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Linguistic Biases and the Establishment of Conceptual Hierarchies: Evidence from Preschool Children

Sandra R. Waxman
Harvard University

These experiments test the hypothesis that preschool children are predisposed to interpret nouns as referring to taxonomic relations, and that this bias guides the early establishment of conceptual hierarchies (e.g., *collie, dog, mammal, animal*). Two familiar hierarchies—animals and food—and two linguistic form classes—nouns and adjectives—were examined in detail. Experiment 1 tested the effect of introducing novel nouns at multiple hierarchical levels (subordinate, basic, intermediate, and superordinate). Some children were introduced to novel nouns for the classes (e.g., *suikahs*); others heard no labels. Nouns facilitated superordinate level classification, but made subordinate classification more difficult. In Experiment 2, another group of children labeled the classes to enable a direct comparison of preschoolers' linguistic descriptions and conceptual groupings. They tended to label all subordinate classes identically (e.g., they labeled all subclasses of *dogs* as '*dogs*'), yet when they were explicitly instructed to distinguish them, they used adjectival phrases (e.g., '*big dogs*'). In Experiment 3, novel labels were presented in two different linguistic contexts, either as nouns (e.g., *suikahs*) or as adjectives (e.g., *suk*-ish ones). As in Experiment 1, nouns made subordinate classification more difficult. Conversely, adjectival phrases facilitated subordinate classification, but made superordinate classification more difficult. Children's early sensitivity to the different applications of nouns and adjectives served to guide the establishment of conceptual hierarchies.

In their first few years, children develop two uniquely human capacities: They learn language and they develop rich conceptual systems. It is unlikely that their linguistic and conceptual advances are entirely independent. For language, and in particular the process of naming, carries with it an implicit conceptual mechanism. Providing a common label (e.g., '*animal*') for multiple referents is in itself

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Correspondence and requests for reprints should be sent to Sandra R. Waxman, Department of Psychology, Harvard University, William James Hall, 33 Kirkland St., Cambridge, MA 02138.

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an act of classification. Likewise, providing different labels (e.g., '*dog*', '*horse*') reveals conceptual distinctions among referents. This article concerns the contributions of the linguistic system to the early establishment of conceptual hierarchies (e.g., *collie, dog, mammal, animal*). It focuses on the recent claim that children honor powerful yet implicit biases in word learning, and, in particular, that they are predisposed to interpret nouns as referring specifically to taxonomic[1] relations.

The notion that early development may be guided by constraints or biases is not a new one. There is now evidence for biases in the development of several domains that are acquired universally and rapidly (see R. Gelman & Brown, 1985, and Keil, 1981). In particular, implicit biases appear to guide the acquisition of syntax (Chomsky, 1965; Pinker, 1979; Wexler & Culicover, 1980), the lexicon (Landau & Gleitman, 1985; Soja, 1987), number concepts (R. Gelman & Gallistel, 1978), and object concepts (Spelke, 1982).

The bias under investigation incorporates two related claims: first, that children are predisposed to interpret nouns as referring to taxonomic relations, and second, that this bias guides the early establishment of conceptual hierarchies (Markman & Hutchinson, 1986; Waxman & Gelman, 1986). This bias is based on specific convergences between the children's linguistic and conceptual systems; this point is crucial because human conceptual organization is remarkably flexible. From infancy, humans exploit a rich variety of different types of conceptual relations, including thematic, associative, and causal relations (Baillargeon, 1986; Barsalou, 1983; Mandler, Fivush, & Reznick, 1987; Nelson, 1974). The taxonomic bias would preserve this conceptual flexibility, and at the same time would specifically highlight taxonomic relations in the context of word learning. It could benefit young children both as they learn language and as they establish conceptual hierarchies.

Hierarchical systems figure centrally in Western philosophic tradition and have long been adapted to studies of human conceptual organization (Anderson, 1983; Bruner, Goodnow, & Austin, 1956; Smith & Medin, 1981). These systems are characterized by a unique logical structure in which lower-order classes (e.g., *dog, horse*) are nested within subsequently higher-order classes (e.g., *animal*). By virtue of this class-inclusion structure, hierarchies support a rich set of inferences. For example, when one encounters an unfamiliar item (e.g., an aardvark) and one is told that it is an animal, a great deal can be inferred about it

[1] In cultural anthropology and ethnobiology, the term *taxonomy* is typically reserved for hierarchical classification systems in the plant and animal kingdoms. In these cases, the taxonomy itself incorporates classes or categories at various hierarchical levels. In the psychological literature, the term *taxonomy* carries a slightly different meaning. Taxonomic relations are contrasted with other types of conceptual relations (e.g., thematic, associative, or causal relations).

with little or no first hand experience; knowing that it is an animal licenses the induction that it is alive and must eat to survive. In this way, hierarchies give us "[T]he greatest command over our knowledge already acquired, and lead most directly to the acquisition of more" (J.S. Mill, 1843, p. 432).

While there is little doubt as to the cognitive power and efficiency of conceptual hierarchies, questions regarding their development have been more controversial. The traditional developmental literature (e.g., Bruner et al., 1961; Inhelder & Piaget, 1964; Vygotsky, 1962) carries the pervasive assumption that children do not possess the cognitive structures necessary to support hierarchical systems until they are well into their later elementary school years. This research begins with a very different assumption: Because young children acquire a wealth of information in their first few years and because conceptual hierarchies are particularly well suited for this endeavor, it stands to reason that children might establish hierarchies early and use them in the service of learning. Although this assumption is compatible with other developmental work demonstrating that children command an impressive array of cognitive capacities, what is the evidence for this view?

It is presently known that preschoolers, and possibly infants, can form at least some taxonomic classes, notably those which Rosch and her colleagues have called the basic level classes (Mervis, 1987; Mervis & Crisafi, 1982; Ricciuti, 1965; Rosch, Mervis, Gray, Boyes-Braem, & Johnson, 1976). Basic level classes occupy a mid-level position within hierarchical systems, falling between superordinate and subordinate level classes. A number of different psychological measures, including object naming, classification, and mental imagery, support the notion of a 'basic level advantage' for adults as well as children (Rosch et al., 1976). Indeed, children's early mastery of basic level relations reveals that they first 'carve the world' into just those categories that adults consider most salient. Across development, across individuals, and across cultures, the basic level is remarkably stable.

The primacy of the basic level is a robust empirical phenomenon and is important in its own right.[2] However, it does not directly address the development of conceptual hierarchies. Because the logical power of hierarchies derives from inclusion relations among classes at multiple hierarchical levels, it is critical that we determine how children go beyond the basic level to establish higher- and lower-order classes.

[2] The basic level advantage is a robust empirical phenomenon. Many different explanations for the special status of the basic level have been advanced (including correlated attributes, cue validity, perceptual differentiation, and schema theory), yet none of these has proven sufficient (see Medin, 1982; Armstrong, Gleitman, & Gleitman, 1982; Mervis, 1987). For the purposes of these experiments, we accept the primacy of the basic level and go on to ask how children acquire higher- and lower-order categories within hierarchical systems.

TAXONOMIC RELATIONS AT NONBASIC LEVELS

To be sure, evidence that young children appreciate taxonomic relations at nonbasic levels has been difficult to uncover (see Gelman & Baillargeon, 1983, and Markman & Callanan, 1983, for reviews). Developmental research has been based, for the most part, on two different measures—object labeling and object classification. Children's labeling has been examined under a variety of conditions, ranging from spontaneous utterances to comprehension. Likewise, children's classification has been measured under various conditions, ranging from spontaneous groupings to performance on standard "free classification tasks" (Inhelder & Piaget, 1964). In free classification, children are presented with a group of objects or pictures of objects, and instructed to "Put the things that go together together."

Preschoolers' performance on such tasks varies considerably, depending upon the hierarchical level under consideration. Their facility in labeling and classification at the basic level (e.g., *dogs* vs. *horses*) contrasts sharply with their difficulty at subordinate (e.g., *terriers* vs. *collies*) and superordinate levels (e.g., *animals* vs. *food*). Researchers seeking an explanation for the striking discrepancy between performance at basic and nonbasic levels have recently begun to examine the influence of language in classification.

LANGUAGE-BASED BIASES

There is a growing body of work indicating that very young children are sensitive to abstract information conveyed by linguistic form class (e.g., noun, adjective) (Gordon, 1987; Valian, 1986), and that they use this information to determine whether a novel word refers to an action, an object, or a substance (Brown, 1957). They assume that novel nouns refer to whole objects, rather than to parts or functions (Shipley & Spelke, 1990), and they appreciate the linguistic cues that distinguish individual items (such as proper nouns) from classes of items (common nouns) (S. Gelman & Taylor, 1984; Katz, Baker, & Macnamara, 1974). More to the point, children as young as 3 years of age appear to interpret novel nouns as referring specifically to taxonomic relations, as opposed to thematic or idiosyncratic relations (Markman & Hutchinson, 1984; Waxman & Gelman, 1986).

To test the hypothesis that taxonomic relations become especially salient in the context of word learning, Waxman and Gelman (1986) compared preschool children's superordinate classification with and without novel labels. Children who were introduced to novel Japanese nouns (e.g., *dobutzus, kimonos, gohans*) for superordinate classes (e.g., *animals, clothing, food*) performed significantly better than those who heard no novel words. The introduction of the novel labels alerted children to the higher order relation among the items and licensed the induction of superordinate level classes. In fact, simply introducing children to

novel words led those children to classify as successfully as their age-mates who had been given familiar English superordinate labels. Markman and Hutchinson (1984) offer converging evidence that novel nouns highlight taxonomic relations in preschool children.

Findings like those previously described have contributed to the view that children come upon the task of word learning equipped with powerful biases and that these biases support the early establishment of conceptual hierarchies. However, the empirical support for the claims has thus far been limited. Different experimenters using various methods and criteria have linked one particular linguistic form class, nouns, to the establishment of taxonomic relations at basic and superordinate levels. Because other linguistic forms (e.g., adjectives) have not been systematically examined, it is unclear whether the bias operates for word learning in general, or whether it is restricted to nouns in particular.

Furthermore, there have been no investigations of the bias at subordinate levels; indeed, there is reason to suspect that nouns may not highlight taxonomic relations at that level. Cross-linguistic (Berlin, 1978; Newport & Bellugi, 1978) and etymological evidence (Adams, 1973; Marchand, 1969) suggest that subordinate level distinctions tend initially to be marked with adjectival phrases, rather than with nouns. It is therefore conceivable that although novel nouns highlight taxonomic relations at superordinate levels, they will fail to do so at subordinate levels.

The following experiments represent the first coordinated analysis of the relation between preschoolers' linguistic biases and the conceptual organization at multiple hierarchical levels. They test the notion that information from linguistic form class plays a crucial role in the establishment of conceptual hierarchies, particularly at nonbasic levels. To evaluate this hypothesis, two familiar object hierarchies—animals and food—and two form classes—nouns and adjectives—were examined in detail. Experiment 1 was designed to test the effect of introducing novel nouns at multiple hierarchical levels. Children classified pictures of objects at multiple levels within these two hierarchies. Some children were introduced to novel nouns for the classes; others heard no novel words. In Experiment 2, another group of children labeled the classes that their age-mates in Experiment 1 had classified. This enabled a direct comparison of preschoolers' linguistic descriptions and conceptual groupings. Finally, in Experiment 3, the classification paradigm was employed once again, this time to test specific hypotheses regarding the complex relation between linguistic form class (adjectives vs. nouns) and the establishment of conceptual hierarchies.

EXPERIMENT 1

The primary goal of this experiment was to examine systematically the effect of introducing novel nouns on preschool children's classification at multiple hierarchical levels. To this end, we developed a multiple-level classification pro-

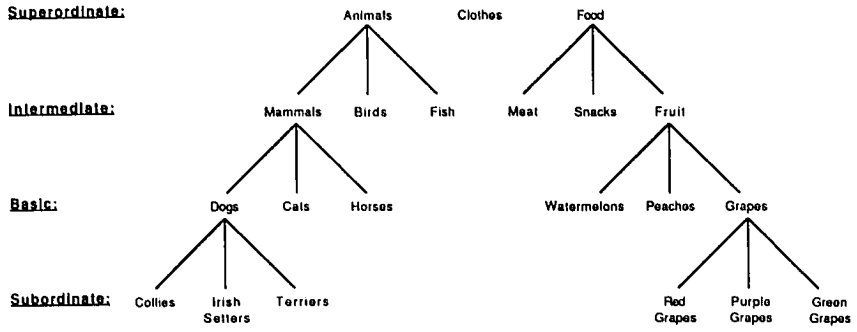

Figure 1. Design for the multiple-level classification task. Experiment 1.

cedure, using photographs of members of the animal and food hierarchies. Figure 1 displays the structure of these hierarchies.

The introduction of the intermediate level requires some explanation. Clearly, some object hierarchies are more elaborate than others and extend beyond the three idealized levels (superordinate, basic, subordinate) discussed in most psychological research. Indeed, based upon their extensive cross-cultural and cross-linguistical research, Berlin and his colleagues (Berlin, Breedlove, & Raven, 1973) had found that folk taxonomies typically incorporate between three and five levels. In many folk taxonomies, a distinct *intermediate* level falls between the highest levels (or *unique beginner* and *lifeform* ranks) and the basic level (or *generic* rank). We therefore decided to include an intermediate level in this developmental study; both the animal and food hierarchies offer this possibility. There are, however, two noteworthy differences between them. First, the animal hierarchy is comprised entirely of natural kinds, and second, within the hierarchy the intermediate level classes (*mammals, birds, fish*) are familiar to most preschoolers and are supported in modern biological theory (see Murphy & Medin, 1985, for the role of theories in conceptual organization). However, within the food hierarchy, no such scientific or cultural consensus appears to exist at the intermediate level. As a result, the classes of a group of six adult judges agreed upon *meats, sweets,* and *fruits* for the food hierarchy.[3] Despite these differences, we expected novel nouns to exert the same effects in both hierarchies.

A repeated measures design allowed us to (a) observe each child's classification at all levels within both hierarchies, and (b) examine the effect of introducing novel nouns at each level. We expected the influence of the novel nouns to be most pronounced at nonbasic levels, where preschoolers typically encounter difficulty composing taxonomic classifications.

[3] Classes were agreed upon if they were judged to be (a) mutually exclusive and (b) familiar to preschool children.

Method

Subjects. Twenty-four 3-year-olds (mean age = 3.6, ranging from 3.0 to 3.11) and twenty-four 4-year-olds (mean age = 4.6, ranging from 4.0 to 4.11) were drawn from several preschools serving a racially-mixed, middle-class population in Philadelphia. An approximately equal number of boys and girls participated in each age group and condition.

Stimuli. Colored photographs were selected from picturebooks and magazines and mounted on 4″ × 6″ cards. Different sets were compiled to correspond to each level within each hierarchy (see the Appendix for a complete list of stimuli). Each set included 21 photographs, seven taken from each of the three contrastive classes at each hierarchical level. For each contrastive class, three out of the seven photographs served as the experimenter's "clue cards" (see Experimental Conditions, to follow); the remaining four were classified by the children themselves in the experiment proper.

Procedure. Children were tested individually, in a quiet, vacant room in their preschools. They participated in two testing sessions, each lasting approximately 35 minutes. They classified at all four levels in one hierarchy (either animal or food) in one session, and classified the other hierarchy on another day. The interval between testing sessions ranged from three to seven days. The order of presentation of Hierarchy (animal or food) and Level within Hierarchy (superordinate, intermediate, basic, or subordinate) was completely counterbalanced.

In all conditions, the experimenter first introduced the child to a group of small dolls,[4] explaining that these were from Japan and could not speak English. Next, she presented clues (see Experimental Conditions, to follow) for each classification trial. Finally, she asked the child to sort the remaining 12 photographs, and presented them to the child one at a time, in random order. She encouraged the children to sort each set more than once. All experimental sessions were audiotaped and then fully transcribed.

Experimental Conditions. Children were assigned randomly to one of three experimental conditions, which differed in the amount and type of information provided at the beginning of each classification trial. No English class labels were used to refer to the photographs in any of the experimental conditions.

In the Control condition, the experimenter set three dolls out in a horizontal line in front of the child and explained that each doll ". . . is very picky and only likes a certain kind of thing." The experimenter randomly selected one photograph from each contrastive class and presented these first, in random order

[4] The 12 dolls are commercially manufactured. Each represents a different cartoon-like character and stands about 2″ high.

(most children distributed the photographs evenly, giving one to each of the three dolls. Those few children who failed to distribute them in this manner were instructed to do so). Children were then reminded that the dolls were "very picky." Thereafter, photographs were presented in a completely random order.

In both the Instance and Novel Noun conditions, the experimenter placed three "clue cards" beneath each of the three dolls to indicate ". . . the kinds of things each doll likes." These remained in full view as the children sorted the remaining photographs.

In the Instance condition, the experimenter drew attention to the clue photographs as she set them out, saying, "This doll likes things like this, and this, and this, and other things like that . . ." as she placed the appropriate clue cards beneath each doll.

In the Novel Noun condition, the experimenter introduced a novel label (derived from actual Japanese category terms) in conjunction with the clue photographs. Pointing to each doll in turn, she said, ". . . This one says she (or he) wants _____. I don't know what _____ means, but I *know* she (or he) likes things like this, and this, and this, and other things like that. She (or he) calls these things _____." (see the Appendix for a complete list of novel labels).

Scoring. A score for each classification trial was determined by counting the number of photographs a child placed correctly. Scores could range from 0 to 12.[5] Chance performance yields an average score of 4. Recall that each child was encouraged to classify each set more than once. Both initial and final trials were recorded, yielding a total of sixteen (4 Levels × 2 Hierarchies × 2 Repetitions) scores per child.

Results

To examine the effect of introducing novel nouns at multiple hierarchical levels, children's scores were submitted to a 5-way mixed analysis of variance (ANOVA): Age(2) × Condition(3) × Hierarchy(2) × Level(4) × Repetition(2). The first two factors were between-subject variables; the last three were within-subject variables.[6]

Novel nouns did not produce a uniform effect at all levels. The Condition × Level interaction, F (6,126) = 3.08, $p < .008$, illustrated in Figure 2, reveals that novel nouns facilitated superordinate level classification, but interfered with performance at the subordinate and intermediate levels. This result is best under-

[5] In the Control condition, scores could range from 3 to 12 because the experimenter ensured that the first three photographs were placed correctly.

[6] At the superordinate level, children classified the same set of stimuli (*animals, clothing, food*) twice, once as part of the animal hierarchy and once as part of the food hierarchy. A preliminary analysis revealed no difference between these two classifications. Therefore, in the following analyses, each superordinate level score is analyzed as part of the hierarchy within which it was obtained.

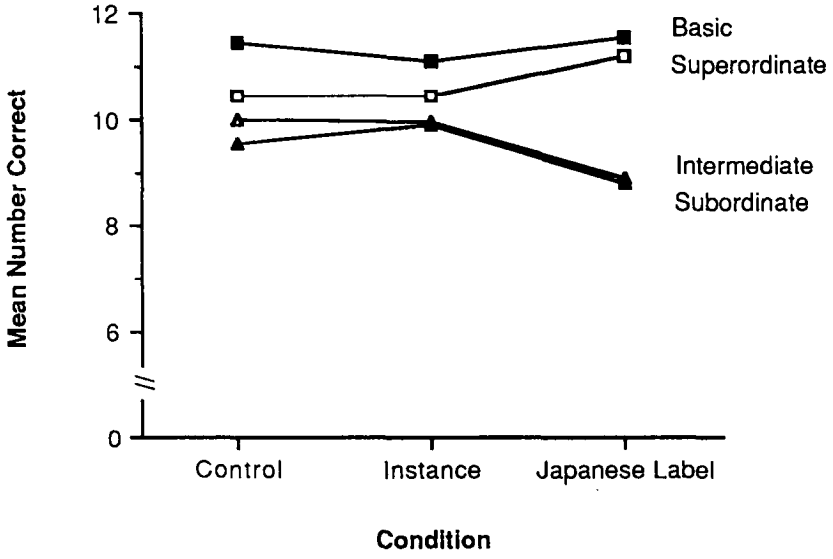

Figure 2. Condition × Level interaction. Experiment 1.

stood by examining the 3-way Condition × Level × Age interaction, F (6,126) = 2.92, $p < .01$, illustrated in Figure 3.

For 3-year-olds, novel nouns facilitated superordinate level classification, but had the opposite effect at the subordinate and intermediate levels. In fact, with novel labels serving as clues, 3-year-olds had significantly more difficulty at the subordinate and intermediate levels than at the basic and superordinate levels (Tukey pairwise comparisons, $p < .05$). The 4-year-olds' pattern of results reveals an interesting developmental phenomenon: Novel nouns no longer interfered with classification at the intermediate level, but their deleterious effect at the subordinate level persisted ($p < .05$, Tukey).

In addition to these language-related effects, we obtained several other main effects and interactions. For example, the main effect for Age, F (1,42) = 5.11, $p < .05$, revealed that 4-year-olds classified more accurately than did 3-year-olds. The main effect for Level, F (3,126) = 27.44, $p < .0001$, indicated that in both hierarchies, children classified most accurately at the basic level, followed by performance at the superordinate, intermediate, and subordinate levels.

Although there was no main effect for Hierarchy (animal vs. food), this variable did contribute to two significant interactions. The Hierarchy × Level interaction, F (3,126) = 13.91, $p < .0001$, indicated that children classified more successfully at the animal-intermediate level than at the food-intermediate level (Tukey pairwise comparison, $p < .05$). At all other levels, performance in the two hierarchies was indistinguishable. The Hierarchy × Age interaction, F (1,42) = 35.25, $p < .03$, indicates that although 3-year-olds performed com-

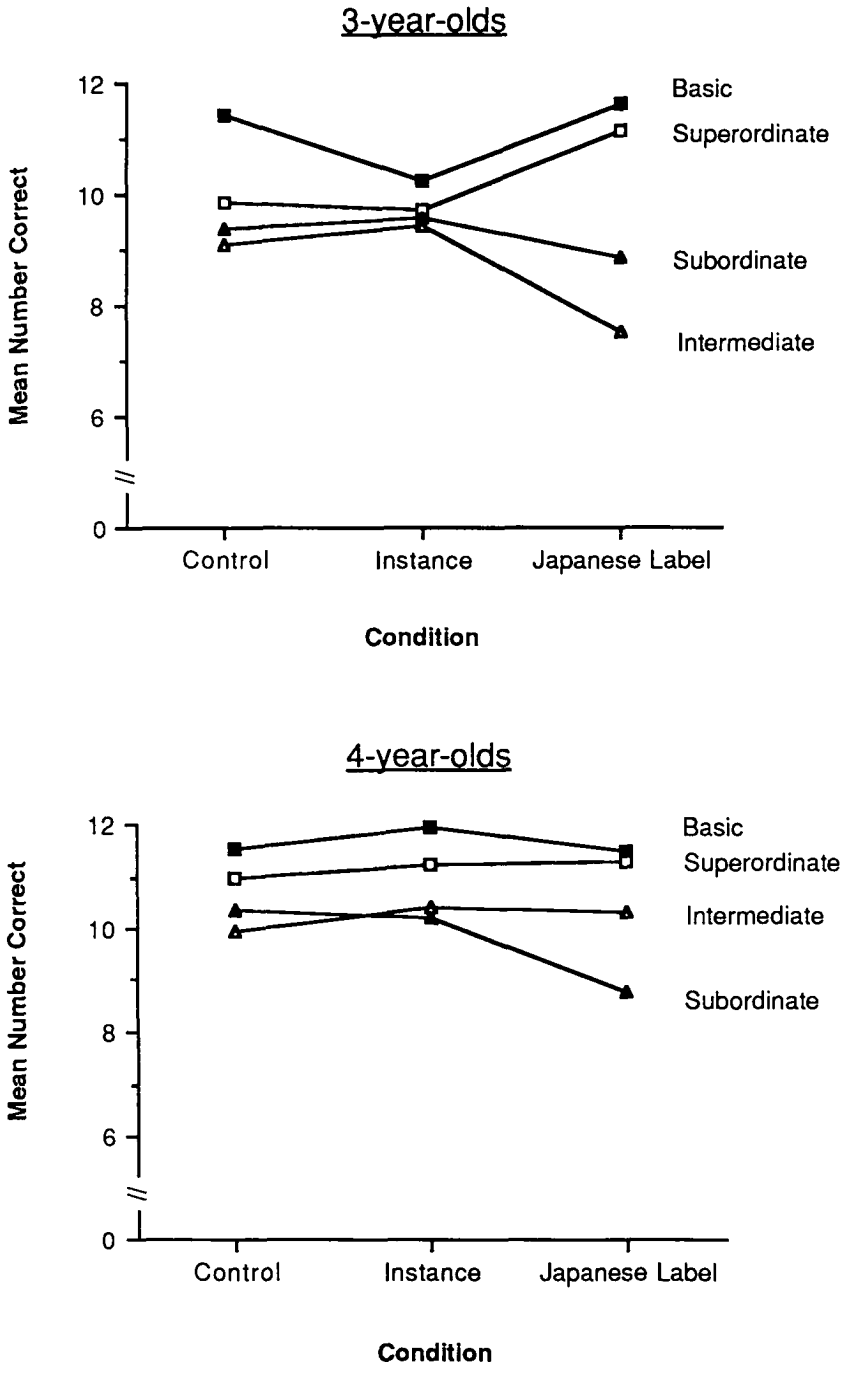

Figure 3. Condition × Level × Age interaction. Experiment 1.

parably across the two hierarchies, 4-year-olds classified more accurately in the animal than in the food hierarchy. Apparently, between the ages of 3 and 4, children learn more about the organization of the animal than of the food hierarchy (see Carey, 1985, for a discussion of the development of biological knowledge).

There was no main effect or interaction involving the Repetition factor.

Discussion

Novel nouns do not produce uniform effects in classification at all hierarchical levels. They facilitate superordinate classification, but exert the opposite effect at the subordinate level (and at the intermediate level for 3-year-olds only). These differences among levels in the Novel Noun condition are due to the introduction of the novel nouns themselves and cannot be attributed to the particular instances serving as clues. For in the Instance condition, where the same instances served as clues, there were no significant differences among hierarchical levels.

Does any consistent interpretation exist that can account for both the novel nouns' advantage at superordinate levels and disadvantage at subordinate levels? This surprising finding appears to reflect an interaction between children's existing knowledge and the role of a novel label. Consider the two possible conceptual representations illustrated in Figure 4. Perhaps preschool children have not yet differentiated their basic level classes into distinct *kinds* or *subclasses* (as in Figure 4a), but know something about individual *members* of basic level classes (as in Figure 4b) (Shipley, Kuhn, & Madden, 1985). If their conceptual representation resembles Figure 4a, then novel nouns should direct the childrens' attention to the subclasses and facilitate subordinate classification. If, on the other hand, preschoolers do not yet appreciate distinctions among kinds (as in Figure 4b), then novel nouns may have a very different effect. The nouns may highlight

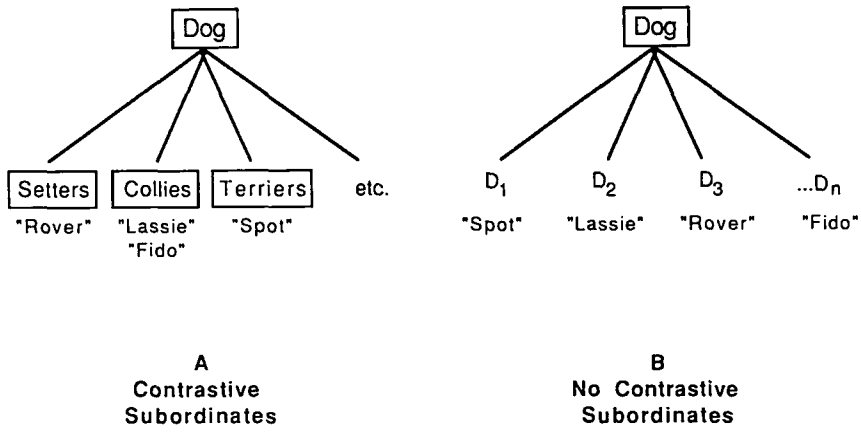

Figure 4. Two alternative conceptual representations of a category.

taxonomic relations at the familiar and especially salient *basic* level, thereby making it less likely that children will search for systematic subordinate distinctions.

According to the preceding argument, the bias to interpret novel nouns taxonomically is powerful enough to interfere with the establishment of new, lower-order classes if an already familiar overarching taxonomic class (e.g., *dog*) is available. This interpretation rests on the assumption that children do not yet distinguish among the subclasses of *dogs* and *grapes*. Experiment 2 was designed to examine this assumption closely.

EXPERIMENT 2

Because labels can serve as a valuable additional source of information regarding conceptual status, in this experiment we asked another group of children to name the classes we had used in Experiment 1. We then observed the ease with which children produced labels as well as the linguistic form of the labels (e.g., noun vs. adjectival phrase).

Considering first the subordinate level, if, as previously argued, preschoolers do not appreciate subordinate level distinctions, they should label the subclasses identically. For example, when faced with a set of *collies*, a set of *terriers*, and a set of *setters*, they should label each set as '*dogs*'. On the other hand, if preschoolers do appreciate conceptual distinctions among these classes, they should offer linguistic distinctions among them as well. Of course, we would not expect children (or all adults, for that matter) to know names of specific breeds of dogs or varieties of grapes. If they appreciate categorical distinctions, they are likely to indicate these linguistically with adjectival phrases (e.g., '*big dogs*', '*green grapes*') as opposed to nouns (see Waxman, 1985, for evidence pertaining to adults' labeling). This prediction follows directly from cross-linguistic evidence indicating that new distinctions within known classes tend to be marked with adjectival phrases (Berlin, 1978; Newport & Bellugi, 1978).

The claim we make is not that children cannot learn to create clear subordinate level distinctions, but rather that the distinctions are not yet salient enough to warrant unique labels. If one could highlight the distinctions or make them more relevant to the task at hand, then children should mark the distinctions with descriptive phrases.

Method

Subjects. Eight 3-year-olds (mean age = 3.3, ranging from 2.11 to 3.9) and eight 4-year-olds (mean age = 4.4, ranging from 4.1 to 4.8) were drawn from the same preschool programs as those described in Experiment 1.

Stimuli. A subset of the stimuli used in Experiment 1 was selected (see the appendix). This set included only the 12 photographs sorted by the children

themselves. As in Experiment 1, each set corresponded to a hierarchical level in either the animal or the food hierarchy.

Procedure. The experimenter enlisted each child's help in "teaching words" to a collection of small dolls. She arranged a set of photographs into its three contrastive classes and placed a doll with each class. Pointing to each doll, she asked, "What did she (or he) get? She (or he) got all different kinds of . . ." The sets were presented in a completely counter-balanced order.

Scoring. In pilot work, children demonstrated the following four general types of responses, each requiring a different follow-up question from the experimenter:

Type 1. The child's response was contrastive and at the appropriate level of abstraction. For example, at the animal-basic level, the child labeled the classes '*dogs*,' '*horses*,' and '*cats*.' For this type of response, there was no further questioning.

Type 2. The child's response was contrastive, but involved terms that adults judge to be too specific for the intended class. Typically, this pattern involved the child using a label for one individual class member (e.g., '*dog*') as the class term (e.g., *animal*). For this type of response, the experimenter encouraged the child to label the class itself, saying, for example, "Yes, but all of them aren't dogs. All together, they are all different kinds of . . ."

Type 3. The child resisted providing class terms (e.g., *animal*) and listed individual basic level labels (e.g., '*horse*,' '*duck*') for each photograph instead. For this type of response, the experimenter acknowledged the individual labels and said, "But all together, they're different kinds of . . ."

Type 4. The child's response was correct, but too general (by adult standards), and therefore not contrastive. For example, a child might label the classes *mammals, birds,* and *fish* as '*animals*,' '*animals*,' '*animals*.' In such cases, the experimenter encouraged the child to distinguish the classes, saying, for example, "But if these are all animals, how can we tell the difference? What kind of animals did the doll get?"

Results

The preschoolers' labeling patterns converged nicely with the classification data obtained in Experiment 1. Both the ease with which children labeled the photographs and the linguistic form of their labels varied systematically with the hierarchical level under consideration. As can be seen in Table 1, at the basic level, children provided contrastive labels at the appropriate level of abstraction (Type 1) on 94% of their trials. In contrast, at the subordinate level, most

Table 1. Proportion of Initial Response Types (Type 1, 2, 3, or 4) within Each Hierarchical Level (Superordinate, Intermediate, Basic, or Subordinate). Experiment 2

	Response Type			
	Type 1 Labels classes contrastively	*Type 2* Mentions a single member	*Type 3* Lists individual members	*Type 4* Labels classes identically
Level				
Superordinate	.54	.19	.25	.02
Intermediate	.43	.23	.18	.16
Basic	.94	.00	.00	.06
Subordinate	.11	.00	.00	.89

children labeled all classes identically, failing to provide any semantic contrast (Type 4). At the superordinate and intermediate levels, children's response types were more evenly distributed. We submitted the data to a 3-way (Age × Set × Repetition) ANOVA with the number of Type 1 responses serving as the dependent variable; we then conducted planned comparisons.

Basic Level. Children's facility in labeling at the basic level is parallel to their ease in classification (Experiment 1), is consistent with previous research on the primacy of the basic level (Anglin, 1977; Rosch et al., 1976), and contrasts sharply with their labeling at other hierarchical levels.

Subordinate Level. As predicted, the overwhelming majority of children initially failed to provide any semantic contrast among the subordinate level classes. In the animal hierarchy, fully 100% of the children's initial subordinate labels were identical. They labeled all three classes as '*dogs.*' In the food hierarchy, the pattern differed slightly. Eight out of the 16 children (two 3-year-olds; six 4-year-olds) initially labeled all three classes identically as '*grapes.*' Five others (four 3-year-olds; one 4-year-old) labeled two of the subclasses identically, but provided a different label for the third. Finally, three children supplied contrastive labels for all three kinds of grapes. The first, a 3-year-old, used nouns; the second, a 4-year-old, used adjective-noun phrases. The last child in this group, a 3-year-old, was the most interesting. She recognized a distinction among the classes and actually created descriptive phrases for them herself—'*Booshel grapes,*' '*shooshy grapes,*' '*grapes.*' The form of these phrases is conventional in English; only the content—her idiosyncratic modifiers—is unconventional (Clark, 1983).

Whenever a child failed to provide semantic contrast among classes (Type 4), the experimenter encouraged the child to do so. After the experimenter's explicit probe, most children began to distinguish among the classes using the predicted

adjective-noun form. At both the animal- and food-subordinate level, 14 out of the 16 children (seven from each age group) ultimately labeled the three subclasses contrastively.

Superordinate Level. Although children comprehended the superordinate labels used in this experiment (Waxman & Gelman, 1986), these were not readily accessible, even in an explicit labeling task. At this level, children revealed a tendency to consider the items as distinct individuals, rather than as members of a single cohesive class. They offered fewer Type 1 responses at the superordinate (54%) than at the basic level (94%), $F(1,15) = 19.41$, $p < .0008$. When they failed to provide an inclusive class term, their predominant response was to list individual items (Type 3).

Intermediate Level. Children of both ages produced significantly more Type 1 responses at the animal-intermediate (67%) than at the food-intermediate level (19%), $F(1,14) = 27.88$, $p < .0003$. Recall that in Experiment 1, children also sorted more successfully at the animal-intermediate than at the food-intermediate level. Children's labeling patterns offer an interesting explanation for this discrepancy: Children appear to view *birds* and *fish* as basic level classes and *mammals* as a superordinate. More than 90% of the children provided Type 1 responses for *birds* and *fish*. In contrast, when labeling *mammals*, they were more likely to cite basic level members (Type 2: 25%, or Type 3: 50%) than to provide an inclusive class label (Type 1: 19%). (Of course, we did not expect children to use the term '*mammals*'; '*animals*' would be an appropriate, and certainly more likely, label in this context.) Even after the experimenter's follow-up questions, fewer than half of the children (44%) were able to provide an inclusive class label for *mammals*.

Recall that in Experiment 1, novel nouns interfered with 3-year-olds' classification at both the intermediate and subordinate levels. However, as can be seen in Table 1, their labeling patterns at these two levels were reliably different. At the intermediate level, they offered mostly Type 2 and Type 3 responses; there were no Type 4 responses. At the subordinate level, however, they offered mostly Type 4 responses. This divergence between labeling patterns at these two levels suggests that different cognitive mechanisms may underly performance at the subordinate and intermediate levels.

Discussion

The results of this experiment clarify the effect of introducing novel nouns, particularly at the subordinate level. Children do not readily distinguish among subordinate level classes in their labeling; this appears to be related to the deleterious effect of introducing novel nouns in subordinate level classification. Novel nouns appear to draw attention to the overarching and very salient basic level and, in this way, make subordinate classification more difficult.

This argument provides a consistent account for the role of nouns in classifi-

cation, yet it simultaneously raises an interesting question. Clearly, young children as well as adults discover new classes, and these take their place within our conceptual and semantic systems. If nouns provide a strong clue to already established taxonomic relations, then how are *new* conceptual distinctions marked in our language? Children's labeling patterns outline an answer to this question. When children are explicitly encouraged to attend to subordinate distinctions, they offer descriptive phrases in which the head noun refers to the existing basic level class (*dog* or *grape*) and the modifiers (typically adjectives) mark distinctions within that class. This linguistic convention is not unique to children of a particular developmental stage. For example, although most adults are unfamiliar with the specific labels for types of grapes, they recognize the systematic distinctions among them and mark these with adjectival phrases (e.g., '*green grapes*'). (See Waxman, 1985, for a thorough description of adult performance in a multiple level labeling task.) Across human languages, both spoken and signed, new distinctions within a known class tend to be marked with adjectival phrases, incorporating a head noun to indicate the basic level class, and a modifier to distinguish its subtype (Berlin, 1978; Brown, Kolar, Torrey, Truong-Quang & Volkman, 1976; Newport & Bellugi, 1978).

Preschool children are sensitive to subtle differences in linguistic form class: Nouns tend to highlight coherence among members of a higher-order class and adjectives tend to signal new distinctions within a known (basic level) class (also see S. Gelman & Markman, 1985; Valian, 1986). Perhaps this distinction between nouns and adjectives facilitates the establishment of conceptual hierarchies. This hypothesis is tested in Experiment 3.

EXPERIMENT 3

In this experiment, we extended the multiple-level classification paradigm to examine specific interactions between linguistic form class and the formation of conceptual hierarchies. Novel labels were presented in two different linguistic contexts—either as nouns or as part of adjectival phrases. Because children themselves use adjective-noun phrases to describe subordinate level distinctions (Experiment 2), we predicted that adjectival phrases, even novel ones, should highlight subordinate, but not superordinate, level classification. Conversely, single nouns (again, novel ones), should facilitate classification at the superordinate, but not subordinate, level.

The procedure differed from that used in Experiment 1 in several ways: (a) We included only 3-year-olds because the effect of the novel noun was most pronounced for this age group (Experiment 1), (b) we included only three hierarchical levels (see Figure 5) (Further investigations of the intermediate level are currently under investigation using a different paradigm.), and (c) children in this experiment classified each stimulus set only once because there was no evidence that performance changed over repeated classification trials (Experiment 1).

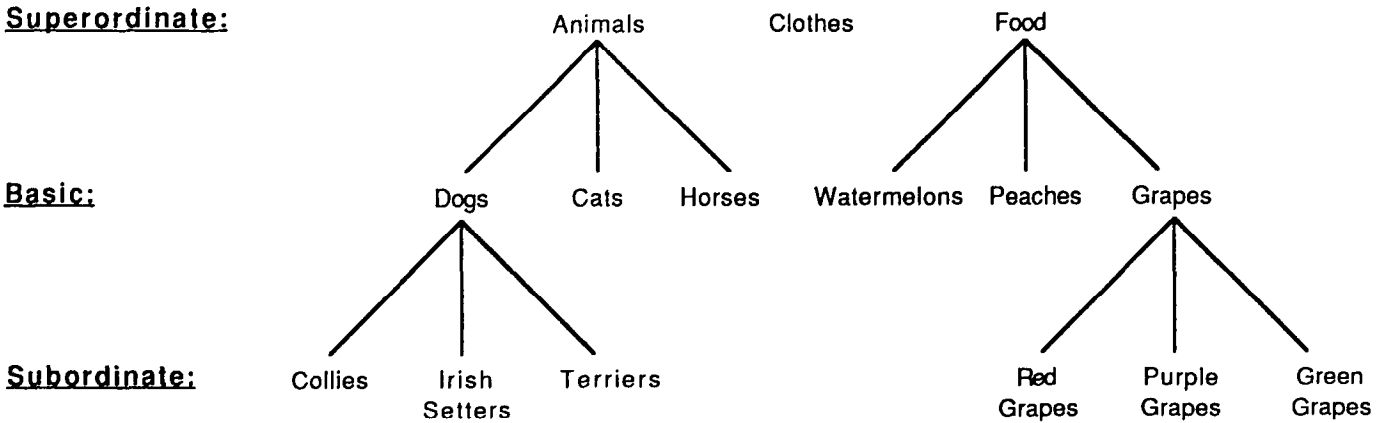

Figure 5. Design for Experiment 3.

Method

Subjects. Twenty-four 3-year-olds (mean age = 3.5, ranging from 3.3 to 3.11) were drawn from several preschools serving a racially-mixed, middle-class population in Philadelphia. An approximately equal number of boys and girls were involved in each condition, none of whom had participated in the earlier experiments.

Stimuli. The stimuli were identical to those used in Experiment 1, with one exception: The intermediate level sets were omitted (see the appendix).

Procedure. The general procedure was identical to the one described in Experiment 1. All children classified at all levels within both hierarchies, for a total of five classifications: superordinate, animal-basic, animal-subordinate, food-basic, and food-subordinate. The order of presentation was completely counterbalanced. Testing was completed in one 20-minute session. The experimenter did not use any English superordinate labels when referring to the photographs in any of the experimental conditions.

Children were randomly assigned to one of three experimental conditions. In the Instance condition, typical instances of each contrastive class were presented, but no novel terms were introduced. This condition served as a control for the Novel Noun and Novel Adjective conditions, in which the instances were presented in conjunction with novel words.

The Novel Noun and Novel Adjective conditions differed only in the linguistic context in which the novel words were presented. (The labels from Experiment 1 were modified to create the uniformly bi-syllabic set presented in the appendix.) In the Novel Noun condition, the experimenter told the child, for example, "This doll only wants *suikahs*, and these are the *suikahs*. He (the second doll) only wants *momos*, and these are the *momos*. And he (the third doll) only wants *budos*, and these are the *budos*. . . ." She mentioned each novel noun twice.

In the Novel Adjective condition, she told the child, for example, ". . . this doll only wants *suk*-ish ones, and these are the ones that are *suk*-ish. He (the second doll) only wants *mom*-ish ones, and these are the ones that are *mom*-ish. And he (the third doll) only wants *bud*-ish ones, and these are the ones that are *bud*-ish. . . ." She mentioned each novel adjective twice.

Scoring. As in Experiment 1, scores reflect the number of photographs correctly placed on each classification trial and could range from 0 to 12. Chance performance yields an average score of 4.0.

Results and Discussion

The data were submitted to a 3-way Condition (3) × Level (3) × Category (2) ANOVA. Condition is a between-subjects factor; Level and Category are within-subjects factors. Planned comparisons were conducted.

The Condition × Level cross-over interaction (Figure 6), $F(4,42) = 3.23$, $p < .02$, revealed that preschool children are indeed sensitive to the linguistic context in which novel words are introduced. As expected, linguistic clues neither facilitated nor hindered children's near-ceiling performance at the basic level. At non-basic levels, however, children used syntactic information to aid in the establishment of taxonomic classes.

As in Experiment 1, 3-year-olds in the Instance and Novel Noun conditions classified better at superordinate than at subordinate levels. This pattern, however, was completely reversed in the Novel Adjective condition, where children classified better at subordinate than at superordinate levels, Tukey, $p < .05$. Unlike novel nouns, novel adjectives facilitate subordinate level classification, but make superordinate level classification more difficult.

The preceding cross-over interaction provides straightforward evidence that children interpret nouns and adjectives differently, and that each form class produces specific effects in classification. Nouns signal higher-order classes and adjectives emphasize lower-order distinctions; children's appreciation of these differences promotes the establishment of conceptual hierarchies.

One difference between Experiments 1 and 3 bears mention. The effect of introducing novel nouns is not as apparent in Experiment 3 as it was in Experiment 1 and in previous investigations (Markman & Hutchinson, 1984; Waxman & Gelman, 1986). In both Experiments 1 and 3, 3-year-olds in the Novel Noun condition classified remarkably well at the superordinate level. However, in Experiment 3, children in the Instance condition also classified very successfully

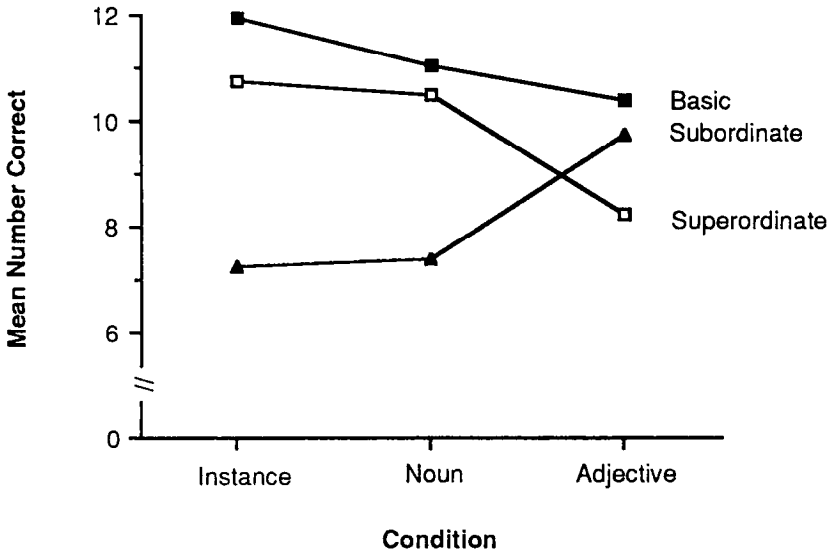

Figure 6. Condition × Level interaction. Experiment 3.

at the superordinate level. The inability to detect a facilitory effect from the noun in Experiment 3 may be best interpreted as stemming from the improved performance in the Instance condition rather than as a diminution of the Novel Noun effect. Precisely why the noun failed to influence performance at the subordinate level in this experiment is not clear. However, it is important to point out that both (a) the benefit of introducing novel nouns in superordinate classification and (b) the deleterious effect of introducing novel nouns at subordinate levels, have since been replicated and extended to include additional object categories as well (Waxman & Kosowski, in press; Waxman & Shipley, 1987).

In addition to these language-related effects, the hierarchy × Level interaction, $F(2,42) = 12.68$, $p < .0001$, revealed that children classified better at the food-subordinate than at the animal-subordinate level, Tukey, $p < .05$. At other levels, scores are indistinguishable. This discrepancy may be specific to the stimuli selected for these experiments. Attending to a single dimension (color) yields a consistent taxonomic classification of kinds of grapes; classifying kinds of dogs requires attention to at least two dimensions (size and color). Nonetheless, although the magnitude of the subordinate level effect differs, the same overall pattern of results emerges in both hierarchies.

GENERAL DISCUSSION

Two different sources of evidence—classification and labeling—support the view that preschool children are sensitive to powerful links between conceptual hierarchies and the language we use to describe them. They distinguish between the form classes "noun" and "adjective" and expect that each form class will have a unique referring function. In particular, they expect that nouns will refer to higher-order classes and that adjectival phrases will refer to lower-order classes. These expectations or biases serve to guide the early formation of conceptual hierarchies.

Novel labels had no effect at the basic level, where children's classification was uniformly high. The "primacy" of the basic level has been acknowledged by anthropologists, linguists, and historians of science, as well as by cognitive and developmental psychologists. Across a wide range of cultures, the basic level "cries out to be named" (Berlin, 1978). Moreover, across different classification systems (Western and non-Western), there are remarkable correspondences at the basic (or "species") level. In contrast, at nonbasic levels, classification systems can vary widely, reflecting the ". . . subtle and pervasive aspects of culture" (Gould, 1980, p. 211). Because ". . . most of the categories we possess are cultural . . . we need some sort of indication from those in the culture (which) . . . things they treat as equivalents and those that are distinguished" (Brown, 1958, p. 208). The experiments reported here reveal that our linguistic systems provide one 'sort of indication.' Novel labels exert strong influences, promoting classification at precisely those levels (that is, nonbasic levels) that are most subject to cultural influence and variation.

A sensitivity to the different applications of nouns and adjectives is evident throughout the course of development and across a wide range of object categories. Children as well as adults continue to refine and elaborate upon their existing hierarchical systems. As they incorporate new information and clarify relations among classes, they establish increasingly accurate bases for logical reasoning. These conceptual modifications tend to run parallel with linguistic modifications. The history of science is filled with illustrations of this phenomenon. For example, when astronomers first discovered distinct *kinds* of stars, they used adjectival phrases, such as '*double stars*,' '*quasi-stars*,' and '*pulsing stars*,'to describe them. Several of these phrases have since evolved into single nouns, such as '*quasars*' and '*pulsars*.' Similarly, the names for most breeds of dogs have their origins as modifier-noun phrases in which the head noun referred to the common basic level class dog. The word '*terrier*' is derived from the Latin *terra*, for these dogs went underground in search of small game. New conceptual distinctions initially tend to be marked with adjectival phrases. Later, as these gain importance, the linguistic stress patterns begin to change and often these adjectival phrases evolve into single nouns.[7]

Word Learning—The Mapping Problem

A key to successful word learning involves mapping a novel word onto its correct referent. In these experiments children faced a word-learning task, but one that differed from naturally-occurring first language acquisition in at least one crucial respect: Many children already knew an appropriate English label for some of the classes under consideration. Might the results reported here simply reflect children's efforts to "translate" the novel (Japanese) words onto known English labels, and then use their translations to guide their classification? Several pieces of evidence caution against this interpretation. First, superordinate classification in the Novel Noun condition was more successful than could be expected if children had relied upon transition alone; for children were not especially successful at translating at the superordinate level, even when explicitly asked to do so (Experiment 2). It is therefore unlikely that the children's near-ceiling performance at the superordinate level in the Novel Noun condition (Experiments 1 and 3) is attributable to direct translation. Further, if the children's strategy was simply to map novel words directly onto known ones, performance in both the Novel Noun and Novel Adjective conditions should have been comparable, which was clearly not the case.

Although translation cannot fully account for the pattern of results obtained in these experiments, it may still play a role, albeit an indirect one. It is quite likely

[7] Nominalization is a linguistic phenomenon that is accomplished in a variety of different ways. In some cases, the head noun is dropped and the modifier serves as a noun (e.g., *chihuahua*). In other cases, the modifier and noun may be joined (due to a change in the stress patterns) to form a compound noun (e.g., *mailman*) (see Gleitman and Gleitman, 1970, Marchand, 1969, or Adams, 1973, for a discussion of nominalization).

that at some point some children tried to translate the novel Japanese words into known English labels. However, this is likely to be a consequence, rather than the cause, of their predispositions in word learning. Novel nouns focus attention on higher-order relations and, as a consequence, may call up English superordinate labels for some children. Novel adjectives focus attention on distinctions within a given class and, as a consequence, may highlight semantic distinctions.

Another question regarding the problem of mapping requires consideration. We presented the novel terms as tokens from a foreign language. If the labels had been introduced as novel English (rather than Japanese) terms, would the results have been different? Two related principles, the Principle of Mutual Exclusivity (Markman, 1987) and the Principle of Contrast (Clark, 1983), predict that they indeed would have been. According to the Principle of Mutual Exclusivity, children expect that words (in a given language) pick out mutually exclusive classes. The Principle of Contrast makes the more moderate claim that no two words within a given language are wholly synonymous (but see Gathercole, 1987). On both of these accounts, children who know English category terms (e.g., *dogs, horses, cats*) should resist accepting novel "English" terms (*dobus, akas, sukahs*) for those same categories. Indeed, according to these principles, children would demonstrate considerable confusion at the basic level, where English terms are most readily accessible. Studies in which novel labels are introduced as English terms may put these principles to test.

The Origin of the Bias

Even our youngest subjects evidenced a predisposition to interpret novel terms differently, depending upon the linguistic context in which they were introduced. However, questions regarding the origins of these biases remain unanswered. Children may *learn* or *induce* these biases from experience, as they begin to notice convergences between types of object categories and the linguistic devices used to describe them (see Nelson, 1988, for this interpretation). Researchers taking this view must provide an account of how these subtle and untutored predispositions are acquired. Alternatively, the biases may be present from the very earliest stages of linguistic and conceptual development and may operate well before children accumulate a sufficient number of examples to make the appropriate induction. Researchers taking this view must demonstrate such biases in very young word learners. Research with toddlers on the brink of using language may help to adjudicate between these two alternative possibilities (see Waxman, 1987, and Waxman & Kosowski, in press, for evidence of linguistic biases in 2-year-olds).

Existing Knowledge and Conceptual Modification

Because the effect of introducing novel labels (whether nouns or adjectives) is influenced considerably by the subject's existing knowledge, it will be important in future research to delineate more specifically the joint influences of prior knowledge and language in establishing conceptual hierarchies (see Waxman &

Shipley, 1987). Detailed studies designed to capture modifications within hierarchical systems are likely to advance our understanding of these joint influences. Carey's (1985) cross-sectional work illustrates the conceptual reorganization that is characteristic of the development of the concept "animate." Longitudinal case studies represent another promising method for studying conceptual change. Researchers interested in children's implicit rules in problem solving and language (Bowerman, 1982; Karmiloff-Smith, 1981) have used this method successfully to uncover brief but important periods of change. Adapting this method to trace an individual subject's development within a particular domain of knowledge may allow us to compare the nature of the modifications made in early childhood with those made later in adulthood. Further, although novel labels seem to promote identical effects in both the animal and food hierarchies, replications with other items and other hierarchies are warranted to strengthen the claim that these effects are not limited to the stimuli used here.

In conclusion, fascinating parallels link our conceptual hierarchies and the language we use to describe them. Although it will be several years before children will be able to explicitly articulate the logical properties of hierarchical systems and use them consistently in problem solving (Miller & Johnson-Laird, 1976; C. Smith, 1979), the experiments reported here demonstrate that they use information from linguistic context to lay the foundation for that hierarchical structure. Preschool children's early sensitivity to these parallels ensures that in learning new words, they simultaneously learn about conceptual relations among objects and classes of objects.

REFERENCES

Adams, V. (1973). *An introduction to the modern English word formation.* London: Longman.

Anderson, J.R. (1983). *The architecture of cognition.* Boston: Harvard University Press.

Anglin, J. (1977). *Word, object, and conceptual development.* New York: W. W. Norton.

Armstrong, S.L., Gleitman, L.R., & Gleitman, H. (1982). What some concepts might not be. *Cognition, 13,* 263–308.

Baillargeon, R. (1986). Representing the existence and the location of hidden objects: Object permanence in 6- and 8-month-old infants. *Cognition, 23,* 21–41.

Barsalou, L. (1983). Ad hoc categories. *Memory and Cognition, 11,* 211–227.

Berlin, B. (1978). Ethnobiological classification. In E.H. Rosch & B.B. Lloyd (Eds.), *Cognition and categorization.* Hillsdale, NJ: Erlbaum.

Berlin, B., Breedlove, D., & Raven, P. (1973). General principles of classification and nomenclature in folk biology. *American Anthropologist, 75,* 214–242.

Bowerman, M. (1982). Starting to talk worse: Clues to language acquisition from children's late speech errors. In S. Strauss (Ed.), *U-shaped behavioral growth.* New York: Academic.

Brown, C.H., Kolar, J., Torrey, B.J., Truong-Quang, T., & Volkman, P. (1976). Some general principles of biological and non-biological folk classification. *American Ethnologist, 3,* 73–85.

Brown, R. (1957). Linguistic determinism and the part of speech. *Journal of Abnormal and Social Psychology, 50,* 1–5.

Brown, R. (1958). *Words and things: An introduction to language.* New York: MacMillan.

Bruner, J.S., Goodnow, J.J., Austin, G.A. (1956). *A study of thinking.* New York: Wiley.

Carey, S. (1985). *Conceptual change in childhood.* Cambridge, MA: MIT Press.

Chomsky, N. (1965). *Aspects of a theory of syntax.* Cambridge, MA: MIT Press.

Clark, E.V. (1983). Meanings and concepts. In J.H. Flavell & E.M. Markman (Eds.), *Cognitive Development: Vol. 3. Carmichael's manual of child psychology* (pp. 167–230). New York: Wiley.

Gathercole, V.C. (1987). The contrastive hypothesis for the acquisition of word meaning: A reconsideration of the theory. *Journal of Child Language, 14,* 493–531.

Gelman, R., & Baillargeon, R. (1983). A review of some Piagetian principles. In J.H. Flavell & E.M. Markman (Eds.), *Cognitive Development: Vol. 3. Carmichael's manual of child psychology* (pp. 167–230). New York: Wiley.

Gelman, R., & Brown, A. (1985). Early foundations of cognitive development. *Annual Report of the Center for Advanced Study in the Behavioral Sciences,* 46–56.

Gelman, R., & Gallistel, C.R. (1978). *The young child's understanding of number: A window on early cognitive development.* Cambridge, MA: Harvard University Press.

Gelman, S.A., & Markman, E.M. (1985). Implicit contrast in adjectives vs. nouns: Implications for word-learning in preschoolers. *Journal of Child Language, 12,* 125–143.

Gelman, S.A., & Taylor, M. (1984). How two-year-old children interpret proper and common names for unfamiliar objects. *Child Development, 55,* 1535–1540.

Gleitman, L.R., & Gleitman, H. (1970). *Phrase and paraphrase.* New York: Norton.

Gordon, P. (1987, April). *Determiner and adjective categories in children's grammars.* Paper presented at the meeting of the Society for Research in Child Development, Baltimore, MD.

Gould, S.J. (1980). *The panda's thumb.* New York: Norton.

Inhelder, B., & Piaget, J. (1964). *The early growth of logic in the child.* New York: Norton.

Karmiloff-Smith, A. (1981). Getting developmental differences of studying child development? *Cognition, 10,* 151–158.

Katz, N., Baker, E., & Macnamara, J. (1974). What's in a name? A study of how children learn common and proper names. *Child Development, 45,* 469–473.

Keil, F.C. (1981). Constraints on knowledge and cognitive development. *Psychological Review, 88,* 197–227.

Landau, B., & Gleitman, L.R. (1985). *The language of perception in a blind child.* Cambridge, MA: Harvard University Press.

Mandler, J.M., Fivush, R., & Reznick, J.S. (1987). The development of contextual categories. *Cognitive Development, 2,* 339–354.

Marchand, H. (1969). *The categories and types of present-day English word-formation* (2nd ed.). Munich: Beck.

Markman, E.M. (1987). How children constrain the possible meanings of words. In U. Neisser (Ed.), *Concepts and conceptual development: Ecological and intellectual factors in categorization.* Cambridge, England: Cambridge University Press.

Markman, E.M., & Callanan, M.A. (1983). An analysis of hierarchical classification. In R. Sternberg (Ed.), *Advances in the psychology of human intelligence* (Vol. 2). Hillsdale, NJ: Erlbaum.

Markman, E.M., & Hutchinson, J.E. (1984). Children's sensitivity to constraints on word meaning: Taxonomic versus thematic relations. *Cognitive Psychology, 16,* 1–27.

Medin, D.L. (1982). Structural principles of categorization. In B. Shepp & T. Tighe (Eds.), *Interaction: Perception, development, and cognition.* Hillsdale, NJ: Erlbaum.

Mervis, C.B. (1987). Child-basic object categories and lexical development. In U. Neisser (Ed.), *Concepts and conceptual development: Ecological and intellectual factors in categorization.* Cambridge, England: Cambridge University Press.

Mervis, C.B., & Crisafi, M.A. (1982). Order of acquisition of subordinate-, basic-, and superordinate-level categories. *Child Development, 53,* 258–266.

Mill, J.S. (1843). *A system of logic, ratiocinative and inductive.* London: Longmans.

Miller, G.A., & Johnson-Laird, P.N. (1976). *Language and perception*. Cambridge, MA: Harvard University Press.

Murphy, G.L., & Medin, D.L. (1985). Role of theories in conceptual coherence. *Psychological Review, 92*, 289–316.

Nelson, K. (1974). Concept, word, and sentence: Interrelations in acquisition and development. *Psychological Review, 81*, 267–285.

Nelson, K. (1988). Constraints on word learning? *Cognitive Development, 3*, 221–246.

Newport, E.L., & Bellugi, U. (1978). Linguistic expression of category levels in a visual-gestural language: A flower is a flower is a flower. In E. Rosch & B.B. Lloyd (Eds.), *Cognition and categorization*. Hillsdale, NJ: Erlbaum.

Pinker, S. (1979). Formal models of language learning. *Cognition, 7*, 217–283.

Ricciuti, H. (1965). Object grouping and selective ordering in infants 12 to 24 months old. *Merrill-Palmer Quarterly, 11*, 129–148.

Rosch, E.H., Mervis, C.B., Gray, W.D., Boyes-Braem, P., & Johnson, D.N. (1976). Basic objects in natural categories. *Cognitive Psychology, 8*, 382–439.

Shipley, E.F., Kuhn, I.F., & Madden, C.A. (1985). *Categories, hierarchies, and induction*. Unpublished manuscript, University of Pennsylvania, Philadelphia.

Shipley, E.F., & Spelke, E.S. (1990). *Ostensive definitions and labels for parts*. Manuscript submitted for publication.

Smith, C.L. (1979). Children's understanding of natural language hierarchies. *Journal of Experimental Child Psychology, 27*, 437–458.

Smith, E.E., & Medin, D.L. (1981). *Categories and concepts*. Cambridge, MA: Harvard University Press.

Soja, N. (1987). *Ontological constraints on the induction of word meaning in two-year olds*. Unpublished doctoral dissertation, Massachusetts Institute of Technology, Cambridge.

Spelke, E.S. (1982). Perceptual knowledge of objects in infancy. In J. Mehler, M. Garrett, & E. Walker (Eds.), *Perspectives on mental representation*. Hillsdale, NJ: Erlbaum.

Valian, V.V. (1986). Syntactic categories in the speech of young children. *Developmental Psychology, 22*, 562–579.

Vygotsky, L.S. (1962). *Thought and language*. Cambridge, MA: MIT Press.

Waxman, S.R. (1985). *Hierarchies in classification and language: Evidence from preschool children*. Doctoral dissertation, University of Pennsylvania, Philadelphia.

Waxman, S.R. (1987, April). *Linguistic and conceptual organization in 30-month olds*. Paper presented at the meeting of the Society for Research in Child Development, Baltimore, MD.

Waxman, S.R., & Gelman, R. (1986). Preschoolers' use of superordinate relations in classification and language. *Cognitive Development, 1*, 139–156.

Waxman, S.R., & Kosowski, T. (in press). Nouns mark category relations: Toddlers' and preschoolers' word learning biases. *Child Development*.

Waxman, S.R., & Shipley, E.S. (1987, April). *Interactions between existing knowledge and language in subordinate classification*. Paper presented at the meeting of the Society for Research in Child Development, Baltimore, MD.

Wexler, K., & Culicover, P. (1980). *Formal principles of language acquisition*. Cambridge, MA: MIT Press.

Appendix A. Complete list of stimuli

	Superordinate Level		
Classes	**Animals**	**Clothing**	**Food**
Experimenter's clue cards*	dog bird (macaw) fish (grunt)	jacket shirt pants	cookies beef grapes
Child's classification cards	horse elephant duck pig	coat t-shirt skirt dress shirt	banana cake steak ice cream

	Animal-Intermediate Level		
Classes	**Mammals**	**Birds**	**Fish**
Experimenter's clue cards*	rabbit cow fox	tern macaw hummingbird	salmon jack trout
Child's classification cards	cat lamb dog goat	parrot osprey wood-thrush bird	discus parrot-fish cichlid wrasse

	Animal-Basic Level		
Classes	**Dogs**	**Cats** (a variety of members from each class)	**Horses**
Experimenter's clue cards*	setter bulldog poodle	cat cat cat	horse horse horse
Child's classification cards	dog dog dog dog	cat cat cat cat	horse horse horse horse

	Animal-Subordinate Level		
Classes	**Collies**	**Irish Setters** (a variety of members from each class)	**Terriers**
Experimenter's clue cards*	collie collie collie	setter setter setter	terrier terrier terrier
Child's classification cards	collie collie collie collie	setter setter setter setter	terrier terrier terrier terrier

Appendix A. *(Continued)*

	Food-Intermediate Level		
Classes	**Meat**	**Sweets**	**Fruit**
Experimenter's clue cards*	beef chicken ham	pie cupcake chocolate	green grapes banana apple
Child's classification cards	bacon steak chicken ham	cookies pie doughnut cake	canteloupe raspberries pear strawberries
	Food-Basic Level		
Classes	**Watermelons**	**Peaches**	**Grapes**
	(a variety of members from each class)		
Experimenter's clue cards*	watermelon watermelon watermelon	peach peach peach	green grapes red grapes purple grapes
Child's classification cards	watermelon watermelon watermelon watermelon	peach peach peach peach	red grapes green grapes purple grapes purple grapes
	Food-Subordinate Level		
Classes	**Red Grapes (Ribier)**	**Purple Grapes (Concord)**	**Green Grapes (Thompson)**
	(a variety of members from each class)		
Experimenter's clue cards*	red grapes red grapes red grapes	purple grapes purple grapes purple grapes	green grapes green grapes green grapes
Child's classification cards	red grapes red grapes red grapes red grapes	purple grapes purple grapes purple grapes purple grapes	green grapes green grapes green grapes green grapes

*The experimenter presented the clue cards in the Instance and Novel Noun conditions. The clue cards were not used in the Control condition.

(continued)

Appendix A. (*Continued*)

Novel Labels Used in Experiments 1 and 3

Superordinate Level:

Class	Animals	Clothing	Food
Experiment 1:	dobutsus	kimonos	gohans
Experiment 3:			
Noun	dobits	kimens	hogids
Adjective	dob-ish	kim-ish	hog-ish

Animal-Intermediate Level:

Class	Mammals	Birds	Fish
Experiment 1:	torays	honus	sakanas

Animal-Basic Level:

Class	Dogs	Cats	Horses
Experiment 1:	umas	inus	nikos
Experiment 3:			
Noun	umoks	tornads	nekins
Adjective	um-ish	in-ish	nik-ish

Animal-Subordinate Level:

Class	Collies	Setters	Terriers
Experiment 1:	akitas	akas	tosas
Experiment 3:			
Noun	akids	kitas	toseps
Adjective	ak-ish	kit-ish	tos-ish

Food-Intermediate Level:

Class	Meat	Sweets	Fruits
Experiment 1:	ayatzus	nikus	kudas

Food-Basic Level:

Class	Watermelons	Peaches	Grapes
Experiment 1:	suikahs	momos	budas
Experiment 3:			
Noun	suikahs	momos	budips
Adjective	suk-ish	mom-ish	bud-ish

Food-Subordinate Level:

Class	Red Grapes	Purple Grapes	Green Grapes
Experiment 1:	kudahs	fadas	shiras
Experiment 3:			
Noun	kudahs	fabins	shirets
Adjective	kud-ish	fab-ish	shir-ish