

also go to the Chinese University of Hong Kong which has provided me with a scholarship for the doctoral study and a travel grant for attending the BU Conference on Language Development.

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## Characteristics of word learners at 12 and 30 months: Early emergence and modification of the noun-category linkage

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What is the relation between human language and conceptual organization? This question, which has aroused spirited debate over the centuries, has recently been revitalized, as developmental psychologists have begun to apply new techniques to explore with precision the relation between early linguistic and conceptual organization. One inventive program of research has been designed to examine whether and how children's categorization of objects -- a conceptual task -- is influenced by the introduction of novel words.

To address this issue, researchers have compared infants' and children's categorization of objects in neutral conditions involving no novel words, with their performance when they are introduced to novel words for the objects or categories under consideration. Results from several different developmental laboratories have converged on the finding that English-speaking children perform quite differently under these two circumstances. For example, children are much more likely to form categories of objects when they hear a novel word applied to a category member, than when no novel words are introduced. In particular, children appear to expect that a count noun applied to a solid object will refer to that object and to other members of that object category.

In this paper, my goal is to trace the emergence and modification of the noun-category linkage in the first few years of life. Data from 12-month-old subjects will reveal whether the noun-category linkage is available to infants in their initial efforts to map words to their meanings. Data from 30-month-old subjects will reveal whether and how infants' initial expectations are modified.

### Background

There is now considerable research revealing that when preschool-aged children hear an object labeled, the grammatical form of the label directs their attention to particular aspects of that object. For example, by two to three years of age, children interpret novel count nouns applied to solid objects as referring to categories of objects at the basic and superordinate level (See Markman, 1992 and Waxman, 1994 for reviews). For English-speaking children, this expectation appears to be specific to count nouns, for when children are introduced to novel proper nouns or adjectives under similar circumstances, they exhibit very different patterns of interpretation.<sup>1</sup> They expect that proper nouns will refer only to the named individual and not to other members of its kind (c.f., Hall, 1991); they interpret novel adjectives as referring to properties of objects (e.g., color; texture; size) and to subordinate level conceptual distinctions (c.f., Taylor

& Gelman, 1988; Waxman, 1990). Thus, particular types of linguistic units (e.g., nouns) highlight particular types of conceptual relations (e.g., solid objects and categories of objects) for young children.

This cluster of findings has typically been taken as evidence that children do not approach the task of word learning in an unconstrained fashion: when mapping words to their meaning, children reveal a bias for certain interpretations over others. These biases are presumed to play a role in advancing both the word learning and conceptual abilities of young children. The idea that implicit biases make possible the early and rapid acquisition of complex systems of human knowledge is now at the core of many current theories of development.

While this idea has influenced programs of research in several different domains, it has also provoked considerable controversy. One controversial topic concerns the source of these proposed biases; another concerns the unfolding of these biases over development. Do the linkages between linguistic and conceptual organization exist at the onset of acquisition? Are these linkages rigidly fixed at the outset, exerting a uniform influence throughout development, or are they modified over development?

#### The research question and plan

To address some of these controversies, I will examine infants' and toddlers' interpretation of novel nouns and novel adjectives in what are essentially object categorization tasks. The first series of studies involves 12-month-old infants. Because these infants have just begun to produce their first words, they will help us to ascertain whether the biases in word learning that we have observed in older preschool aged children are available to infants in their initial efforts to map words to their meanings. The second series of studies involves 30-month-old toddlers. Because these subjects have considerably more advanced lexical knowledge, and because they have begun to reveal early syntactic abilities as well, they will permit us to ascertain whether and how infants' initial expectations concerning word meaning are modified over the course of early development.

#### The noun-category linkage

The noun-category linkage is likely to play a role early in development, perhaps across human languages. Infants appear to have a special "talent" for learning nouns: Infants' lexicons consist predominantly of nouns -- or, words that are considered nouns in the adult grammar (c.f., Fenson, Dale, Reznick, Bates, Thal & Pethick, 1994; Huttenlocher & Smiley, 1987). Apparently, infants' early interest in objects (c.f., Baillargeon, 1993) provides a firm conceptual foundation for the acquisition of their labels.

In addition to these predispositions inherent in word-learners, there also appear to be universal features inherent in the design of language that are relevant to the import of the noun-category linkage. For example, the

grammatical category noun is unique among the form classes for its stability across languages (c.f., Gentner, 1982; Maratsos, 1991). Across languages, this grammatical category includes terms for referring to object categories (Gleitman, 1990, Grimshaw, 1981; Jackendoff, 1990). In contrast to nouns, there is substantially more variation across languages as to what information is conveyed as part of one predicate class as opposed to another (e.g., adjective, preposition, verb) (Bowerman, 1985; Dixon, 1982; Gentner, 1982; Maratsos, 1991; Talmy, 1985). Finally, although mappings between nouns and object categories may be established without recourse to other grammatical categories, predicates appear to depend upon noun reference to fix their meanings (Fisher, in press).

#### A Developmental Proposal

Based on these cross-linguistic and developmental lines of work, I have proposed that infants commence the process of lexical acquisition equipped with a general expectation that a novel word applied to an object will refer to that object and to other members of its kind. This initial expectation guides infants in their first efforts to map words to their meanings; it facilitates infants' ability to establish reference. Later, infants begin to appreciate the particular syntactic distinctions drawn in their native language and the particular types of meaning associated with each. In this way, the more finely-tuned linkages between specific linguistic forms and specific types of meaning will emerge, as infants gain experience with the language to which they are being exposed.

If this proposal is correct, then 12-month-old infants will reveal a bias to interpret all novel words applied to objects as referring to object categories. Only later will they begin to distinguish nouns from the other linguistic forms vis a vis object categorization. At this point, they may come to interpret novel nouns, but not adjectives, as referring to object categories. Notice that this proposal predicts developmental stability with respect to the interpretation of novel nouns; it predicts developmental change with respect to the interpretation of novel adjectives.

#### 12-month-olds: Initial expectations of novel nouns and adjectives

To test this idea, Markow and I recruited 12- to 13-month old subjects. (Please refer to Waxman and Markow (in press) for a complete description of the method and results.) In the familiarization phase, an experimenter offered an infant four different toys from a given category (e.g., four animals) one at a time, in random order. Familiarization was immediately followed by a test phase in which the experimenter presented both a) a new member of the given category (e.g., another animal) and b) an object from a novel contrasting category (e.g., a fruit). Each infant completed this procedure with four different sets of objects, two at the basic level (cars vs. airplanes; horses vs. cats) and two at the superordinate level (animals vs. fruit; tools vs. vehicles). Infants manipulated toys freely during each phase; their interest in the toys, measured

by looking and manipulation, served as the dependent measure in our analyses.

In novelty-preference procedures, if the infant detects the commonality or category relation among the stimuli offered during the familiarization phase, then the infant will exhibit decreasing attention during this phase. At test, when the familiar and novel objects are presented simultaneously, the infant should show a preference for the novel, over the familiar, test object. In brief, if an infant has formed an object category, that infant should reveal a decrease in attention during the familiarization phase and a novelty-preference at test.

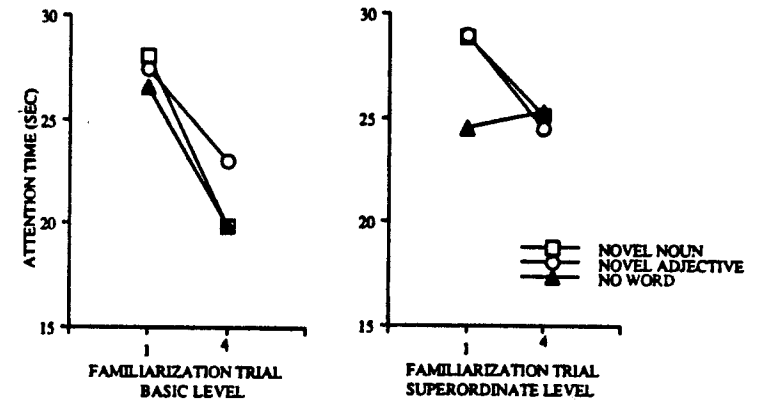
To examine the effect of novel words on infants' categorization, we randomly assigned infants to one of three conditions. In the No Word (Control) condition, she said, "See here?"; in the Novel Noun condition, she said, "See the *fauna*?"; in the Novel Adjective condition, she said, "See the *faunish* one?" In the test phase, infants in all conditions heard precisely the same labeling phrase ("See what I have?").

Markow and I reasoned that if a linkage between nouns and object categories is unavailable at 12 months, then performance in the Novel Noun, Novel Adjective and No Word conditions should be indistinguishable. However, if this linkage is available at the outset of lexical acquisition, then infants in the Novel Noun condition should be more likely than those in the No Word condition to form object categories. The Novel Adjective condition permits an examination of the specificity of this initial linkage. If the linkage is initially general, then subjects in both the Novel Noun and Novel Adjective conditions should show a) a greater decrease in attention during the familiarization phase, and b) a stronger preference for the novel object in the test phase than should infants in the No Word condition.

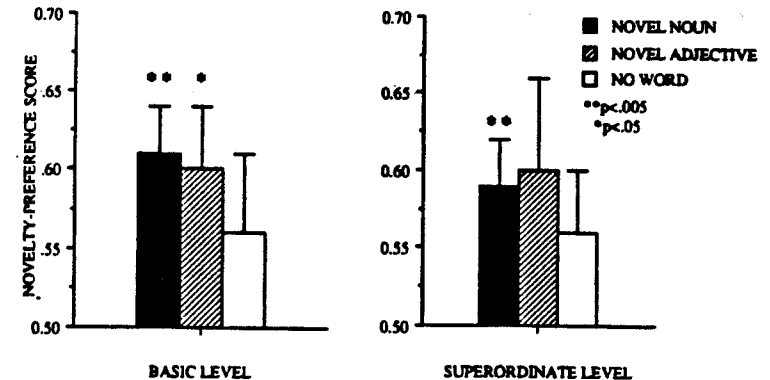
This is precisely what we found, as can be seen in Figure 1. Consider first the results from the familiarization phase. Infants in the Novel Noun and Novel Adjective conditions showed a significant decrease in attention over familiarization, while those in the No Word condition did not. On the basic level sets, infants in all three conditions exhibited a linear decrease in attention. It was at the superordinate level that the effect of the novel words became evident. Infants in the Novel Noun and Novel Adjective conditions showed a linear decrease in attention. Only those in the No Word condition failed to exhibit such a trend.

Figure 1  
12-Month-Olds' Object Manipulation Task: Familiarization and Test Phases

#### FAMILIARIZATION PHASE



#### TEST PHASE



In the test phase, the effects of novel nouns and adjectives were also quite comparable. At the basic level, infants in both the Novel Noun and Novel Adjective conditions showed reliable novelty preferences. Only infants in the No Word condition showed no such preference. At the superordinate level, infants in the Novel Noun condition revealed a novelty preference. This preference

failed to reach statistical significance in the Novel Adjective condition, but this appears to reflect the high variability exhibited in this condition. Once again, infants in the No Word condition revealed no evidence that they preferred the novel over the familiar test object. To amplify these group effects, we also considered the patterns of behavior displayed by each individual subject in this study. This analysis revealed precisely the same patterns of behavior.

Thus, at this early point in acquisition, novel labels, both nouns and adjectives, focus infants' attention on commonalities among objects, particularly at superordinate levels. This clear pattern of results is consistent with the hypothesis that when infants embark upon the process of lexical acquisition, they are initially biased to interpret words (from various grammatical categories, including both nouns and adjectives) applied to solid objects as referring to those objects and to other members of the same category.

However, there is no doubt that this general expectation will become more specific over time. For although we found that 12-month-olds treated nouns and adjectives identically with respect to object categorization, preschool-aged children clearly do distinguish between novel nouns and adjectives and assign them particular types of meanings (e.g., Taylor & Gelman, 1988; Waxman, 1990). Clearly, then, between infancy and the preschool years, there is a burgeoning sensitivity to using syntax as a cue to meaning.

To examine this developmental transition, we turn next to an investigation with 30-month-olds. We selected this group because we suspected that two types of advances – syntactic and lexical – would be important in this transition. First, 30-month-old English speakers have productive command over the syntactic distinction between nouns and adjectives, and it is likely that they appreciate the particular types of meaning associated with each.

Second, we were curious to examine subjects with more advanced lexical abilities, because previous work has shown that children's familiarity with an existing label for an object plays a crucial role in their interpretation of novel words: Even preschoolers are likely to use syntactic form as a cue to meaning only if they are already familiar with a category label for the object under consideration (Hall, 1991; Hall, Waxman, & Hurwitz, 1993; Markman & Wachtel, 1988; Taylor & Gelman, 1988). When children learn a new word (e.g., *fauna*) applied to a familiar object (e.g., a horse),<sup>2</sup> their interpretation will vary as a function of its grammatical form. But when children learn a new word for an unfamiliar object (e.g., an armadillo), they reveal a strong bias to interpret the word, independent of its grammatical form, as referring to the object kind. This suggests that there is a strong conceptual priority for establishing names for basic level kinds.

This is relevant to the findings with the 12-month-old infants, for whom the overwhelming majority of objects were, in this sense, unfamiliar. This is, by definition, the modal case for infants just beginning to establish a lexicon. Perhaps infants' tendency to interpret novel adjectives, like novel nouns, as

referring to object kinds is, at least in part, a consequence of their limited lexical repertoires. In the next study, we sought to examine this possibility directly by comparing young word learners' interpretations of novel nouns and adjectives applied to familiar and unfamiliar objects.

### 30-month-olds: Modification of initial expectations?

To accomplish this task, we selected a group of 30-month-old toddlers with a mean productive vocabulary exceeding 250 words; all subjects were combining words. We suspected that both their syntactic and lexical advances would increase the likelihood that they would reveal different expectations for novel nouns and adjectives in an object categorization task. We predicted that toddlers in the Novel Noun condition would be more likely to form object categories than would those in either the Novel Adjective or the No Word conditions. And we expected that this distinction between their interpretation of novel nouns and adjectives vis a vis object categorization would be more apparent on the familiar than on the unfamiliar sets of objects.

To test this hypothesis, we employed a modified forced-choice task, in which children made two independent selections for each target object. See Table 1 for a sample of stimuli used in the experiment. (A trial from a Basic-Familiar set will be used as illustration.) An experimenter presented subjects with a target object (e.g., a horse). She then introduced two choice objects. One choice was a member of the same object category as the standard (e.g., another horse); the other was a foil, drawn from a contrasting object category (e.g., a bear). Once children made a selection, the experimenter presented the same target object again (e.g., the target horse), but this time offered children a different pair of test objects, (e.g., yet another horse and bear).

Table 1.

#### 30-Month-Olds' Triad Task: Some Examples of Familiar and Unfamiliar Objects

SET	TARGET OBJECT	CHOICE OBJECTS
<u>Basic - Familiar</u>		
horse	horse . . . . .	horse, bear horse, bear
<u>Superordinate - Familiar</u>		
animal	dog. . . . .	cat, banana lion, apple
<u>Basic - Unfamiliar</u>		
lizard	lizard. . . . .	lizard, turtle lizard, turtle
<u>Superordinate - Unfamiliar</u>		
vegetable	pepper. . . . .	onion, armadillo eggplant, rhinoceros

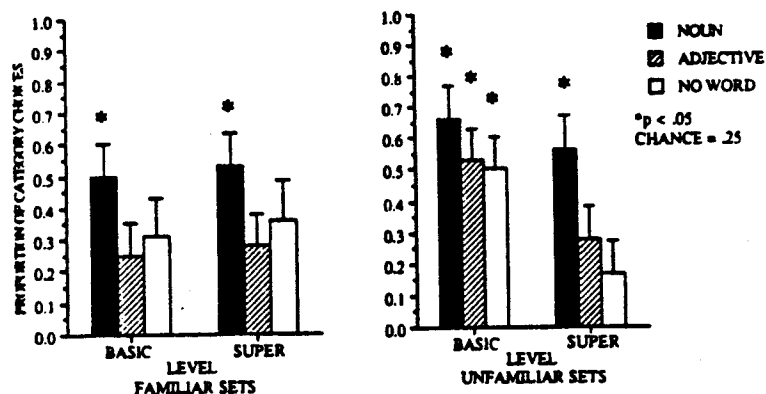
Our dependent variable in this experiment was the proportion of trials on which children made consistently category-based selections on both the first and second trials for a given target. The probability that they would select both the category-based choices (e.g., both horses) by chance is therefore .25.

We treated familiarity as a within-subjects factor. For each subject, half of the trials included familiar objects and half included unfamiliar objects.<sup>3</sup> We also varied the hierarchical level of the categories under observation. On half of the trials, the category-based selection was related to the target at the basic level; on the remaining trials, the category-based selection was related to the target at the superordinate level.

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, "See this? This is a *daxin*. This one is a *daxin*." She introduced the choices, saying, "Can you find another *daxin*?" In the Novel Adjective condition, she said, "See this? This is *dakish*. This one is *dakish*. Can you find another *dakish* one?" In the No Word condition, she said, "See this? Look at this one. Can you find another one?"

Data from the familiar and unfamiliar sets of objects is depicted in Figure 2. Our results were entirely consistent with our predictions. At 30 months, toddlers distinguished novel nouns from adjectives on the basis of syntactic context, and they revealed an expectation that novel nouns, but not adjectives, would refer to categories of objects.

Figure 2  
30-Month-Olds' Triad Task: Proportion of Consistent Category Choices



Familiar trials. On both the basic and superordinate level sets, toddlers in the Novel Noun condition made consistently more category-based selections than did their counterparts in either the Novel Adjective or the No Word condition. Only performance in the Novel Noun condition exceeded the pattern expected by chance. This pattern differs markedly from that exhibited by 12-month-olds. By 30 months, children clearly distinguish novel nouns from novel adjectives and interpret novel nouns, but not novel

adjectives, as referring to categories of objects.

Unfamiliar trials. It is important to note that it is on these sets that the 30-month-olds found themselves in a situation most closely analogous to that of the 12-month-olds: They were unfamiliar with labels for these objects. On the basic level trials, children in all three conditions were more likely than chance to make consistently category-based selections. Like the 12-month-olds, children in all conditions were drawn to the objects from the same basic level category as the target. At the superordinate level, however, only children in the Novel Noun condition made consistently category-based selections. Their performance differed reliably from chance and from performance in the other two conditions.

#### Integrating the results of 12- and 30-month-old subjects

Interestingly, although they are based on different paradigms, the patterns of performance exhibited by 12- and 30-month-olds are identical in many important respects. The data from the unfamiliar sets with the 30-month-olds comprise an especially relevant comparison, because like the 12-month-olds, they were unfamiliar with labels for the objects under consideration. At the basic level, children at both ages responded on the basis of the object category in all conditions. Apparently, the commonalities within these perceptually and conceptually salient kinds are evident even without the introduction of a novel word. At the superordinate level, children at both ages revealed the influence of novel labels. At 12- and 30-month-olds, novel nouns focused attention on object categories; yet no such focus was evident in the No Word condition.

The interesting developmental differences emerged in the interpretation of novel adjectives. At 12 months, novel adjectives (like novel nouns) highlighted object categories; at 30 months, we observed this effect exclusively with novel nouns.

#### General Discussion

Infants begin the process of lexical acquisition with an initially general expectation linking words to objects and categories; the more specific linkages 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 initially general linkage is important in two respects. First, the fact that it is evident at 12 months of age reveals that it is available to guide infants in their early efforts to map words to their meanings (also see Waxman & Hall, 1993). This strong finding challenges directly any claims that the noun-category linkage is unavailable at the onset of lexical acquisition (L. Bloom, Tinker & Margulis, 1994; Nelson, 1988).

Second, the fact that it is initially general (evident with both nouns and adjectives) is consistent with developmental work suggesting that at 12 months, infants have probably not yet identified the relevant surface cues that distinguish among the particular grammatical categories in the input. It is also consistent with the cross-linguistic fact that languages converge in the mappings between nouns and categories of objects, but differ in the ways in which they recruit other grammatical categories to convey particular types of meaning. Indeed, 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 patterns and variations encountered in their native language. This account is flexible enough to accommodate the finding that infants readily acquire languages that differ among themselves in the ways in which they recruit particular grammatical categories to convey particular types of meaning.

This account also raises a crucial question: How can an initially general linkage, in which infants treat nouns and adjectives identically with respect to object categorization, give way to the more specific linkages revealed in older preschool aged children? There are several mechanisms by which this evolution may come about.

First, infants may begin the process of lexical acquisition with a truly general expectation that words applied to objects, independent of their grammatical form, will refer to kinds of objects; only later do they infer that (in English) this linkage is typically true for count nouns, but not for words from other grammatical categories (e.g., adjectives). In this scenario, infants hold a different set of expectations than do older children and adults.

Second, infants may initially expect that there are distinct grammatical categories and that these are linked to particular types of meaning (c.f., Gleitman, 1990; Grimshaw, 1981; Pinker, 1984). In this scenario, infants hold the same expectations as do adults, but fail to reveal these for a number of reasons: Perhaps processing limitations prevent them from perceiving the different syntactic frames surrounding novel words (Fisher, in press); perhaps they cannot yet identify the grammatical categories from surface cues.

Third, even if infants do expect that distinct grammatical forms map to distinct types of meaning, and even if they do perceive the differences between novel nouns and adjectives in the sentences we provided, they might still fail to exhibit this sensitivity because of their limited lexical knowledge.

Although these three alternatives reflect very different theoretical positions, they are difficult to disentangle empirically, for they each predict the same pattern of behavior – and this is precisely the pattern revealed here. Initially, infants interpret both novel nouns and adjectives, applied to objects, as referring to object kinds; later, English-speaking toddlers and children reserve this interpretation for novel nouns only.

In conclusion, this series of experiments underscores four major conclusions regarding the emergence and modification of the noun-category linkage. First, 12-month-old infants who have just begun to produce words on their own reveal a general expectation that novel words (both nouns and adjectives) applied to objects will refer to categories of objects. Second, this general linkage between words and object categories undergoes developmental change. Third, the developmental change from 12 to 30 months of age is in the interpretation of novel adjectives. This finding dovetails with the observation of cross-linguistic variation in the mappings of the predicate classes. Fourth, from infancy through the preschool years (e.g., Waxman, 1990), the effect of introducing novel words is most dramatic at non-basic levels, where the commonalities among objects may not be as salient as those at the basic level.

Finally, let me place these findings within the context of the theoretical position that there are constraints guiding the acquisition of complex and sophisticated arenas of

human knowledge. I have argued that infants commence the process of lexical acquisition equipped with a general expectation that words will refer to object categories. However, I do not assume that the endpoint of development is precisely guaranteed by the form of the initial constraints. On the contrary, I have argued that the infants' early expectations, which guide the initial process of acquisition, become fine-tuned and modified as a consequence of infants' experiences with the linguistic forms and the objects they encounter.

## Notes

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1. See Waxman, Senghas, and Beveniste (1995) for evidence from children learning French or Spanish as their first language.
2. By familiar, I mean that they have at their command a label for the basic level kind of which the object is a member; by unfamiliar, I mean that they have no demonstrable label for the basic level kind.
3. We determined the familiarity of the objects in pilot work, testing an independent group of 30-month-olds on production and comprehension of the labels for these objects.

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## Do Children's First Object Kind Names Map onto Adult-like Conceptual Representations?

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### Introduction

One of the controversies in lexical development concerns the meanings children assign to their first words, in particular, their first count nouns. Some have argued that children's first words are not "real words" but mere associations (e.g., McShane, 1979); some have argued that children's first words have complexive meanings, e.g., pen could mean pen, eraser, paper, the act of writing or drawing, etc (e.g., Bowerman, 1980); and some have argued that children's first object kind labels map onto distinct shapes (e.g., Landau, Smith, & Jones, 1988). In this paper, we will present some preliminary evidence which suggests that children's first object names do not refer to distinct shapes, but rather they are more likely to refer to sortal concepts, just like in the adult's lexicon.

According to a number of philosophers, sortal concepts underlie count nouns in a natural language, e.g., *dog, person, ball* (Wiggins, 1967, 1980; Gupta, 1980; Hirsch, 1982; Macnamara, 1987; Macnamara & Reyes, 1994). A sortal is a concept that provides criteria for individuation and numerical identity. Criteria for individuation enable us to tell one thing from another (e.g., we know if we are in the presence of one chair or two chairs); criteria for numerical enable us to decide whether something is the same one we have encountered before. Criteria for individuation and identity are sortal relative. For example, our identity criteria for plants and chairs are different. Plants grow so that shape and size changes are not necessarily an indication of identity change, whereas chairs do not grow so that shape and size changes are very good indicators of identity change.

Only the count nouns in a natural language fulfill the role of sortals. Predicates, i.e., adjectives, verbs, and prepositions, do not provide criteria for individuation and identity. For example, if we were asked to "count the red in this room", we would not know if a red sweater should be counted as one red or many -- should we count the sleeves and threads as separate? In contrast, a question such as "count the sweaters in this room" is unambiguous. A sweater will be counted as one sweater not two. Similarly, we can only ask about numerical identity by specifying a count noun. For instance, a grown-up is the same person throughout development but she is not the same baby as she was many years ago. In contrast, a red table may be painted green and still remains the same table.

Adults' count nouns, including object kind names, map onto sortal concepts. Do children's first object kind names map onto sortal concepts as well? Addressing this question requires establishing the age at which