of these different linguistic forms facilitated object categorization at particular hierarchical levels.

An interesting parallel to this phenomenon in children has been documented across a wide variety of adult languages, both spoken and signed. According to ethnobiological data, count nouns typically mark objects and object categories at the basic and superordinate levels while adjectives tend to mark subordinate level distinctions (Berlin et al. 1973, Newport and Bellugi 1978). Although these correlations between linguistic form and object categories at particular hierarchical levels are not perfect, they do suggest that a relation between naming and object categorization may exist throughout the lifespan. (See Waxman, 1991, for a more thorough discussion of this literature and its relevance to acquisition.)

The developmental finding that novel nouns and adjectives each produced systematic, but distinct, patterns of results at distinct hierarchical levels reveals that three-year-olds are not only sensitive to the distinctions between these two linguistic forms, but also consider linguistic form as relevant to establishing meaning. This important finding constitutes strong support for the hypothesis that by three years of age, children appreciate powerful and precise linkages between word learning and conceptual organization.

Notice, however, that the data from preschool-aged children cannot address crucial questions concerning the development of these linkages in infants and toddlers. (See Nelson, 1988, for an extended discussion of this point.) Neither does the existing evidence address questions concerning the universality of such linkages across languages. These questions become

¹ In fact, although novel nouns facilitated classification at the superordinate level, they made classification at the subordinate level more difficult. Children in the *Novel Noun* condition classified less successfully at the subordinate level than did their age-mates in the *No Word* condition. This very interesting result has spurred a whole independent line of research (see Waxman et al. 1991) which suggests that children's interpretations of novel words are mediated by their existing lexical and conceptual information.

especially engaging when they are considered in light of the normative pattern; also see Gopnik and Choi, 1990, for a suggestion that this pattern may not obtain in the acquisition of Korean.) The milestones of early lexical acquisition have been well-documented. Infants typically produce their first words at approximately 12 months of age and continue to add new words to their productive vocabularies at a gradual pace. However, at approximately 17–20 months, both the pace and character of lexical acquisition changes dramatically. Infants exhibit a sudden burst in vocabulary development (Benedict 1979, Carey and Bartlett 1978, Goldfield and Reznick 1990). Because most of the words acquired at this period and at this pace are basic level count nouns (Dromi 1987, McShane 1980, Gentner 1982), this period has been dubbed the naming explosion. The naming explosion draws to a close as infants begin to produce combinatorial speech, typically around their second birthdays.

Clearly, any thorough account of the early development of an appreciation of linkages between word learning and conceptual organization must be compatible with these milestones in lexical development. Bearing this in mind, three broad alternative accounts concerning the development of this appreciation warrant consideration.

3. Three alternative accounts of the development of an appreciation of linkages between linguistic form and conceptual organization

The first alternative account posits that these linkages are learned entirely on the basis of infants' experience with human language. On this account, infants embark upon the process of lexical development with no a priori expectations concerning linkages between word meaning and conceptual organization. Instead, they learn their first words in an unconstrained fashion, slowly establishing the mappings between words and their meanings. Later, once they have made a sufficient number of word-to-meaning mappings, infants may come to notice a correlation between particular linguistic forms (e.g., nouns, adjectives) and particular types of meaning (e.g., object categories, object properties). They may then exploit this correlation in future word learning (see Nelson, 1988, for a fuller discussion of this account).

This first account is plausible because prior to the naming explosion, lexical acquisition is indeed comparatively slow; later, perhaps once infants come to notice the linkages between form and meaning, their rate of acquisition increases exponentially. It is possible that it is only at the onset of the naming explosion that infants have accumulated enough word-to-meaning mappings

to make the appropriate induction regarding the relation between linguistic form and meaning. If this account is correct, then infants who have yet to commence the naming explosion should evidence no labeling effects. Instead, novel words should influence object categorization for infants only after the onset of the naming explosion.

The second account posits that the specific linkages that we have observed in preschool children are available even at the very onset of lexical acquisition. This alternative requires that preverbal infants expect (a) that there are distinct linguistic forms and (b) that these distinctions are relevant to establishing meaning (c.f., Pinker 1984, Grimshaw 1981). If this account is correct, then novel words should influence preverbal infants in just the same way as they influence older infants and preschool children. That is, even infants who have yet to commence the naming explosion should expect that object categories will be marked by count nouns and that object properties will be marked by modifiers.

The third alternative account strikes a balance between those outlined above. On this account, infants begin the process of lexical acquisition equipped with a general rudimentary expectation that will become further refined over development and with experience with the particular language to which they are exposed. On this account, infants will interpret words (independent of their linguistic form) as referring to objects and object categories. This alternative is plausible because prior to about two years of age, infants do not yet distinguish among linguistic form classes in their language production or comprehension (Bloom 1990, Gordon 1985, McPherson 1991, Prasada 1993, Valian 1986). Later, at around 2 years of age, when infants do begin to distinguish among the linguistic forms, so do they discover the finer correlations made in their native language between particular linguistic forms and meaning.

There are actually two variants of this account. One possibility is that infants begin with an abstract expectation that particular linguistic forms will mark particular kinds of conceptual relations; however, because they have not yet learned how these linguistic distinctions are marked in their own language, they (mistakenly) interpret adjectives as they do nouns. Another possibility is that infants begin with an expectation that words in general will mark object kinds; they only later learn that this linkage is true for count nouns, but not for other grammatical categories (e.g., adjectives).

These two variants are quite difficult to disentangle empirically. For in either case, the patterns of performance should be the same: prior to the onset of the naming explosion, infants should interpret all novel words, independent of their linguistic form, as referring to objects and object

categories. This pattern would suggest that infants embark upon the process of lexical acquisition with a rudimentary linkage between words and object categories that will become increasingly specific as a function of their experience with the particular syntactic distinctions drawn in their language.

To adjudicate among these broad alternative accounts, I have initiated a detailed examination of the influence of words of various linguistic forms on infants' and toddler's object categorization. I have also begun to examine young children learning languages other than English.

To foreshadow, the results of these two complementary sets of experiments converge to provide initial support for the third alternative account. Infants at 12 months begin the process of lexical acquisition with a general expectation that words (independent of their linguistic form class) will refer to objects and object categories. This initial, rudimentary linkage becomes increasingly specific in the second year of life, perhaps as a function of their own language experience.

4. Early development of linkages in toddlers and in preverbal infants

The overarching goal of this series of studies is to elucidate the manner in which the linkages between word learning and conceptual organization unfold in infants and toddlers. The studies are designed to go beyond the well-established finding that infants and toddlers form object categories. Instead, each study is designed to ascertain whether and how the introduction of novel words from different linguistic form classes influences their object categorization.

Before describing the studies themselves, one important issue bears mention. It is clear that the distinctive intonational contours characteristic of 'motherese' are especially effective in arousing and sustaining infants' attention (Fernald 1992). Several previous studies have explored the influence of labels on infants' attention to objects by comparing performance in a *label* condition with performance in a *silent* condition (e.g., Baldwin and Markman 1989). However, in such designs, it is unclear whether the effect observed in a label condition is due to labels, per se, or to infant-directed human language, in general. Therefore, we use the motherese register to capture the attention of infants in all conditions. Even subjects in a *No Word* condition are introduced to the objects (or pictures of objects) with infant-directed speech. Then, against this 'baseline', we examine the effect of introducing words from various linguistic form classes. In this way, we are able to determine whether

our effects are attributable to the introduction of labels, per se, or to the arousing effects of motherese in general.

4.1. Evidence from toddlers: Forced choice procedures

Two-year-old children are at an important developmental crossroad. They have just completed the naming explosion and have entered a phase of rapid syntactic and semantic development. To examine the influence of linguistic form class on object categorization during this very active period of development, we compared 2-, 3- and 4-year-olds' performance in a match-to-sample task. Children read through a picture book with an experimenter. On each page, there were 5 pictures: a target (e.g., a cow), two taxonomic alternatives (objects from the same superordinate class as the target, e.g., a fox and a zebra), and two thematic alternatives (objects that were thematically related to the target, e.g., a barn and milk) (Waxman and Kosowski 1990).

Children participated in one of three conditions. In the *No Word* condition, the experimenter pointed to the target and said, 'See this? Can you find another one?' 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 *fop-ish* one? Can you find another one that is *fop-ish*?' The child and experimenter read 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. In this way, we were able to examine the conditions under which children make consistently taxonomic choices.

We reasoned that if children are sensitive to a specific link between nouns and superordinate relations, then children in the *Novel Noun* condition should be more likely than children in the *Novel Adjective* and *No Word* conditions to select the superordinate category members on a page, and not the thematic alternatives. The results with the 3- and 4-year-olds supported this prediction entirely. Only in the *Novel Noun* condition did children consistently select taxonomic alternatives. In both the *Novel Adjective* and *No Word* conditions, children performed at chance. Thus, superordinate relations gained priority *only* in the context of novel nouns, not in the context of word learning in general. Moreover, the effect of the novel noun was powerful enough to guide both a first and second set of choices, even in the presence of a clear thematic alternative.

Two-year-olds' performance was very similar to that of the older preschoolers. Two-year-olds in the *Novel Noun* condition were more likely than

those in the *Novel Adjective* and *No Word* conditions to select superordinate category members. However, when comparing performance in each condition to chance, one slight developmental difference emerged: 2-year-olds in the *Novel Noun* condition selected taxonomic alternatives more often than would be expected by chance; those in the *No Word* condition selected taxonomic alternatives less often than would be expected by chance; those in the *Novel Adjective* condition were intermediate. As predicted, 2-year-olds in this condition selected taxonomic alternatives less often than did children in the *Novel Noun* condition; however their mean rate of taxonomic selections was greater than would be predicted by chance.

This difference in the 2-year-olds' interpretation of novel adjectives, though it is a slim one, provides an important clue into the development of an appreciation of linkages between word learning and conceptual relations. Although the linkage between nouns and object categories is clearly evident by two years of age, toddlers at this age also revealed some inclination to interpret adjectives in a similar fashion. This suggests that 2-year-old children may overextend the linkage between count nouns and object categories to include new words from other linguistic form classes. This possibility is consistent with the hypothesis that infants embark upon the task of word learning with an assumption that words (not specifically nouns) highlight object categories. If this is the case, then the tendency to interpret adjectives, like nouns, as referring to object categories should be even more pronounced in younger subjects.

4.2. Evidence from infants: Novelty-preference procedures

With this question in mind, we designed a procedure to examine the impact of novel words on object categorization in 12- and 13-month-old infants (Markow and Waxman 1992, 1993). Infants at this age are acutely interested in human language, but produce very little, if any, of their own. To accommodate the very active nature of the infants, we developed an object manipulation task, analogous to standard novelty-preference procedures (see also Ruff 1986, Ross 1980, Oakes et al. 1991).

In the *familiarization phase*, the experimenter offered the child four toys from a given category (e.g., four different animals) one at a time, in random order, for 30 secs each. This was immediately followed by the *test phase* in which the experimenter presented both (a) a new member of the familiar category (e.g., another animal) and (b) an object from a novel contrasting category (e.g., a fruit). In both phases, infants manipulated the objects freely. Each infant

completed this procedure four times, with four different sets of objects: 2 basic level sets (cows vs. horses; cars vs. planes) and 2 superordinate level sets (animals vs. vehicles; tools vs. animals).

Infants were assigned to one of three conditions, which differed only in the experimenter's comments during the Familiarization phase. See figure 2. In the *Novel Noun* condition, the experimenter labeled objects during the *familiarization phase* (e.g., 'See the *auto*'). In the *Novel Adjective* condition, she introduced the novel word in an adjectival context (e.g., 'See the *aut-ish one*'). In the *No Word* condition, she drew attention to each object but offered no label (e.g., 'See this'). The *test phase* was identical for infants in all three conditions. The experimenter introduced the test pair (e.g., cow vs. horse), saying, 'See what I have'. No object labels were introduced in the test phase.

Because infants at the age do not yet distinguish among linguistic form classes such as *noun* and *adjective* in their own language production or comprehension (Bloom 1990, Gordon 1985, McPherson 1991, Prasada 1993, Valian 1986), it is unlikely that they would consider linguistic form as relevant to establishing meaning. We therefore hypothesized that for infants at this developmental moment, object categories would be highlighted in word learning in general, not by nouns in particular. We predicted that infants in both the *Novel Noun* and *Novel Adjective* conditions would categorize more readily than would infants in the *No Word* condition. More specifically, we predicted that infants hearing novel words (be they nouns or adjectives) would show (1) a greater decrease in attention to the objects over the familiarization phase, and (2) a stronger preference for the novel object in the test phase than should infants in the *No Word* condition.

The results of the experiment were consistent with these predictions. Consider first the data from the familiarization phase, depicted in figure 3. We calculated individual contrast scores to test the prediction that infants would show a linear decrease in attention across the four familiarization trials. At the basic level (figure 3a), infants in all three conditions showed this linear trend. This is consistent with arguments concerning the primacy of the basic level. However, on the superordinate level trials (figure 3b), only infants hearing novel words (in the *Novel Noun* and *Novel Adjective* conditions) showed a decrease in attention.

During the test trials, the effects of novel nouns and adjectives were also quite comparable. Figure 4 displays the proportion of attention the infants devoted to the novel test object. At the basic level, infants in both the *Novel Noun* and *Novel Adjective* conditions showed a reliable novelty preference; those in the *No Word* condition showed no such preference. At the superordinate

Familiarization Phase

Familiarization Trial 1
(Animal vs. Fruit)



NOUN: "See the fauna?"
ADJECTIVE: "See the faunish one?"
NO WORD: "See here?"

Familiarization Trial 2
(Animal vs. Fruit)



NOUN: "See the fauna?"
ADJECTIVE: "See the faunish one?"
NO WORD: "See here?"

Familiarization Trial 3
(Animal vs. Fruit)



"See what I have?"

Familiarization Trial 4
(Animal vs. Fruit)



NOUN: "See the fauna?"
ADJECTIVE: "See the faunish one?"
NO WORD: "See here?"

Test Phase

Test Trial
(Animal vs. Fruit)



"See what I have?"

Fig. 2.

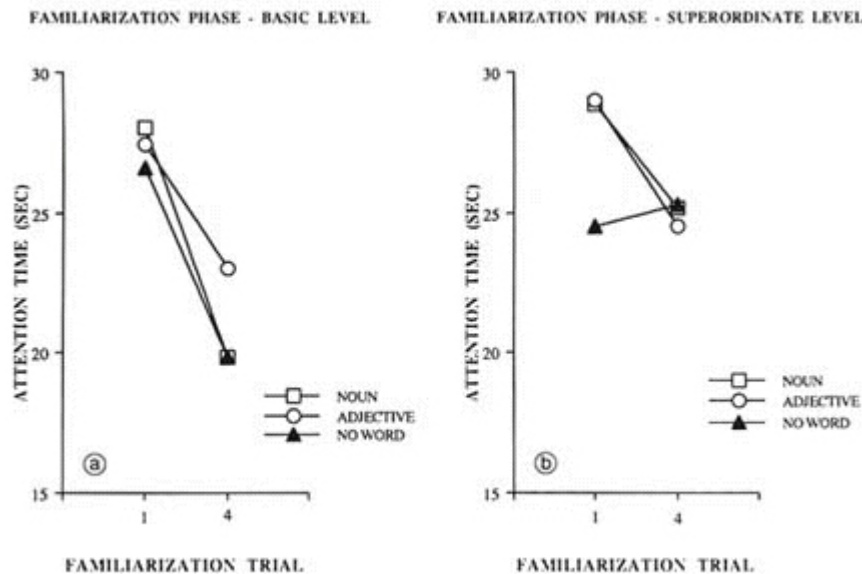


Fig. 3.

level, only infants in the *Novel Noun* condition showed this preference.

These are very striking results, for they reveal a nascent appreciation of a linkage between words and object categories in infants who have yet to commence the naming explosion. This finding weakens considerably the first alternative account — that prior to the naming explosion, infants fail to appreciate any linkages between word learning and conceptual organization. Clearly, novel words do focus infants' attention on object categories. These results also weaken the second alternative account — that infants embark upon the process of word learning with a fully developed appreciation of the specific linkages between types of words (e.g., nouns and adjectives) and types of meaning. Instead, these data support the third view — that 12- and 13-month-old infants begin the process of word learning with a general expectation that words, be they nouns or adjectives, will refer to object categories.

How do the pieces of evidence from the infants fit together with the data from the 2-year-olds? Together, the data suggest that from the earliest stages of lexical acquisition, count nouns focus infants' attention on object categories. Indeed, we have also obtained converging evidence on this point with 16- and 20-month-old subjects, using an entirely different method (Waxman

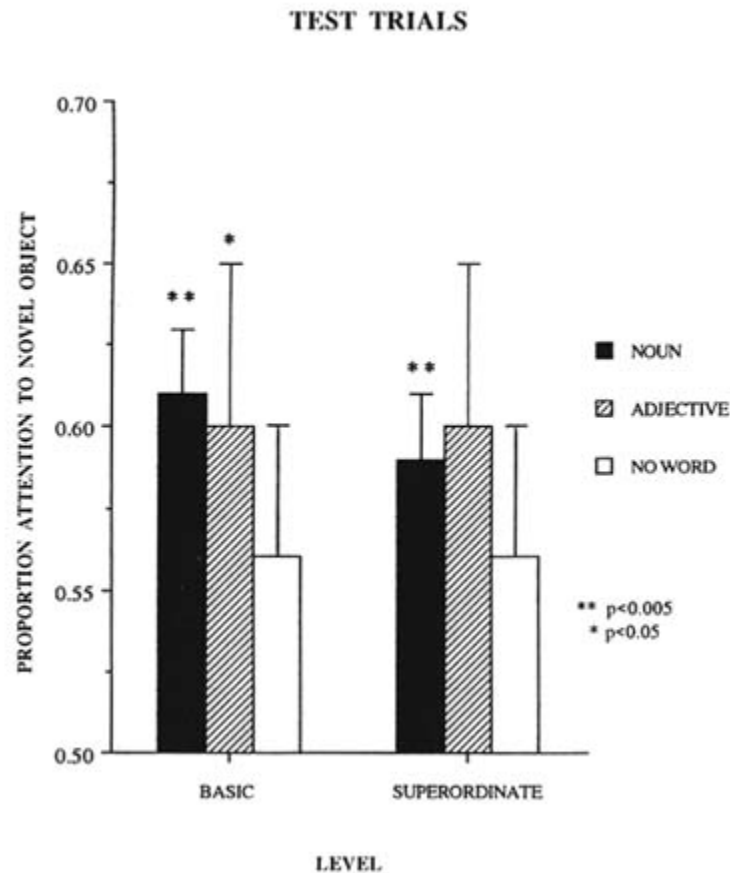


Fig. 4.

and Hall 1993). However, initially, this focus is not specific to count nouns. At 12 and 13 months, both nouns and adjectives focus infants' attention on object categories. The infants' ability to distinguish between linguistic form classes and to use these distinctions as a guide to establishing word meaning must undergo important developmental change during the second year. By the time they are approximately two years of age, infants begin to tease apart the syntactic form classes; by two and a half years, we begin to get evidence that they treat nouns and adjectives differently with respect to object categorization (Waxman and Kosowski 1990, Taylor and Gelman 1988).

Put differently, the data suggest that the affinity between count nouns and object categories is evident even in preverbal infants, but the specificity of this

affinity increases over development. This pattern fits nicely with some anecdotal evidence concerning early word learning. One interesting observation has been made by several researchers: Prior to the naming explosion, infants seem to interpret most words, independent of syntactic form, as referring to objects and categories of objects. This is illustrated by the oft-cited anecdote regarding infants' initial interpretation of adjectives like *hot*. In the earliest stages of lexical acquisition, when children hear, 'Don't touch that. It's hot', they often interpret *hot* as referring to an object (e.g. a stove), rather than to a salient property of that object. Indeed, all of the data documenting that children use syntactic form to affix meaning to a new word comes from children who have at least embarked upon the naming explosion (Hall 1992, Hall et al. 1993, Katz et al. 1974, Markman and Wachtel 1988, Soja et al. 1991, Waxman 1990, Waxman and Kosowski 1990).

Based on the data reviewed thus far, I have suggested that the appreciation of a linkage between count nouns and object categories undergoes no developmental change: it appears to emerge early, requiring little, if any, experience with the language. In contrast, an appreciation of specific linkage between other grammatical categories (e.g., adjectives, mass nouns, verbs) and meaning emerges later in development and may depend upon language experience.

Notice, however, that this suggestion is based almost exclusively on English-speaking subjects. This is a serious limitation, for it is important to determine whether the patterns observed in our English-speaking samples are universal to human development. (See Slobin, 1985, for excellent discussions of the necessity of cross-linguistic work in establishing theories of acquisition.)

5. Cross-linguistic developmental studies: French and Spanish

Because cross-linguistic evidence is essential in piecing together the nature and development of an appreciation of linkages between linguistic and conceptual development, I have begun to examine these linkages in young children learning languages other than English. The studies have been designed to pinpoint universals, and at the same time, document any differences in children's appreciation of the relation between linguistic form and meaning. If the hypotheses proposed here are correct, then the effect of introducing novel nouns should be universal: In all languages, count nouns should highlight object categories. In contrast, the effect of introducing novel adjectives may vary, depending upon the particular language being acquired.

To date, our sample includes unilingual speakers of two different language communities. The French-speaking preschool children came from Montreal, Canada. All of the children in this sample were members of families for whom French was the language spoken at home. Moreover, these children were enrolled in French-speaking preschool programs. The Spanish-speaking children came from Buenos Aires, Argentina. Despite the similarities among these two Indo-European languages, there are variations in their grammars that bear on the questions at hand. For example, in Spanish and French, as opposed to English, each object or class of objects has associated with it a grammatical gender. Therefore, the words (e.g., nouns, adjectives, determiners) which refer to these carry gender markings as well. One possibility is that the gender markings associated with the various terms would influence the children's interpretations of the novel words. Briefly stated, we found that this was not the case (Waxman et al., in preparation).

Another difference in these languages was of greater potential relevance. In Spanish and French, nouns are typically dropped if the grammatical subject is recoverable from context. If I have six mugs before me, in English, I distinguish them linguistically by pairing the noun 'mug' with an adjective (e.g., 'the big mug' or 'the big one'). In Spanish, such constructions are ungrammatical. Instead, the noun is dropped, leaving the determiner and adjective (e.g., 'el grande') to refer to the intended mug. This construction is also common (although not obligatory) in French, where one might ask for 'la petite' to refer to the smallest mug. In such instances, adjectives have referential status and convey nominal information. This grammatical difference in the referential status of adjectives may have consequences for children's interpretations of novel words. Perhaps in Spanish, novel adjectives, like nouns, will highlight category relations. Perhaps in Spanish, the influence of novel adjectives is less distinct from that of novel nouns.

To address this hypothesis, we adapted the five-item forced-choice method (Waxman and Kosowski 1990) to test 2- to 4-year-old unilingual speakers of French and Spanish (Waxman et al., in preparation). For French-speaking preschoolers, the results were identical to those obtained in English: Children in the *Novel Adjective* and *No Word* conditions demonstrated no particular preferences; only those in the *Novel Noun* condition chose predominantly taxonomically related items. These data support the view that the specific linkage between nouns and object categories in English is evident in French as well.

However, our results with the Spanish-speaking children were different: Like English- and French-speaking children, Spanish-speaking preschoolers

in the *Novel Noun* condition exhibited a strong preference for taxonomically related items; those in the *No Word* condition showed no particular preference for taxonomic, thematic, or gender-related matches. The essentially random performance in this condition replicates the results from our other two language samples. However, unlike their English- and French-speaking counterparts, Spanish-speaking children in the *Novel Adjective* conditions did display a systematic inclination toward the taxonomically related items. In Spanish, then, adjectives also seem to focus young children's attention on superordinate category relations. This finding has now been replicated twice with two independent groups of Argentine preschool children (Waxman et al., in preparation).

This observed difference in Spanish-speaking children's interpretation of novel adjectives cannot be attributed to any procedural differences between the Spanish and English protocols, for the procedures employed were identical in all languages. Neither can the differences be attributed to the stimuli themselves, for when we tested a group of English-speaking children using the picture book designed for the Spanish-speakers, the data were identical to the original English findings (Waxman and Kosowski 1990).

This difference, then, may indeed be due to cross-linguistic differences in the referential status of adjectives. In English, adjectives *do not* (as a rule) convey object reference. Although 2-year-old English-speakers are somewhat inclined to interpret adjectives as referring to objects and classes of objects, this is not the case for 3- and 4-year-olds. In Spanish, where adjectives *do*, in fact *must*, convey nominal information, experience with the language may lead to a different outcome. Here, even 3- and 4-year-olds often interpret adjectives as referring to objects and classes of objects.

Thus, the role of adjectives appears different in Spanish than in French or in English. And it appears to differ in a predictable way, given the grammar of the adult languages. There are several possible explanations for this difference. First, it is possible that in Spanish, the grammatical distinction between *nouns* and *adjectives* develops over a more protracted period. It is also possible that the grammatical distinction between these linguistic forms is made early, but that the appreciation of specific linkages between linguistic form and meaning develops over a more protracted period in Spanish. Additional research is currently underway to examine these possible explanations.

Let us now integrate these findings from the French- and Spanish-speaking children with those from children, toddlers, and infants learning English. The results of these complementary lines of research converge to provide initial support for the hypothesis that from the earliest stages of lexical acquisition,

infants expect that words (independent of their grammatical form) will refer to objects and categories of objects. Later, this general linkage gives way to more specific pairings between particular grammatical forms and particular types of meaning. The affinity between count nouns and object categories emerges early and is evident in all three languages we have examined to date. In contrast, the more specific linkages for adjectives emerge later and may vary, depending upon the language being acquired.

This account of the child's emerging appreciation of linkages between linguistic and conceptual organization is consistent with other major milestones in lexical acquisition. It gains further plausibility by virtue of the fact that it is also consistent with cross-linguistic evidence concerning the linguistic categories *noun* and *predicate* (including, e.g., adjectives, verbs).

6. Cross-linguistic analyses of *nouns* and members of the *predicate system*

The cross-linguistic consistency of the grammatical category *noun* and the variability of the category *adjective*, which has been documented by linguists (c.f., Dixon 1982), is quite relevant to issues of acquisition. The syntactic category *noun* has a stable and uniform function across human languages. Count nouns refer primarily to objects and classes of objects. Furthermore, unlike words from other form classes, nouns supply principles of individuation and identity for their referents. (See Macnamara, 1986, for thorough discussions of these principles; see Hall 1992, Hall and Waxman, 1993, for evidence that preschool children, like adults, expect that count nouns supply these principles.) Additionally, early lexical acquisition consists predominantly of nouns (Gentner 1982, Nelson 1973).

In contrast to the cross-linguistic stability of the class *noun*, members of the predicate system (e.g., adjectives, verbs) have a more fluid status. There is considerable cross-linguistic variation as to what information is conveyed as part of one predicate and what is conveyed as part of another (Gentner 1982, Talmy 1985). Furthermore, there is cross-linguistic variability in the evolution of particular predicates. Dixon's (1982: 1–3) discussion of the distinction between nouns and adjectives is quite revealing.

'It is an empirical fact that there is *always* a major class that is aptly termed Noun; there is *never* any doubt as to the applicability of this traditional label, and *never* any question as to which class should be called Noun ... However, not all languages have the major word class Adjective. Either they have no Adjective class at all, or else there is a small non-productive minor class that can be called Adjective. In either of these cases it is interesting to ask how the

language gets along without a full Adjective class ... Some (languages) ... express all adjectival concepts through intransitive verbs ... others express some through nouns and some through verbs ... and others invoke further means.'

Thus, the syntactic category *adjective* differs widely across languages. Some languages (like English and the Australian language Dyirbal) have extensive and elaborate adjective systems; others (like Igbo and the Bantu languages) have very few adjectives (Dixon 1982). Further, adjectives and other predicates appear to be acquired later than nouns. Moreover, there is question as to whether there is anything analogous to the naming explosion for the acquisition of predicates (Gopnik 1988). Finally, members of the predicate system are both semantically and syntactically dependent upon nouns.

7. The development of an appreciation of linkages between linguistic and conceptual relations

Taken together, the cross-linguistic analyses of the *noun* and *predicate* systems converge with the developmental data to suggest the following account of the development of an appreciation of linkages between linguistic and conceptual relations.

Early in infancy, infants' visual attention is augmented by what appear to be very general sensory and/or perceptual factors, rather than by specifically linguistic ones. Throughout infancy, the distinctive intonational contours characteristic of motherese are especially effective in arousing and sustaining infants' attention (Fernald 1992). Moreover, in the first six months, infants' visual attention is also heightened when objects are presented in conjunction with moderate auditory stimulation (Kaplan et al. 1991, Mendelson and Haith 1976, Paden, 1975, Self 1975). Initially, then, general auditory factors (rather than specifically linguistic ones) appear to intensify infants' general visual interest (rather than their interest in objects or categories of objects).

In the latter half of their first year, a more specific pairing becomes evident as infants begin to single out words from other, more general sources of auditory input. By 9- to 12-months of age, infants focus more on objects and categories of objects in the presence of novel words than in their absence (Baldwin and Markman 1989, Echols 1992, Waxman and Heim 1991, Markow and Waxman 1992, 1993). Indeed, we find evidence that 9-month-old infants establish object categories more readily when the objects are accompanied by a label (e.g., 'a bird') than when they are accompanied by a sine wave

tone (Waxman and Balaban 1992). Thus, by 9 months of age, labels facilitate categorization of objects. Moreover, this labeling effect appears to be tied to language, rather than to auditory stimulation, in general. (But see Roberts and Jacob 1991, for a different view.)

However, at this point in development, the data do not support the claim that infants make systematic distinctions among words from various form classes. The data from our laboratory reveal that at 12 months, infants tend to interpret most words, independent of their syntactic status, as referring to objects or categories of objects. Therefore, prior to the onset of the naming explosion, there appears to be a general (and possibly universal) linkage between words (not specifically count nouns) and object categories.

As the naming explosion draws to a close, and as infants begin to distinguish among the linguistic form classes (e.g., count nouns, mass nouns, adjectives, verbs) in their own language production and comprehension (Bloom 1990, Gordon 1985, McPherson 1991, Prasada 1993, Valian 1986), infants probably begin to consider syntactic form class as relevant to determining a novel word's meaning. By two to three years of age, children begin to reveal an appreciation of specific linkages between particular linguistic forms and particular types of meaning.

For example, English-speaking children expect that object categories will be marked linguistically by count nouns (Brown 1957, Markman and Wachtel 1988, Waxman 1990, Waxman and Kosowski 1990, Taylor and Gelman 1989, Waxman and Senghas 1991), that substances will be marked by mass nouns (Dickinson 1988, Soja et al. 1991), that individuals will be marked by proper nouns (Katz et al. 1974, Gelman and Taylor 1984, Hall 1992), and that various properties (e.g., size, color, temperament) will be marked by modifiers (Hall et al. 1993, Markman and Wachtel 1988, Waxman 1990, Taylor and Gelman 1988).

It is interesting to note that even at this point, when children are clearly capable of using syntactic information as a cue to meaning, they do not do so invariably. Instead, the tendency to use syntactic information is modified considerably by the child's existing lexical and conceptual knowledge (Au 1990, Banigan and Mervis 1988, Callanan 1985, Chi 1983, Mervis 1984, Mervis and Mervis 1988, Waxman et. al. 1991; Hall et al. 1993). Children's interpretation of a novel word depends, at least in part, upon whether or not they already have an existing label for the referent object. If the object is *familiar* (that is, if children have already acquired a count noun label for the object), then they use syntactic information as a guide in interpreting the meaning of subsequent words applied to that object. For example, if a child is

taught a new noun for a familiar object (e.g., a dog), the child exhibits a strong tendency to interpret the word as referring to an object category that is subordinate to (e.g., collie), superordinate to (e.g., mammal), or overlapping with (e.g., household pet) the familiar basic level category (Taylor and Gelman 1989, Waxman and Senghas 1992). For a new adjective, children tend to interpret the word as referring to a salient property, substance or part of the object (Hall et al. 1993, Markman and Wachtel 1988).

However, if the object is *unfamiliar* (that is, if children have not yet acquired a count noun for the object), they tend to rely upon an earlier pattern of behavior; they tend to interpret any word applied to that object (be it a count noun, proper noun, or adjective), as referring to an object category, typically at the basic level (Hall 1992; Hall et al. 1993, Markman and Wachtel 1988). Thus, children are attentive to syntactic form in ascribing meaning *only* after a count noun has been assigned to that object and to other members of its kind.

8. Summary and conclusion

In summary, an appreciation of the linkage between nouns and object categories is likely to be a universal phenomenon which guides human development from the very onset of lexical acquisition. In contrast, a distinct role for other form classes (such as adjectives) appears to emerge later, may rely upon an existing base of linguistic and conceptual knowledge, and may vary according to the specifics of the language being acquired.

What do these emerging linkages between linguistic and conceptual organization mean for the developing child? In the first few years of life, children encounter a virtually continuous stream of new sounds, new objects, and new events. The linkages described in this article help infants to organize these encounters rapidly into efficient and coherent systems. When ascribing meaning to a novel word, infants and children do not sample randomly among all the possible relations and meanings that might logically be considered. Instead, in the context of word learning, they pay special attention to particular types of meanings. Although the linkages may initially be quite general, by 2 to 3 years of age, children are acutely sensitive to linguistic form and use it to arrive at a novel word's meaning.

The existing evidence suggests that a nascent linkage is in place at the onset of lexical acquisition, that it may serve as a general guide to lexical acquisition, and that it will become increasingly specific over the course of development.

Of course, linkages like the ones described here cannot tell the entire developmental story, for children do not learn meaning on the basis of syntactic context alone. Additional research with preverbal infants and with children learning diverse languages will further clarify when these various linkages between linguistic and conceptual development emerge, how they are modified by linguistic input, and how they are modulated within the context of the child's existing fund of knowledge.

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