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One Cow Does Not an Animal Make: Young Children Can Extend Novel Words at the Superordinate Level

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Six match-to-sample picture/object selection experiments were designed to explore children's knowledge about superordinate words (e.g., "food") and how they acquire this knowledge. Three factors were found to influence the learning and extension of superordinate words in 3- to 5-year-old children (N = 230): The number of standards (one versus two), the type of standards presented (from different basic-level categories versus from the same basic-level category), and the nature of the object representations used (pictures versus objects). A different pattern of superordinate word acquisition was found between 3-year-olds and 4- and 5-year-olds. Although 4- and 5-year-olds could learn and extend novel words to superordinate categories in the presence of two picture exemplars from different categories or a single three-dimensional (3-D) exemplar, 3-year-olds could do so only in the presence of two 3-D exemplars. These findings indicate that young children's acquisition of superordinate words is influenced by multiple factors and that there is a developmental progression from multiple exemplars to single exemplars in superordinate word learning.

INTRODUCTION

Research in both language acquisition and categorization converges on the precedence of basic-level words and basic-level categories (Anglin, 1977; Golinkoff, Shuff-Bailey, Olguin, & Ruan, 1995; Mervis, 1987). That is, children can categorize and label objects at the basic level (e.g., shirt) long before they can do so at other levels (e.g., clothes). However, previous studies are at odds about the acquisition of superordinate words (Golinkoff et al., 1995; Imai, Gentner, & Uchida, 1994; Markman & Hutchinson, 1984). On the one hand, it has been reported that children as young as 23 months can use a few superordinate words, such as "animal" and "food" (Fenson et al., 1994). On the other hand, reliable novel-word extension at the superordinate level when perceptual similarity between category members was controlled was not observed until age 7 (Golinkoff et al., 1995). Ultimately, children do acquire words for both basic- and superordinate-level categories, regardless of their initial assumptions about novel words (Golinkoff, Mervis, & Hirsh-Pasek, 1994; Kemler-Nelson, 1995; Landau, Smith, & Jones, 1988; Markman & Hutchinson, 1984). Nevertheless, why are the findings on superordinate word acquisition so disparate, and, more fundamentally, how do children learn novel words for superordinate categories? Previous studies have explored the effect of cognitive constraints (Golinkoff et al., 1995; Imai et al., 1994; Markman & Hutchinson, 1984), linguistic input, and pragmatic factors (Callanan, 1989; Clark & Grossman, 1998) on superordinate word acquisition. One important factor that has been little studied in superordinate word learning is the nonlinguistic context. In this study, we explored how nonlinguistic context—in particular the presence of multiple exemplars, as well as the nature of object representations—can influence children's acquisition of superordinate words.

Superordinate words make it possible to talk about a diversity of kinds in a more efficient and economical way than mentioning each basic-level category (Markman, 1989). Knowing superordinate terms allows one to take different conceptual perspectives on the same entity or to take the same perspective on several different entities (Clark, 1997). For example, knowing that a furry creature can be referred to more specifically as a "cat" (in contrast to a dog) or more generally as an "animal" (in contrast to a plant) is useful. Knowing that both a banana and an orange are "fruit" allows one to infer the characteristics these objects share. Unlike basic-level words that refer to objects that are often perceptually similar and found in all languages, superordinate words refer to categories that are often perceptually more diverse and functionally more variable cross-culturally (Markman, 1985; Rosch, Mervis, Gray, Johnson, & Boyes-Braem, 1976). For example, the two superordinate categories of "animals" and "plants" are separated into three categories for Groote Eylandt Australian aborigines: biological, food, and totemic (Waddy, 1982). Thus, in order to use superordinate words appropriately, children have to learn the way in which their community "carves up" superordinate categories.

Given the complicated nature of superordinate words, research has yielded discrepant findings about children's acquisition of novel superordinate words.

The Taxonomic Assumption (Markman & Hutchinson, 1984) proposed that 4-year-old children could extend novel words to both basic- and superordinate-level categories. In a match-to-sample task, children presented with a picture standard (e.g., a cow) referred to using a novel label (e.g., a *dax*), a thematic choice label (e.g., milk), and a taxonomic choice label (e.g., a pig), often selected the taxonomic option when asked to "find another dax" in the Word condition. When asked to "find another one" in the No Word condition, children selected the thematic option—the milk. This finding suggests that children expect novel words to be extended to taxonomic categories, or to categories of "like kind." However, the greater perceptual similarity between the standard (a cow) and the taxonomic choice (a pig) than between the standard and the thematic choice (milk) suggested another possible reason for children's apparent taxonomic extension: Children may expect novel word extension to be based on perceptual similarity, particularly shape (Landau et al., 1988). If true taxonomic extension is occurring, children should tend to select the taxonomic item even when the taxonomic item does not resemble the standard.

This is not what Imai et al. (1994) found, however. In their study, the perceptual similarity between the superordinate taxonomic options and the standards was controlled and a shape option was added. For example, when the standard was an apple, the taxonomic option was a bunch of grapes, the thematic option was a knife, and the shape option was a balloon. Both 3- and 5-year-olds demonstrated a marked shift from thematic responses in the No Word condition to shape responses in the Word condition, with 5-year-olds displaying a higher number of taxonomic selections than 3-year-olds in the Word condition. Such a shift might be caused by the different types of instructions used in the two conditions. In the Word condition, children were asked to "Find another dax," whereas in the No Word condition they were asked to find the one that "goes with" the standard. Because the instruction "goes with" tends to elicit more thematic responses (Waxman & Namy, 1997), this may have caused the difference between the Word and No Word condition. Despite a significant increase in taxonomic responses to 28% in the Word condition, however, 5-year-olds' performance did not exceed chance level (33%).

Golinkoff et al. (1995; Experiment 6) used the more neutral "Find another one" instruction in the No Word condition, and minimized the overall perceptual similarity between the standards and the taxonomic items. Again, 4-year-olds failed to display reliable novel word extension at the superordinate level, although they could do so at the basic level. Furthermore, not until they were 7 years of age could children reliably learn and extend novel words at the superordinate level when perceptual similarity was controlled (Golinkoff et al., 1995; Experiment 5). Apparently, unlike the extension of basic-level words, superordinate word extension is not a prominent hypothesis at the beginning of word learning.

Nevertheless, young children seem to be able to use some superordinate words by the age of 23 months (Fenson et al., 1994). So why do they fail to show novel superordinate word extension in match-to-sample tasks? Perhaps young children prefer not to accept superordinate labels for single objects, as would be predicted by the Mutual Exclusivity Hypothesis (Markman & Watchel, 1988) which states that children assume that each object has only one label. Because young children often learn basic-level names first, they may resist mapping superordinate labels to the same objects. In contrast to this hypothesis, however, Blewitt (1994) reported that 2- and 3-year-olds accepted both basic- and superordinate-level words for single objects.

Another possibility is that young children may know less about superordinate categories than their use of the superordinate terms suggests. For example, when asked to give instances of categories such as animals, only 7-year-olds demonstrated knowledge that different basic-level objects (e.g., cat and horse) were exemplars of the same superordinate category (Lucariello, Kyratzis, & Nelson, 1992). Younger children, when asked to give instances of food, tended to list only names of event-bound objects, such as chicken and steak, that are often eaten at dinner. Furthermore, although 4- and 5-year-olds could accurately and consistently make taxonomic inferences about novel objects based on familiar superordinate labels (Blewitt, 1989; Gelman & O'Reilly, 1988), only some 3-year-olds could do so (Blewitt, 1989, 1994). Bauer and Mandler (1989) claimed that children as young as 19 months displayed comprehension of both basic and superordinate taxonomic relations. Their study, however, explicitly used nonverbal reinforcement and systematically alternated the correct choices during testing trials when only two choices were available. In general, these findings indicate that children's occasional use of familiar superordinate labels is insufficient evidence for comprehension of superordinate words (Clark, 1997; Smith & Medin, 1981). They may simply interpret a superordinate label as another name for a specific object, just as "boy," "brother," and "David" can refer to the same person.

Children's comprehension of novel superordinate words, however, may involve groups of objects instead of single objects. Superordinate words have been shown to be used more often (70% of the time) in written context to refer to groups of objects than to refer to single objects (Wisniewski & Murphy, 1989). In addition, mothers are more likely to use superordinate words to label groups of objects rather than single objects (Lucariello & Nelson, 1986; Shipley, Kuhn, & Madden, 1983). When presented with several objects from different basic-level categories, mothers used superordinate words 68% of the time and 2-year-olds used superordinates 48% of the time. When introducing a single object, however, mothers used superordinates only 27% of the time and children mirrored this frequency by using superordinate words 17% of the time. These data show that children *can* use familiar superordinate words when presented with multiple objects, which is consistent with the finding that preschoolers might understand superordinate words as referring to "categories of categories" (Shipley, 1989). For example, when asked to give instances of a superordinate label—"Tell me two animals"—3- and 4-year-olds consistently mentioned two different kinds of animals: for example, "giraffe and monkey." When asked to "Tell me two dogs," they would give two proper names: for example, "Silo and Timon."

Theoretically, the presence of multiple exemplars from different basic-level categories labeled by a novel word provides a context that allows for the comparison of exemplars and the ability to make inferences about the common taxonomic relation between them (Structural Alignment Theory; Gentner, 1997), as well as a context that allows for the alteration of initial hypotheses about the novel word (most probably at the basic level) and enables word generalization at the appropriate level of specificity (Bayesian Framework in word learning; Tenenbaum & Xu, 2000). For example, 18-month-olds who compared instances of two object kinds in a sorting task were more likely to spontaneously sort objects into categories than those who did not engage in comparison (Namy, Smith, & Gershkoff-Stowe, 1997). In addition, preschoolers who compared several instances of a category in a sorting task were more likely to learn and extend a novel word correctly in a word-learning task (Kuczaj, Borys, & Jones, 1989). In Tenenbaum and Xu (2000), when a single exemplar was presented, adults tended to interpret novel words at the basic or subordinate level. On the contrary, when multiple exemplars were presented, they switched to an all-or-none, rule-based generalization, which resulted in an increase in superordinate word interpretation.

Both empirical findings and theoretical reasoning suggest that the presence of multiple exemplars may help children to learn superordinate word. Perhaps children's inability to show convincing superordinate word extension in previous studies (e.g., Golinkoff et al., 1995; Imai et al., 1994) is attributable to the presence of a single standard. With a single exemplar labeled by a novel word, and a demonstrated preference for basic-level names (Golinkoff et al., 1995; Rosch et al., 1976), children may have been confused as to whether the novel word was a basic-level word, a superordinate word, or a subordinate word. In the presence of a single object, a basic-level interpretation makes sense. When multiple exemplars from the same superordinate category (e.g., a banana and an orange) are labeled by a novel word, a basic-level interpretation of the novel word is inappropriate. Consequently, superordinate words may be elicited and best understood in the presence of several objects from different basic-level categories. This speculation was supported by research (Callanan, 1989), in which a puppet "taught" new words to 3- and 5-year-old children by pointing to either one or two pictures and labeling them with one or two novel names. Two kinds of instructions were used in the single-standard condition when the puppet pointed to a picture (e.g., a dog). One was, "This is a *terval.*" The other contained an inclusion statement, "This is a *wug.* A wug is a kind of terval." In the two-standard condition, the puppet pointed to the two standards (e.g., a dog and a cat) saying, "This is a terval. This is another terval." or "This is a wug. A wug is a kind of terval. This is another terval." Children were then shown an array of stimuli composed of three basic-level objects, three superordinate-level objects, three subordinate-level objects, and three unrelated objects. Presented with these objects one by one, children were asked whether each one was a "terval." Children who saw one standard were most likely to interpret the novel word at the subordinate or basic level, despite the presence of an inclusion statement or multiple labels. Children who saw two standards without an inclusion statement or multiple labels did not show superordinate word interpretation. When presented with two standards (each from a different basic-level category) in addition to an inclusion statement or multiple labels, however, half of the children tended to interpret the word at the superordinate level. Such results indicate that nonlinguistic context, such as multiple objects, is an important factor that will increase the likelihood that a novel word will be interpreted at the superordinate level.

Unfortunately, Callanan's (1989) study did not control for the perceptual similarity between category members. Taxonomic membership was confounded by perceptual similarity. For example, a truck, a jeep, and a tractor are much more similar to the standard (i.e., a sedan) than a drum, sandals, and a watermelon. As Callanan (p. 210) herself noted, no doubt children "were more likely to choose pictures that were most similar to the exemplar(s)." Furthermore, the proportion of children's word extension at the superordinate level was only marginal.

Importantly, Callanan's findings suggest that young children are sensitive to the linguistic instructions as well as the nonlinguistic context (i.e., the presence of multiple exemplars) in superordinate word learning. Whether young children interpreted novel words as labels for superordinate categories or simply objects that looked alike is unclear, however. To show that children can indeed extend novel words to superordinate categories based on taxonomic relations instead of perceptual attributes, perceptual similarity must be experimentally separated from taxonomic membership.

In the present study, we strictly controlled the perceptual similarity between category members in an attempt to explore the effect of multiple exemplars on children's superordinate word learning. Another nonlinguistic factor addressed was the nature of the exemplars children saw when learning new superordinate words. Much literature has indicated that children are sensitive to whether the stimuli they see are real objects, miniature objects, photographs, or pictures (Cocking & McHale, 1981; DeLoache, Miller, & Pierroutsakos, 1998). In this study, we compared the effectiveness of pictures versus miniature objects in helping children to learn and extend novel superordinate words. We believed that the presence of multiple objects as opposed to single objects, or real objects as opposed to pictures, would provide the information necessary for children to learn and extend superordinate words.

EXPERIMENT 1

This first experiment tested whether 3- to 5-year-olds could extend novel words at the superordinate level when presented with two standards from different, familiar basic-level categories. The perceptual similarity between the standards and the taxonomic item was kept to a minimum. There were also a thematic choice and two corresponding perceptual choices, making four response options altogether. The question addressed was whether the presence of two dissimilar objects from different basic-level categories could promote preschoolers' superordinate word extension.

Method

Participants

Forty-two 4- and 5-year-olds (M = 4,9, *range* = 4,1–5,8; 18 boys and 24 girls), were tested individually in a quiet room either in a preschool or in our University laboratory. Participants were semirandomly assigned to either a Word or a No Word condition. Twenty-one 4- and 5-year-olds (12 girls and 9 boys) were tested in the Word condition and the other 21 children were tested in the No Word condition. Sixteen 3-year-olds (M = 3,6, *range* = 3,0–3,11; 8 boys and 8 girls) were tested in the Word condition only. A certificate for participation and a sticker were given as rewards to each participant after the test. Three additional 4- and 5-year-olds and two additional 3-year-olds' data were not included due to the inappropriate selection of all items or failure to finish the experiment.

Stimuli and Similarity Ratings

The stimuli consisted of 30 laminated, colored, line drawings on 10 cm × 10 cm white cards. Each card depicted one object. There were five sets of stimuli, each composed of two picture standards (e.g., a banana and an orange), a thematic choice (e.g., a fruit bowl), a taxonomic choice (e.g., a bunch of grapes), and two perceptual choices (e.g., a crescent moon and a basketball). Because young children are more likely to engage in superordinate word extension with familiar categories, the categories of fruit, clothes, food, animal, and dessert were used. These are among the earliest superordinate words children use (Anglin, 1977; McNamara, 1982; Mervis & Crisafi, 1982). Table 1 gives a complete list of all the stimuli.

Figure 1 shows a sample stimulus set. The two perceptual items also served as unrelated items. For example, the moon was a perceptual item for the banana while being unrelated to the orange; on the other hand, the basketball was unrelated to the banana while being a perceptual item for the orange. Golinkoff et al. (1995; Experiment 2) had shown that 4-year-olds would not extend a novel word to an item that had no apparent relation to the standard.

The four pictures serving as response options for each standard were randomly arranged side by side in a single row. The order of the arrangement was balanced across trials. The two standards were placed in one row above the response options. The position of the two standard pictures also varied for different participants. The order of the presentation of each stimulus set varied randomly across participants.

To determine that the perceptual items were indeed more similar to the standards than either the taxonomic or the thematic items, similarity ratings were obtained from adults. For each of the five sets of stimuli, each of the two standard stimuli was paired with each of the four response options. The resulting 40 pairs of pictures were presented in random order.

Table 1 Stimuli Used in Experiment 1, Experiment 2, Experiment 3, and Corresponding Similarity Ratings

	Response Choices		
Standards	Perceptual 1 Perceptual 2	Taxonomic	Thematic
Banana	Crescent moon 8.47 (.87)		
Orange	Basketball 7.88 (1.10)	Grapes 1.97 (1.24)	Fruit bowl 2.88 (1.55)
Ice cream cone	Tree 7.88 (.99)		
Cookie	Penny 7.00 (2.45)	Brownie 1.74 (1.38)	Open mouth 1.38 (.65)
Donut	Mountain 6.29 (1.90)		
Birthday cake	Top hat 7.82 (1.78)	Slice of pie 2.53 (1.60)	Plate 4.09 (2.18)
Giraffe	Sliding board 6.82 (2.01)		
Zebra	Striped couch 6.82 (1.91)	Rabbit 2.32 (1.45)	Grassland 1.65 (.92)
Shirt	Dalmatian 5.76 (2.19)		
Dress	Lamp 5.94 (2.16)	Pants 2.82 (1.87)	Closet 1.71 (.84)
Mean ratings	7.07 (.85)[a]	2.28 (.43)	2.34 (1.13)

Note: In Experiment 2, each of the 5 sets was divided to make 10 sets. The standard and the corresponding perceptual item on the same line in the table were combined with the same taxonomic and thematic choice to make a set. In Experiment 3, each of the 5 sets was divided to make 10 sets. Each standard was combined with the corresponding four choices to make a set. Values in parentheses are standard deviations.
[a] The perceptual similarity ratings for the two perceptual choices were averaged.

Participants (17 college students; 10 females and 7 males) were told to rate each picture pair on the basis of how much the two pictures looked alike on a scale of 1 (extremely dissimilar) to 9 (extremely similar). They were told to ignore their knowledge of these objects and to focus their attention primarily on the appearance of the objects as if they knew nothing else about them. As predicted, the perceptual choices received a significantly higher mean similarity rating (M = 7.07, SD = .85) than taxonomic choices (M = 2.28, SD = .43), paired-sample $t(16) = 17.80$, $p < .001$; thematic choices (M = 2.34, SD = 1.13), paired-sample $t(16) > 20$, $p < .001$; and unrelated items (M = 2.16, SD = 1.25), paired-sample $t(16) > 20$, p's $< .001$. The resulting ratings for one stimulus set are given in Figure 1.

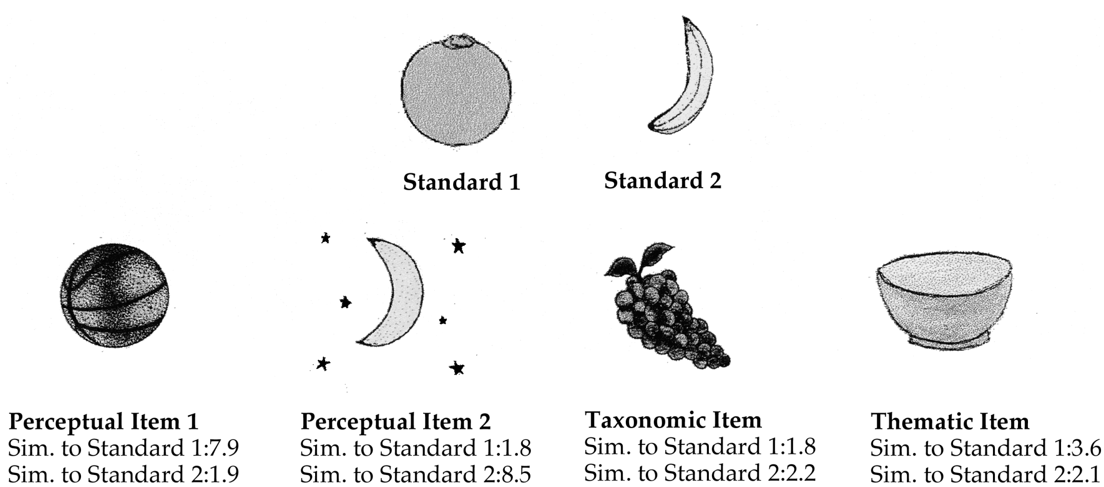

Figure 1 Sample set of stimuli used in Experiment 1. Similarity (Sim.) ratings were based on adult judgment. See Stimuli and Similarity Ratings section in Experiment 1.

Procedure

One experimenter presented the stimulus pictures and asked the questions while another recorded participants' responses. The experiment had two phases.

Familiarization phase. The purpose of this preliminary task was to make sure that each child knew the basic-level name for the stimulus pictures. The stimulus pictures were placed four at a time in front of the participant in random combination. The researcher then asked the participant "What is this?" while pointing to a picture. If the participant did not have a basic-level name for the picture or made a mistake, the researcher would give the correct name and then present this picture to the participant again after all other pictures were correctly identified. This procedure was repeated until the participant correctly produced the names for all the pictures.

Test phase. Children were introduced to a puppet named "Mr. Bear." In the Word Condition, the experimenter told the participant "Mr. Bear speaks a different language, so he has different names for things." Then the researcher presented the standard stimuli (e.g., a banana and an orange), and said while pointing to them, "See these? Mr. Bear calls them *chams.* This is a kind of cham (pointing to one picture), and this is a kind of cham, too (pointing to a second picture). Both of these are called chams." Then she laid out the four choices (a crescent moon, a basketball, a bunch of grapes, and a fruit bowl). Pointing to the two standards again, the experimenter said, "Remember that Mr. Bear calls both of these chams." Then she moved her hand back and forth between the four choices, saying, "Now look at these. Can you find Mr. Bear another kind of cham here? Show me which one of these is another kind of cham." The participant was expected to point to only one of the items. Other novel words used were *dax*, *glorp*, *fep*, and *riv.* The particular novel word used for each stimulus set varied randomly for each participant.

In the No Word Condition, the experimenter presented the two standard pictures and told the participant, "See these? Mr. Bear thinks these are the same kind of things. This is one (pointing to the first picture), and this is another one (pointing to the second picture). Both of these are the same kind of things." Then she presented the four choices. Pointing to the two standards, the experimenter reminded the participant, "Remember Mr. Bear says these are the same kind of things." Moving her hand back and forth randomly between the four choices, the experimenter said, "Now look at these! Can you find Mr. Bear another one that is the same kind of thing? Show me which one of these (pointing to the stimuli) is the same as these (pointing back to the standards)." for both conditions, the experimenter said "OK" or "Thank you" in a neutral tone of voice after the participant's responses. The directions in the No Word condition, although not identical to those in the Word condition, were designed to heighten the likelihood that children would make taxonomic selections, and, therefore, work against our hypothesis.

We expected that participants in the Word condition would select significantly more superordinate taxonomic items than other choices. In the No Word condition, no tendency toward superordinate taxonomic selections was expected. The No Word condition served as a control to examine whether children had any preference for grouping objects in the absence of category labels. Comparison of children's selections in the Word and No Word conditions thus provided information about whether children selected an item based on its taxonomic membership or their personal preference. As a control, 10 adults were tested in the Word condition. They were told that there was a Bear who spoke a language called Bearese and were given the same instructions as in the Word condition. All adults selected taxonomic items on 100% of the trials.

Results

Could children identify the stimulus pictures? Children had little or no difficulty in labeling the pictures. The overall error rate was 1.9% for 4- and 5-year-olds and 2.1% for 3-year-olds, determined by dividing the total number of errors by the total number of pictures presented. All participants correctly labeled the pictures after only one repetition.

Did children make a significant number of taxonomic selections in the Word condition? Different response patterns were found between 3-year-olds and 4- and 5-year-olds. For the 4- and 5-year-olds, the percentage of taxonomic selections (70%) in the Word condition exceeded chance level (25%), $t(20) = 5.41$, $p < .001$. Despite the presence of two salient perceptual choices, children selected more taxonomic items than perceptual items in the Word condition, paired-sample $t(20) = 3.22$, $p < .01$. In the No Word condition, the opposite pattern resulted: children's taxonomic selections (30%) were only at chance level, $t(20) = .50$, $p > .05$. They selected more perceptual than taxonomic items, paired-sample $t(20) = 1.95$, $p < .05$. Their perceptual selections, however, were not significantly different from chance level, $t(20) = 1.61$, $p > .05$. Table 2 displays children's selections by age, condition, and response type.

Table 2 Mean Percentages of Taxonomic, Thematic, and Perceptual Choices in Each Experiment

Experiment	Age (yr)	N	Condition	No. of Standards	Types of Responses			
					Perceptual	Taxonomic	Thematic	Unrelated
1	4 and 5	21	Word	2	23 (29)	70 (38)**	7 (12)	
	4 and 5	21	No word	2	65 (42)**	30 (42)	5 (11)	
	3	16	Word	2	44 (21)	40 (28)	16 (17)	
2	5	22	Word	1	70 (27)**	19 (23)	11 (16)	
3	4 and 5	16	Word	1	54 (35)**	33 (34)	6 (12)	7 (10)
4	4 and 5	21	Word	2	44 (30)	53 (32)*	3 (8)	
	4 and 5	21	No word	2	54 (32)	39 (34)	7 (11)	
5	3	20	Word	2	14 (20)	80 (27)**	6 (13)	
	3	20	No word	2	53 (32)	38 (30)	9 (14)	
6	4 and 5	18	Word	1	23 (29)	68 (30)*	6 (10)	3 (7)
	4 and 5	18	No word	1	69 (30)**	31 (29)	0 (0)	0 (0)
	3	16	Word	1	46 (29)*	20 (18)	18 (19)	16 (19)

Note: Values in parentheses are standard deviations.
$^{*}p < .01$; $^{**}p < .001$.

Three-year-olds made roughly the same number of taxonomic ($M = 2.00$, $SD = 1.41$) and perceptual selections ($M = 2.18$, $SD = 1.04$) in the Word condition, paired-sample $t(15) = .32$, $p > .05$, but very few thematic selections ($M = .82$, $SD = .83$). Their taxonomic selections (40%) were not significantly different from chance (25%), $t(15) = 2.12$, $p > .05$; nor were their perceptual selections (44%) different from chance (50%), $t(15) = 1.19$, $p > .05$. Because 3-year-olds failed to show reliable taxonomic preference in the Word condition, they were not tested in the No Word condition.

Due to the different number of participants in the 3-year-old group versus 4- and 5-year-old group and the dependence of the number of taxonomic, perceptual, and thematic selections (a participant could make only one type of selection on each trial), two separate General Linear Model (GLM) analyses of variance (ANOVAs) were conducted to compare the two groups' taxonomic and perceptual selections in the Word condition. Because there were very few thematic selections, this variable was ignored in the analysis. A significant difference was found between the two age groups: 4- and 5-year-olds made significantly more taxonomic selections, $F(1, 36) = 6.84$, $p < .05$, and fewer perceptual selections, $F(1, 36) = 5.88$, $p < .05$, than 3-year-olds.

Did 4- and 5-year-olds make more taxonomic selections in the Word condition than in the No Word condition? Again, because of the dependence of dependent variables and the unbalanced number of boys and girls in the Word and No Word conditions, two separate GLM ANOVAs were conducted to compare children's performance in the two conditions, with condition and gender as the between-subjects factors, age as the covariate, and response type (taxonomic or perceptual) as the within-subjects factor. Three-year-olds were excluded from this analysis because they were tested in the Word condition only.

A significant effect for condition on the number of taxonomic selections was found, $F(1, 36) = 4.19$, $p < .05$, indicating that 4- and 5-year-olds in the Word condition tended to select significantly more taxonomic items than those in the No Word condition. There was no significant interaction between gender and condition, $F(1, 36) = 2.23$, $p > .05$, although a significant interaction between age and condition was found, $F(1, 36) = 4.26$, $p < .05$. This significant interaction was caused by children's performance in the No Word condition in which the older the children were, the more taxonomic items they selected, $r(21) = .62$, $p < .01$. In the Word condition, children's taxonomic selections were not significantly related to their age, $r(21) = .10$, $p > .05$. An item analysis using item sets as a random variable also yielded a significant effect for condition on children's taxonomic responses, indicating that the effect was caused by all the items, $F(1, 9) = 91$, $p < .001$.

A main effect for condition was also found on the number of perceptual selections, $F(1, 36) = 5.18$, $p < .05$. Children made significantly more perceptual selections in the No Word condition than in the Word condition. There was a significant interaction between age and condition, $F(1, 36) = 4.17$, $p < .05$. Again, this interaction was caused by children's performance in the No Word condition. In general, the older the children were, the fewer perceptual choices they selected in the No Word condition.

Did children show differential response preferences in the two conditions? A response preference was scored if a child selected the same type of choice on over 80%

of the trials (i.e., four or more trials out of five). Children who did not meet this criterion were assumed to have no particular response preference and were scored as inconsistent. As shown in Table 3, in the No Word condition, 62% (13 children) of the 4- and 5-year-olds showed a perceptual response preference. When asked to select an object by name in the Word condition, however, 57% of the 4- and 5-year-olds consistently preferred the taxonomic alternatives. Of these, 90% (11 out of 12) selected taxonomic items on 100% of the trials.

Three-year-olds displayed a different pattern of response preferences. In the Word condition, 19% or 3 children showed taxonomic response preferences and 6% or 1 child showed a perceptual response preference, whereas 75% or 12 children showed no response preferences. No data for 3-year-olds' response preferences were collected in the No Word condition.

Were 4- and 5-year-olds' responses in the two conditions related to how perceptually similar an item was to the standard? In the Word condition, a significant negative correlation was found, $r(20) = -.49$, $p < .05$. In the No Word condition, the correlation was not significant, $r(20) = .38$, $p > .05$. This analysis provided further evidence that children's selection of taxonomic items in the Word condition was not based on perceptual similarity.

Discussion

This experiment examined whether 3- to 5-year-old children could extend novel words at the superordinate level when presented with two standards from different basic-level categories of the same superordinate category. Importantly, the standards and the taxonomic choices did not look alike. Therefore, unlike some prior studies, children could *not* make taxonomic selections merely based on perceptual similarity. The hypothesis that multiple standards would promote the taxonomic superordinate extension of a novel word was confirmed in 4- and 5-year-olds: Children selected significantly more taxonomic items and displayed more taxonomic preferences in the Word condition than in the No Word condition. That is, they extended the novel label "dax," which the experimenter used to refer to a banana and an orange, to another referent within the same taxonomic category, such as a bunch of grapes, rather than to a crescent moon or a basketball—items that were selected to be perceptually similar to the standards. More than half of the 4- and 5-year-olds demonstrated taxonomic response preferences. It appears that the presence of multiple exemplars from different basic-level categories helped 4- and 5-year-olds to construe the meanings of novel words at the superordinate level.

However, 3-year-olds did not demonstrate reliable superordinate word extension under the same circumstance as 4- and 5-year-olds, and only a few 3-year-olds (3 out of 16) displayed taxonomic response preferences. These findings challenge those found in research by Markman and Hutchinson (1984) and Callanan (1989), in which perceptual similarity between category members was *not* controlled. Recall that even 6-year-olds could not extend a novel word at the superordinate level when perceptual similarity was controlled and a single standard was used (Golinkoff et al., 1995). The present experiment showed that the nonlinguistic context, and in particular the presence of

Table 3 Number of Children Showing Response Preferences in Each Experiment

Experiment	Age (yr)	*N*	Condition	Types of Preferences: Perceptual	Taxonomic	Thematic	Inconsistent
1	4 and 5	21	Word	2 (10)	12 (57)	0 (0)	7 (33)
	4 and 5	21	No word	13 (62)	5 (24)	0 (0)	3 (14)
	3	16	Word	1 (6)	3 (19)	0 (0)	12 (75)
2	5	22	Word	14 (63)	1 (5)	0 (0)	7 (32)
3	4 and 5	16	Word	7 (44)	3 (19)	0 (0)	6 (37)
4	4 and 5	21	Word	5 (24)	7 (33)	0 (0)	9 (43)
		21	No word	5 (24)	4 (19)	0 (0)	12 (57)
5	3	20	Word	0 (0)	14 (70)	0 (0)	6 (30)
	3	20	No word	7 (35)	3 (15)	0 (0)	10 (50)
6	4 and 5	18	Word	2 (11)	10 (56)	0 (0)	6 (33)
	4 and 5	18	No word	10 (56)	2 (11)	0 (0)	6 (33)
	3	16	Word	4 (25)	0 (0)	0 (0)	12 (75)

Note: A response preference is defined as four or more out of a possible 5 responses of the same type. All other combinations of choices are defined as inconsistent. Values in parentheses are percentages.

multiple exemplars, could promote superordinate word acquisition in 4- and 5-year-olds.

Before concluding, however, that it was the presence of multiple standards that promoted superordinate word learning and extension, two other possible sources of the effect must be ruled out. First, the instructions in this study were different from those used in previous studies: "Find another kind of dax" was used rather than "Find another dax." Although Markman and Hutchinson (1984) found that there was no significant difference between these two instructions, other research suggested that the use of the "kind of" instruction might give children a sense of hierarchy (Callanan, 1989; Clark & Crossman, 1998). Thus, we performed a second experiment in which we returned to the use of a single standard but paired it with the "kind of" instruction to see if the results in Experiment 1 had been driven by the instructions rather than by the presence of multiple standards. If that was indeed the case, then children would select the taxonomic choice even when a single standard was presented. Furthermore, Experiment 2 also explored the possibility that we inadvertently selected "easy" superordinate taxonomic items in Experiment 1.

EXPERIMENT 2

This experiment was designed to answer the question, "Would young children extend a novel word at the superordinate level in the presence of only a single standard when the 'kind of' instruction used in Experiment 1 was employed?" Although prior research (e.g., Golinkoff et al., 1995; Imai et al., 1994) indicated that children at the ages of 4 and 5 would not make reliable taxonomic selections at the superordinate level with a single standard presented, this experiment was essential to disambiguate the taxonomic effect found in Experiment 1.

Method

Participants

Twenty-two participants (M = 5,3, *range* = 4,2–6,0; 10 boys and 12 girls) were recruited and tested in the Word condition only.

Stimuli

The same stimuli in Experiment 1 were rearranged into two different groups, each group containing five sets of stimuli. Both sets contained the same taxonomic and thematic choices but had different standards and corresponding perceptual items. As seen in Table 1 and Figure 1, one stimulus set now contained an orange (standard), a basketball (perceptual), the grapes (taxonomic), and a fruit bowl (thematic). The other set constructed from the original set contained a banana (standard), a crescent moon (perceptual), the grapes, and a fruit bowl. Half of the participants were presented with one set of stimuli; the other half with the opposite set.

Procedure

The same procedure as in the Word condition of Experiment 1 was followed.

Results

Could children identify the stimulus pictures? The overall error rate was 2.3%, and all participants correctly labeled the pictures after only one repetition.

Did children make a significant number of taxonomic selections when presented with a single standard? A preliminary ANOVA found no selection differences between the groups receiving the two different stimulus sets. Their data were therefore combined. Children made fewer taxonomic selections (M = .95, SD = 1.17) than perceptual selections (M = 3.5, SD = 1.17), paired-sample $t(21) = 5.0$, $p < .001$. As shown in Table 2, children's taxonomic selections (19%) were below chance (33.3%), $t(21) = 2.54$, $p < .05$. In contrast, children's perceptual selections (70%) were significantly above chance (33.3%), $t(21) = 6.49$, $p < .001$. Again, few thematic items were selected (11%).

Did children show any response preferences? As shown in Table 3, 63% of the participants (10 children) showed perceptual response preferences, 5% (1 child) showed a taxonomic response preference, and 32% (7 children) showed no response preference. No thematic response preference was found.

Discussion

When presented with a single standard from the same pool of stimuli used in Experiment 1, and using the same instructions ("Find another kind of dax"), 4- and 5-year-olds could not reliably extend a novel word at the superordinate level. This experiment thus replicated the findings of Golinkoff et al. (1995) and Imai et al. (1994), which used the same experimental design but different stimuli. In those studies, 4- and 5-year-olds did not extend novel words at the superordinate level when given a single standard and with perceptual similarity controlled. Thus, children's reliable superordinate word learning and extension in Experiment 1 was not specific to the stimuli or the particular directions used. Instead, the result seemed to be driven by the presence of two standards from different basic-level categories.

Interestingly, compared with Experiment 1, there was a decrease in children's taxonomic selections and a corresponding increase in perceptual selections. In addition, a large number of children showed perceptual response preferences (63%). Previous studies suggested that children would not extend novel words based on perceptual similarity alone, especially when they were presented with familiar objects (Golinkoff et al., 1995; Shuff & Golinkoff, 1995). Why did so many 5-year-olds in the present study show perceptual response preferences? We believe that the difference between the present and prior studies is in the greater similarity of the perceptual items to the standards: a mean similarity rating of 7.07 in the present study compared with a mean of 5.90 in Golinkoff et al. (1995), both on a 9-point scale of similarity rating. Just as preschoolers can be easily influenced by salient perceptual attributes in judging category membership (Keil, 1994), their construal of word meanings may be influenced by significant perceptual similarities. Thus, children's perceptual response preferences in this study may well be an attempt to extend novel words at the basic level at which perceptual similarity matters most (Rosch et al., 1976).

Alternatively, because young children are sensitive to task variables (Oakes, Plumert, Lansink, & Merriman, 1996; Smith, Jones, & Landau, 1992), perhaps the fewer taxonomic selections in Experiment 2 were a result of the number of choices presented. In Experiment 1 there were four choices, including two perceptual choices corresponding to two standards. In Experiment 2, a perceptual choice corresponding to the removed standard was removed. This left only three choices. Could a different constellation of response options, with one fewer perceptual choice, have suspended young children's taxonomic extension in Experiment 2?

EXPERIMENT 3

This experiment was designed to answer the question, "Would children make taxonomic selections if a single standard and the original four choices were presented?" Results of this experiment combined with those of Experiment 2 were crucial for showing that the results of Experiment 1 were specific to the presence of two standards.

Method

Participants

Sixteen participants (M = 4,11, *range* = 4,0–5,11; 8 boys and 8 girls) were recruited. They were evenly divided into two groups and tested in the Word condition only. Data from 2 additional children were not included because they did not finish the experiment.

Stimuli

The same stimuli in Experiment 1 were rearranged into two different sets, each set containing five sets of stimuli. Both sets contained the same choices but had different standards. As seen in Table 1 and Figure 1, one stimulus set now contained an orange (standard), a basketball (perceptual), grapes (taxonomic), a fruit bowl (thematic), and a crescent moon (perceptual choice for the removed standard banana; unrelated to the present standard orange). In this case, when a standard (e.g., a banana) was removed, its corresponding perceptual choice (e.g., a crescent moon) would become an unrelated item to the remaining standard (i.e., an orange). The other set constructed from the original set contained a banana as the standard and the original four choices. Half of the participants were presented with one set of stimuli; the other half were presented with the opposite set.

Procedure

The same procedure as in the Word condition of Experiment 1 was followed.

Results

Could children identify the stimulus pictures? The overall error rate was 2%.

Did children make a significant number of taxonomic selections when presented with a single standard and four choices? A preliminary ANOVA showed that the groups receiving the two different stimulus sets did not differ in their selections; therefore, their data were combined. As shown in Table 2, children's taxonomic selections (33%) were only at chance level (25%), $t(15) = .86$, $p > .05$. In contrast, children's perceptual selections (54%) were above chance (25%), $t(15) = 3.23$, $p < .01$. There was no significant difference between taxonomic (M = 1.62, SD = 1.75) and perceptual (M = 2.69, SD = 1.78) selections, however, paired-sample $t(15) = 1.23$, $p > .05$. Very few thematic (6%) and unrelated items (7%) were selected.

Did children show any response preferences? As shown in Table 3, 37% or 6 children showed a perceptual response preference. Only 19% or 3 children showed a taxonomic response preference. The other 44% or 7 children showed no response preferences.

Discussion

Experiment 3 showed that when a single standard was labeled, children failed to extend the label at the superordinate level even when the original four response choices were reinstated. Thus, we concluded that children's taxonomic selections in Experiment 1 were indeed a result of the number of standards rather than the number of choices or the instructions used. This conclusion raised a further question: "Could superordinate word extension occur even when the two standards were from the same basic-level categories?"

The Structural Alignment Theory (Gentner, 1997) proposes that a common label given to two objects presumably invites a comparison between the two objects, which facilitates the search for nonobvious taxonomic relations. If the key variable for successful superordinate word acquisition is simply the presence of two objects, regardless of their level in the taxonomic hierarchy, then the presence of two basic-level objects should also help children to extend novel words at the superordinate level. The next experiment explored the parameters of the effect, by addressing the question, "Is superordinate word acquisition specific to the use of two objects from different basic-level categories or will it also occur if the exemplars used are from the same basic-level categories?"

EXPERIMENT 4

Experiment 4 examined whether hearing a novel label for two dissimilar objects from the same basic-level category could also help children to interpret a novel label at the superordinate level. Recall that Experiment 1 used two objects from different basic-level categories and succeeded in obtaining superordinate taxonomic extension. Perhaps when objects are from different basic-level categories, a basic-level interpretation is blocked. When two objects from the same basic-level category are given the same label, as in this experiment, children have the option to interpret the label at either the basic or the superordinate level. However, our hypothesis was that superordinate word extension would be promoted only by the presence of two objects from different basic-level categories and the present experiment would not promote superordinate word learning.

Method

Participants

Forty-two children (*M* = 4,11, *range* = 4,3–5,9; 21 boys, 21 girls) were recruited and randomly distributed into the Word and No Word conditions. There were 11 boys and 10 girls in each condition. Data from 1 additional child who did not complete the study were excluded.

Stimuli and Similarity Ratings

Each of the five sets of stimuli (see Table 4) consisted of two dissimilar standards from the same basic-level category (e.g., a lady's dress and a girl's dress), two perceptual choices corresponding to the two standards (e.g., a bell that resembled the lady's dress and a lampshade that resembled the girl's dress), a taxonomic choice (e.g., a pair of pants), and a thematic choice (e.g., a hanger).

Table 4 Stimuli Used in Experiment 4 and Corresponding Similarity Ratings

	Response Choices		
Standards	Perceptual 1 Perceptual 2	Taxonomic	Thematic
Half orange Orange	Quarter moon 7.41 (1.46) Basketball 7.76 (1.39)	Grapes 1.85 (1.39)	Knife 1.38 (1.10)
Ice cream cone Ice cream	Tree 7.29 (1.16) Torch 8.06 (.97)	Cookie 2.26 (1.29)	Spoon 1.26 (.47)
Donut with frosting Chocolate donut	Mountain 6.00 (2.18) Clock 7.53 (1.12)	Cake 2.94 (1.60)	Mouth 3.24 (1.91)
Side view of a cow Front view of a cow	Tent 5.88 (2.06) Sweater 6.29 (2.42)	Rabbit 2.97 (1.77)	Grassland 1.24 (.75)
Lady's dress Girl's dress	Bell 6.35 (2.47) Lamp 5.79 (2.14)	Pants 2.09 (1.44)	Hanger 1.82 (1.09)
Mean ratings	6.84 (.78)	2.42 (.51)	1.79 (.84)

Note: Values in parentheses are standard deviations.

Similarity ratings for each item to its standard were obtained from 17 adults, as in Experiment 1. The perceptual choices ($M = 6.84$, $SD = .78$) received significantly higher similarity ratings than taxonomic choices ($M = 2.42$, $SD = .51$), paired-sample $t(16) = 15.9$, $p < .001$; thematic choices ($M = 1.79$, $SD = .84$), paired-sample $t(16) = 17.35$, $p < .001$; and unrelated items ($M = 3.62$, $SD = 1.43$), paired-sample $t(16) = 12.89$, $p < .001$.

Procedure

The same procedure and instructions as in Experiment 1 were followed.

Results

Could children identify the stimulus pictures? The overall error rate was 1.5%, and all participants correctly labeled the pictures after only one repetition.

Did children make a significant number of taxonomic selections in the Word condition? As shown in Table 2, children's taxonomic selections (53%) were significantly above chance (25%), $t(20) = 4.01$, $p < .001$; whereas their perceptual selections (44%) did not differ from chance (50%), $t(20) = .92$, $p > .05$. There was no significant difference, however, between the rate at which children made taxonomic ($M = 2.67$, $SD = 1.62$) and perceptual ($M = 2.19$, $SD = 1.54$) selections, paired-sample $t(20) = .70$, $p > .05$.

Did children make more taxonomic selections in the Word condition than in the No Word condition? Results of two separate GLM analyses did not find significant differences in children's taxonomic selections in the Word condition as compared with the No Word condition ($M = 1.95$, $SD = 1.72$), $F(1, 40) = 1.92$, $p > .05$; nor was there a significant difference in children's perceptual selections between the two conditions, $F(1, 40) = 1.23$, $p > .05$. Children selected very few thematic items in both the Word ($M = .14$, $SD = .36$) and the No Word ($M = .33$, $SD = .57$) conditions. There were no significant interactions among the factors, Fs < 1.50, ps $> .05$.

Did children show any response preferences? As shown in Table 3, the patterns of response preferences were similar in the Word and No Word conditions. In the Word condition, 33% (or 7 children) showed taxonomic response preferences, whereas 24% (5 children) showed perceptual response preferences. The remaining children (9) showed no response preferences. In the No Word condition, 19% (4 children) showed taxonomic response preferences, whereas 24% (5 children) showed perceptual response preferences. The remaining children (12) showed no response preferences.

Were children's responses related to how perceptually similar an item was to the standards? No significant correlation was found between the number of times an item was chosen and how similar it looked to the standards, in both the Word condition, $r(20) = -.02$, $p > .05$, and in the No Word condition, $r(20) = .22$, $p > .05$. This indicated that perceptual similarity was not a basis for children's taxonomic selections.

Discussion

When presented with two perceptually dissimilar standards from the same basic-level category and the same novel label for both standards in the Word condition, children selected a significant number of taxonomic items (53%). However, the proportion of their taxonomic selections was not significantly different from the proportion of their perceptual selections (44%), nor did the rate of their taxonomic selections in the Word condition significantly differ from that in the No Word condition (39%). The above-chance taxonomic selections in the Word condition were mostly made by one third or 7 children who showed taxonomic response preferences. Forty-three percent of the children displayed no response preferences. Recall that in Experiment 1 in which children were presented with two standards from different basic-level categories, 57% of the children demonstrated taxonomic response preferences. Do these findings indicate that the presence of objects from different basic-level categories is essential for children to extend a novel word at the superordinate level?

A comparison of Experiment 1 and Experiment 4 using a GLM ANOVA with taxonomic or perceptual selections as the dependent variable and experiment as the between-subjects factor found no significant difference between children's taxonomic selections, $F(1, 41) = 2.50$, $p > .05$. However, children selected significantly more perceptual items when presented with objects from the same basic-level categories (44%) than when presented with objects from different basic-level categories (23%), $F(1, 41) = 5.29$, $p < .05$. Why did this effect occur? Although the presence of two basic-level objects might have facilitated children's taxonomic appreciation at the superordinate level, it might have also activated their preference for basic-level categories. Even though the basic-level objects used here were perceptually dissimilar, they still seem to have caused children to extend novel words on the basis of perceptual similarity.

Having now conducted experiments with two standards (Experiments 1 and 4) and experiments with a single standard (Experiments 2 and 3), we were in a position to compare the effect of the number of standards. Recall that a main purpose of this research was to evaluate whether superordinate taxonomic extension could be promoted when multiple items were labeled. Experiments 1 and 4 were collapsed to form the two-standard group ($n = 42$) whereas Experiments 2 and 3 became the single-standard group ($n = 38$). Because of the unequal error variances across groups, independent sample T tests were performed on the number of perceptual, taxonomic, and thematic selections with the number of standards as the grouping variable. Results showed that there was a significant difference in taxonomic and perceptual selections between the two groups. Children in the two-standard group selected more taxonomic items ($M = 3.05$, $SD = 1.77$) than those in the single-standard group ($M = 1.24$, $SD = 1.46$), $t(79) = 5.04$, $p < .001$. In contrast, children in the single-standard group made more perceptual selections ($M = 3.32$, $SD = 1.53$) than those in the two-standard group ($M = 1.67$, $SD = 1.55$), $t(79) = 4.80$, $p < .001$. Apparently, the presence of two objects, from either the same basic-level category or different basic-level categories under the same superordinate category, facilitated children's attention to taxonomic relations at the superordinate level more than the presence of a single object.

Once it was confirmed that 4- and 5-year-olds were capable of novel word extension at the superordinate level when presented with multiple exemplars, the next question was how superordinate words were learned before the age of 4. The 3-year-olds in Experiment 1 failed to make a significant proportion of taxonomic responses, even in the presence of multiple exemplars. What does it take for a 3-year-old to learn and extend novel superordinate words? Based on prior research findings (Beilin & Pearlman, 1991; Cocking & McHale, 1981; DeLoache et al., 1998), one possibility we explored was whether the nature of the object representation made a difference in children's learning and extension of superordinate words.

EXPERIMENT 5

This experiment explored 3-year-olds' ability to learn and extend novel words at the superordinate level when presented with three-dimensional (3-D) models of objects instead of pictures. Previous findings about 3-year-olds' knowledge of superordinate words are at odds. On the one hand, 3-year-olds do not accept familiar superordinate labels (e.g., fruit) for unfamiliar basic-level objects (e.g., pineapple; Blewitt, 1994). Only some 3-year-olds (unlike most 4-year-olds) made accurate and consistent inferences about taxonomic features based on familiar superordinate words (Blewitt, 1989; Gelman & O'Reilly, 1988). On the other hand, when familiar objects were used, 3-year-olds accepted both basic- and superordinate-level words for the same objects (Blewitt, 1994). Although Callanan (1989) reported that 3-year-olds could interpret novel words at the superordinate level, successful superordinate word extension was possibly correlated with the perceptual similarity between category members. Although there is reason to believe that 3-year-olds might be able to interpret novel words at the superordinate level, it is important to examine whether they can do so when perceptual similarity is controlled.

One possible reason why 3-year-olds look less competent than 4-year-olds in displaying knowledge about superordinate words is that they are often confused about the relation between pictures and their actual referents. For example, 3-year-olds responded affirmatively when asked whether a photograph of a rose would smell sweet and whether a picture of ice cream would be cold to touch (Beilin & Pearlman, 1991). Once they realized that pictures were different from real objects, they tended to overextend their understanding that "a picture is not an X" to the belief that pictures carry different information than real objects (DeLoache et al., 1998). Hence, the use of pictures may underestimate preschool children's language ability (Cocking & McHale, 1981). Prior studies (e.g., Golinkoff et al., 1995; Imai et al., 1994; Markman & Hutchinson, 1984)—including Experiment 1 of this study—used pictures to assess superordinate word acquisition. Young children's failure to demonstrate reliable superordinate word extension could be an effect of their difficulty with pictorial representations, and not with the learning and extension of superordinate words. Thus, this experiment sought to disambiguate the reason for 3-year-olds' failure to learn and extend novel superordinate words in Experiment 1 by presenting 3-D models of real objects.

Method

Participants

Forty-three participants ($M = 3{,}7$, *range* = 3,0–3,11; 22 boys and 21 girls) were recruited and tested in the Word and No Word conditions. Data from two boys and 1 girl were not included (one selected all choices; two did not finish). The final sample had 10 boys and 10 girls in each condition.

Stimuli and Similarity Ratings

The majority of the stimuli were 3-D objects corresponding to the pictures used in Experiments 1 and 4 with only a few of the stimuli replaced because of the difficulty of finding some objects. Table 5 displays all the stimulus sets. Similarity ratings for each item to its standard were obtained from 13 adults, following the same procedure as in Experiment 1. Perceptual choices ($M = 5.97$, $SD = 1.30$) received significantly higher similarity ratings than taxonomic choices ($M = 2.38$, $SD = .42$), paired-sample $t(12) = 13.88$, $p < .001$; thematic choices ($M = 1.76$, $SD = .86$), paired-sample $t(12) = 5.03$, $p < .001$; and unrelated items ($M = 1.77$, $SD = .53$), paired-sample $t(12) = 5.23$, $p < .001$. Similarity ratings for all sample stimulus sets are given in Table 5.

Procedure

The same procedures as in Experiment 1 were followed except for two changes. Pilot data suggested that some 3-year-olds might not understand the meaning of "speaking a different language" and "having different names for things." Therefore, a training phase was added between the familiarization and testing phases. During the training phase, the child was shown two familiar objects (e.g., a car and a baby bottle). The experimenter first pointed to the car and asked the child, "What's this?" or "What do you call this?" After the child produced the label, the experimenter would say, "That's right! You call this "a car," but Mr. Bear has a different name for it. He calls it "a wug." The same procedure was repeated with the baby bottle. The two novel words used in the training phase were always *wug* and *roke.*

A second change reduced the number of objects in the familiarization phase. Pilot testing indicated that after playing with the 30 stimuli and being prompted to say their names, children tended to quit. Therefore, during the familiarization phase, children were asked to label only 10 items randomly selected from the pool of the stimuli.

Results

Could children identify the stimulus pictures? The overall error rate was 2.2%.

Did children make a significant number of taxonomic selections in the Word condition? As shown in Table 2, children's taxonomic selections (80%) were significantly above chance level, $t(19) = 9.19$, $p < .001$. There were very few perceptual (14%) and thematic selections (6%). Children made more taxonomic selections ($M = 4.00$, $SD = 1.34$) than perceptual selections ($M = .70$, $SD = .98$), paired-sample $t(19) = 6.56$, $p < .001$. In the No Word condition, children's taxonomic selections (38%) were only at chance level, $t(19) = 1.96$, $p > .05$. Children's taxonomic selections ($M = 1.90$, $SD = 1.48$) were not significantly different from their selections of perceptual items ($M = 2.65$, $SD = 1.60$), $t(19) = 1.12$, $p > .05$.

Did children make more taxonomic selections in the Word condition than in the No Word condition? Results of an ANOVA revealed a reliable preference for taxonomic items in the Word condition ($M = 4.00$, $SD = 1.34$) as compared with the No Word condition ($M = 1.90$, $SD = 1.48$), $F(1, 38) = 22.10$, $p < .001$. A significant effect for condition was also found on perceptual selections (Word condition, $M = .70$, $SD = .98$; No Word condition, $M = 2.65$, $SD = 1.60$) $F(1, 38) = 21.6$, $p > .001$. Children made very few thematic selections (Word condition, $M = .30$, $SD = .66$; No Word condition, $M = 45$, $SD = .69$).

Did children show differential response preferences in the two conditions? As shown in Table 3, when presented

Table 5 Stimuli Used in Experiment 6 and Corresponding Similarity Ratings

	Response Choices		
Standards	Perceptual 1 Perceptual 2	Taxonomic	Thematic
Banana Apple	Hair clip 8.17 (.99) Red hat 5.58 (1.71)	Grapes 2.75 (1.59)	Basket 1.21 (.49)
Hamburger Fried egg	Jar 5.25 (2.05) Flower 6.33 (1.75)	Hot dog 2.12 (1.21)	Frying pan 3.17 (1.59)
Cow Pig	Cat ball 5.00 (1.78) Pink candle 3.75 (1.48)	Rooster 2.87 (1.43)	Barn 1.04 (.20)
Corn Tomato	Toothbrush holder 6.92 (1.55) Red ball 8.33 (.74)	Broccoli 1.87 (1.03)	Plate 1.46 (.64)
Shirt Dress	Mouse 4.08 (2.02) Puzzle piece 6.25 (1.64)	Pants 2.29 (1.08)	Hanger 1.93 (1.99)
Mean ratings	5.97 (1.30)	2.38 (.42)	1.76 (.86)

Note: Values in parentheses are standard deviations.

with two 3-D standards, 70% (14 children) showed taxonomic response preferences, and 30% (6 children) did not show any response preferences in the Word condition. In the No Word condition, only 15% (3 children) displayed taxonomic preferences and 35% (7 children) displayed perceptual preferences; whereas 50% (10 children) showed no response preferences.

Were children's responses in the Word condition related to how perceptually similar an item was to the standard? In both the Word and No Word conditions, there was no significant correlation between the number of times an object was selected and its perceptual similarity to one of the standards, *p*s $> .05$. Hence, children's taxonomic extension in the Word condition was not based on perceptual similarity but on superordinate category membership.

Discussion

When multiple exemplars of 3-D objects instead of pictures were used, 3-year-olds could learn and extend novel words at the superordinate level. Furthermore, their taxonomic extension was not related to the perceptual similarity of an object to the standard, ruling out the alternative explanation that 3-year-olds were merely guided by perceptual similarity.

Why did the use of 3-D exemplars promote 3-year-olds' superordinate word acquisition? In comparison with the two picture standards used in Experiment 1, 3-D objects can be handled and rotated. The manipulation of 3-D objects offers richer information about the objects than two-dimensional (2-D) pictures and may heighten children's attention to the nonperceptual taxonomic relations highlighted by the novel words.

There is, however, an alternative explanation for 3-year-olds' success with superordinate word acquisition: 3-D taxonomic items may be more similar to the standards than the pictorial taxonomic items. If true, one could argue that the increase in taxonomic selections in the current study is an effect of the greater perceptual similarity between category members. To address this issue, two ANOVAs were conducted to compare the perceptual similarity ratings of the perceptual and taxonomic choices in Experiments 1 and 5. Results showed that the 3-D taxonomic items used in Experiment 5 ($M = 2.38$, $SD = .42$) and the 2-D taxonomic choices in Experiment 1 ($M = 2.28$, $SD = .43$) received roughly the same similarity ratings, $F(1, 8) = .15$, $p > .05$. No significant difference was found between the similarity ratings for the pictorial perceptual items used in Experiment 1 ($M = 7.07$, $SD = .85$) and the 3-D perceptual items used in Experiment 5 ($M = 5.97$, $SD = 1.30$), $F(1, 8) = 2.50$, $p < .05$. These data suggest that the 3-D taxonomic items in Experiment 5 did not resemble the standards more than the pictorial taxonomic items in Experiment 1. Instead of perceptual similarity, it must have been the extra information provided by 3-D models of objects that made the task easier.

Findings of the present experiment in combination with the results of Experiments 1 and 4 indicate that young children's superordinate word acquisition was influenced by at least three nonlinguistic factors: The presence of multiple exemplars, the kind of exemplars, and the type of object representation. An interesting progression thus emerged. The use of 3-D models of objects in addition to the use of multiple exemplars helped 3-year-olds to learn and extend novel words at the superordinate level. Four- and 5-year-olds' construal of novel words at the superordinate level depended on the use of multiple exemplars from different basic-level categories but did not require objects. Two-dimensional pictures were effective in eliciting 4- and 5-year-olds' superordinate word learning and extension. There was, however, a remaining issue that needed to be resolved. Perhaps superordinate word learning only requires the use of a single, 3-D standard. If the argument we formed above was correct, perhaps a single 3-D object that provides a level of information not available in pictures is all that is needed for superordinate word learning, and the use of multiple objects is irrelevant for superordinate word acquisition once real objects are introduced.

EXPERIMENT 6

Experiment 6 examined whether 3- to 5-year-old children could learn and extend novel words at the superordinate level when presented with a single 3-D object. Results of Experiment 5 suggested that the use of multiple 3-D objects helped 3-year-olds to succeed in superordinate word extension even though in Experiment 1 they did not show reliable superordinate word extension with multiple picture standards. Given young children's confusion about the representative nature of pictures (Beilin & Pearlman, 1991; DeLoache et al., 1998) and their poorer performance in labeling pictures than objects (Cocking & McHale, 1981), perhaps the use of 3-D objects, and not the presence of multiple exemplars, was the major reason for 3-year-olds' success with superordinate word extension.

Method

Participants

Thirty-six 4- and 5-year-olds (M = 4,11, *range* = 4,3–5,10) participated. Nine boys and 9 girls were tested in the Word condition and 8 boys and 10 girls were tested in the No Word condition. Sixteen 3-year-olds ($M = 3{,}7$, *range* = 3,2–3,11; 8 girls and 8 boys) were tested in the Word condition only. None of these children had participated in any of the previous studies. Data from two additional 3-year-olds were excluded from the analysis due to failure to complete the study.

Stimuli

The same stimuli in Experiment 5 were rearranged into two different groups, each group containing five sets of stimuli. Both sets contained the same choices but had different standards. The procedure for the regrouping of the stimulus sets was the same as in Experiment 3.

Procedure

The same procedure as in Experiment 1 was followed for the 4- and 5-year-olds. For the 3-year-olds, the same procedure as in Experiment 5 was followed.

Results

Could children identify the stimulus pictures? The overall error rate was 1.1% for 4- and 5-year-olds and 2.3% for 3-year-olds.

Did children make a significant number of taxonomic selections in the Word condition? As shown in Table 2, in the Word condition, 4- and 5-year-olds' taxonomic selections (68%) were significantly above chance level (25%), $t(17) = 5.62$, $p < .001$. Children made more taxonomic ($M = 3.39$, $SD = 1.61$) than perceptual ($M = 1.11$, $SD = 1.18$) selections, paired-sample $t(17) = 3.58$, $p < .01$. There were very few perceptual (23%), thematic (6%), or unrelated selections (3%).

Three-year-olds displayed a different response pattern in the Word condition by selecting taxonomic items (20%) at chance level, $t(15) = 1.04$, $p > .05$. Yet, their perceptual selections (46%) were significantly above chance (25%), $t(15) = 3.03$, $p < .01$. They also selected fewer taxonomic ($M = 1.06$, $SD = 1.06$) than perceptual ($M = 2.25$, $SD = 1.39$) items, $t(15) = 2.16$, $p < .05$. Three-year-olds' thematic (18%) and unrelated selections (16%) were significantly below chance, ts < 2, ps $> .05$.

Two separate GLM analyses of variance on taxonomic and perceptual selections with age, group, and gender as the between-subjects factors suggested that 4- and 5-year-olds selected significantly more taxonomic items, $F(2, 30) = 145.6$, $p < .01$, and significantly fewer perceptual items, $F(2, 30) = 17.8$, $p < .05$, than 3-year-olds.

Did 4- and 5-year-olds make more taxonomic selections in the Word condition than in the No Word condition? Results of two GLM analyses of variances suggested that there was a reliable preference for taxonomic items (68%) in the Word condition as compared with the No Word condition (31%), $F(1, 35) = 13.9$, $p < .01$. The effect of condition was also significant on children's perceptual selections. Children selected more perceptual items in the No Word condition (69%) than in the Word condition, $F(1, 35) = 26.8$, $p < .001$. In addition, their perceptual selections were significantly above chance (25%), $t(17) = 6.08$, $p < .001$. No comparison was conducted for 3-year-olds, because they were tested in the Word condition only.

Did children show differential response preferences in the Word and No Word conditions? As shown in Table 3, when presented with a single 3-D standard and a novel word, 56% of 4- and 5-year-olds (10 children) showed taxonomic response preferences, 11% (2 children) showed perceptual response preferences, and 33% (6 children) showed no response preferences in the Word condition. In the No Word condition, only 11% (2 children) displayed taxonomic preferences, 56% (10 children) displayed perceptual preferences, and 33% (6 children) showed no response preferences.

For the 3-year-olds, in the Word condition only, no taxonomic or thematic response preferences were found. Yet, 25% (4 children) displayed perceptual response preferences, and 75% (12 children) displayed no response preferences. No data were collected for 3-year-olds' response preferences in the No Word condition.

Were children's responses in the Word condition related to how perceptually similar an item was to the standard? For the 4- and 5-year-olds, no significant correlation was found between the number of times an object was selected and how perceptually similar it was to the standard, $r(20) = -.26$, $p > .05$. Apparently, their lexical extension was not based on perceptual similarity. However, for 3-year-olds, a significant correlation was found between the number of times an object was selected and how perceptually similar it was to the standard, $r(20) = .58$, $p < .01$, suggesting that perceptual similarity accounted for at least some of their responses.

Discussion

This experiment examined whether the use of a single 3-D standard could help young children to learn and extend novel words at the superordinate level. Compared to Experiments 2, 3, and previous studies in which 4- and 5-year-olds failed to demonstrate reliable superordinate word acquisition when a single picture standard was used (Golinkoff et al., 1995; Imai et al., 1994), the current study used 3-D stimuli, which must account for 4- and 5-year-olds' success. However, 3-year-olds' taxonomic selections decreased from 80% in the presence of two 3-D exemplars in Experiment 5 to 20% in the presence of a single standard in the current experiment. This finding clearly indicates that both the presence of multiple exemplars and the use of 3-D objects were crucial for 3-year-olds' successful learning and extension of novel superordinate words in Experiment 5.

These results have two implications. First, it appears that 3-year-olds' acquisition of superordinate words requires the presence of multiple exemplars, but not any kind of multiple exemplars will do; they must be 3-D in nature. As suggested by Shipley (1989), 3-year-olds might understand superordinate words as denoting "categories of categories" under certain circumstances. Although Blewitt (1994) found that 3-year-olds accepted both superordinate labels and basic-level labels for single objects, it is not clear whether 3-year-olds understand the relation between superordinate and basic-level words when presented with a single object. In contrast, 4- and 5-year-olds showed understanding of such implications of superordinate words by interpreting a novel word at the superordinate level, even in the presence of a single object. Second, these results, combined with previous findings, indicate the importance of object representations in children's novel-word interpretation. With development, children are able to deal with increasingly abstract object representations. Although 4- and 5-year-olds could learn and extend novel words at the superordinate level when presented with single 3-D objects, they could not do so when presented with single 2-D pictures (Golinkoff et al., 1995; Imai et al., 1994). Three-year-olds, on the other hand, required two 3-D standards to succeed.

GENERAL DISCUSSION

The results of the present experiments help to increase understanding with regard to what it takes for children to learn and extend a novel superordinate label in the forced choice, match-to-sample paradigm first developed by Markman and Hutchinson (1984). In two previous studies, reliable novel superordinate word extension was not found at the ages of 4 and 5 (Imai et al., 1994), nor at age 6 (Golinkoff et al., 1995), although it was noted at age 7 (Golinkoff et al., 1995). In studies that have shown reliable superordinate word extension (Waxman & Kosowski, 1990, at age 2; Markman & Hutchinson, 1984, at ages 4 and 5), perceptual similarity was not controlled. Thus, an apparent taxonomic selection of another item in the same superordinate category was, in all likelihood, reflective of (1) the search for a similar-looking item, and (2) a choice away from the thematic item ("anti-thematic bias"; Golinkoff et al., 1995; Waxman & Namy, 1997).

We reasoned that children were failing to learn and extend novel superordinate labels because only a single exemplar was labeled in those studies. The hypothesis that using multiple exemplars from different basic-level categories to help children learn and extend novel superordinate words was tested and confirmed in Experiment 1. Experiment 2 showed that this finding was not simply a function of the stimulus sets chosen or the directions used, because children failed in the presence of a single standard, replicating Golinkoff et al.'s (1995) Experiment 1. In Experiment 3 of this study, we found that children's taxonomic preferences in the Word condition were not attributable to the reduction in the number of perceptual choices presented. Thus, 4- and 5-year-olds' success with superordinate word learning in Experiment 1 was a result of the presence of multiple standards. Experiment 4 showed that the effect of multiple exemplars on children's superordinate word extension was specific to using standards from different basic-level categories. Children failed to demonstrate reliable superordinate taxonomic preferences when presented with two exemplars from the same basic-level categories. The results of Experiment 5 showed that the use of two 3-D standards could help children as young as 3 years of age to learn and extend novel words to superordinate categories. In Experiment 6, 3-year-olds failed, whereas 4- and 5-year-olds succeeded, in learning and extending novel words to superordinate categories in the presence of a single 3-D exemplar; thus, the importance of three factors (the number and type of standards and object representation) became clear.

The finding that the majority of 3-year-olds could successfully extend novel words to superordinate categories when perceptual similarity between category members was controlled was noteworthy because no such effect had been found at such a young age (Callanan, 1989; Golinkoff et al., 1995; Imai et al., 1994). However, our argument should not be misconstrued: This is not an argument against the role of perceptual knowledge in early word learning. In fact, children are highly attentive to perceptual cues. The precedence of basic-level words and basic-level categories in early development is at least partially due to the perceptual coherence within basic-level categories (Rosch et al., 1976). When no other information is available, perceptual cues could provide children and adults with an anchor for the meanings of a novel word. For example, when presented with novel objects that differ either in shape or color, children rely on shape as a basis for word meaning because shape is a better predictor of category membership than color (Landau et al., 1988). However, when Jones and Smith (1993) added meaningful attributes such as eyes to artificial objects that varied in either texture or shape, children switched to texture instead of shape as a basis for word extension. Apparently, children know that perceptual attributes are not crucial to the meanings of category labels. At the superordinate level, perceptual attributes are often not reliable predictors of category membership (Rosch et al., 1976). Thus, children's appreciation of superordinate taxonomic relations cannot be established unless perceptual similarity is controlled, as was done in the present study.

Why would young children need multiple exemplars from different basic-level categories to extend a novel word at the superordinate level? First, the presence of multiple objects sharing one novel label may help block the basic-level preference (e.g., Mervis, 1987; Rosch et al., 1976), and thus facilitate children's attention to the superordinate taxonomic relations denoted by novel words. Second, the situation of multiple objects sharing one novel label is in accord with the way mothers use superordinate words when addressing their children (Lucariello & Nelson, 1986; Shipley et al., 1983). Such input may aid children in forming their initial association of superordinate words with multiple objects from different basic-level categories (Shipley, 1989). Consequently, children may need the presence of multiple objects from different basic-level categories to activate their superordinate representation. In addition, the association of superordinate words with groups of objects does not violate any of the initial assumptions children may have about novel words, such as the Mutual Exclusivity Hypothesis (Markman & Wachtel, 1988), which states that children tend to avoid mapping a novel word to an already labeled entity. Since it is often the case that children have acquired the basic-level names for objects before they learn the superordinate words, interpreting the novel superordinate words as referring to groups of objects seems to be a natural consequence.

Third and finally, young children do not seem to understand the implications of superordinate terms used to refer to single objects (Lucariello et al., 1992). Such knowledge is necessary for children to successfully extend a novel word for a single object at the superordinate level. Although young children accepted both the superordinate and the basic-level labels for a single object (Blewitt, 1994), and seemed to understand the class inclusion implications of a superordinate word when given explicit linguistic instructions (Callanan, 1989; Clark & Crossman, 1998), these findings do not point to an understanding of the dual function of a superordinate word. That is, a superordinate word includes and at the same time denotes a basic-level object (Lucariello et al., 1992). In the present study, 3- to 5-year-olds displayed understanding of the class inclusion relation between superordinate and basic-level categories. However, only 4- and 5-year-olds demonstrated an understanding of superordinate words used to label a single object. Three-year-olds' understanding of superordinate words seemed to be limited to referring to groups of objects.

The presence of multiple exemplars is only one of the factors that can influence children's superordinate word acquisition. The dramatic increase in 3-year-olds' successful superordinate word learning when 3-D objects rather than pictures were used was striking. Apparently, the use of 3-D objects afforded more information about the items than pictures. A single 3-D standard even resulted in 4- and 5-year-olds' success at the superordinate level. Further research is needed to delineate what extra information is available in 3-D objects and how and why such information facilitates children's lexical acquisition.

Younger children's need for multiple exemplars and 3-D objects in superordinate word acquisition suggests an additive word-learning process. It appears that object representations, the number and type of exemplars presented, children's own hypothesis about novel words, and perceptual salience of objects all combine to influence children's interpretation of novel superordinate words. Three-year-olds required greater contextual support, such as the presence of multiple exemplars in addition to the use of 3-D objects, to succeed. Four- and 5-year-olds, however, succeeded with less support, due to their more advanced comprehension of object representations and perhaps the hierarchical implications of superordinate words. The presence of either two picture exemplars or a single 3-D exemplar could help 4- and 5-year-olds to learn and extend novel words at the superordinate level, indicating the effect of an interaction between object representation and the number of exemplars. At age 7, children could interpret a novel word at the superordinate level (as do adults), even when a single picture standard was used (Golinkoff et al., 1995; Experiment 5). In other words, the younger children are, the more support they need to learn novel superordinate words. These results are reminiscent of Hollich, Hirsh-Pasek, and Golinkoff's (2000) findings on word learning with children in the first 2 years of life. Their "emergentist coalition model" suggests (and their data show) that young children require more cues (e.g., seeing someone handle and look at an object) to support word learning than do older children. Thus, although children are active word learners, parental input and nonlinguistic context are essential to help children learn and extend novel words at the appropriate level of specificity.

Across all experiments, there were few thematic responses. This finding is in accord with the antithematic bias in word acquisition revealed in many previous studies (Golinkoff et al., 1995; Imai et al., 1994; Markman & Hutchinson, 1984; Waxman & Namy, 1997). The absence of a thematic bias logically facilitates children's word learning because it greatly reduces the number of possible referents of novel words. Additionally, the presence of a thematic choice may have provided a common "scene" for the superordinate objects. Previous research has shown that superordinate objects are often spatially related and often found in the same "scene" (Murphy & Wisniewski, 1989). Adults were much quicker at making decisions about superordinate category membership when the tested objects were presented in a scene (e.g., a hammer in a tool case) rather than in isolation. Perhaps the presence of a thematic choice in the match-to-sample tasks provided such a "scene," which eventually facilitated children's word extension. That is, seeing a hanger and hearing a novel label for a shirt might have facilitated children's recall of the superordinate category "clothes." If this were the case, then removal of the thematic choice in future studies would result in a decrease of superordinate word extension.

Although emphasizing the importance of nonlinguistic context in children's acquisition of novel superordinate words, we do not mean to underestimate the importance of linguistic cues. Indeed, mothers use different sentence structures when teaching their children superordinate rather than basic-level words. For example, western, middle-class mothers say things such as, "This is a mixer. A mixer is a kind of machine," when introducing the superordinate category "machine," whereas they seldom say, "This is a machine" (Callanan, 1989; Clark & Crossman, 1998). Such ways of providing superordinate words may well help young children to induce the meanings of novel superordinates. Nevertheless, our findings suggest that young children may still need explicit support from the presence of multiple objects to construe a novel word as a label for a superordinate category (see also Callanan, 1989).

In summary, the present studies support the following conclusions. First, by 3 years of age, young children can extend novel words at the superordinate level even when perceptual similarity between the standards and taxonomic options is minimized. Such findings are consistent with the taxonomic assumption that posits this behavior (Markman & Hutchinson, 1984). However, the evidence from previous studies was inconsistent: When superordinate word learning was reported, the perceptual similarity between the standard and the taxonomic choice was not controlled (Markman & Hutchinson, 1984; Waxman & Markow, 1995). When superordinate word learning was found (Golinkoff et al., 1995), children were much older than would be expected. The use of two exemplars here allowed children to compare and infer the superordinate taxonomic similarities highlighted by the common novel label (Gentner, 1997), possibly by blocking their well-established preference for basic-level labels.

Second, young children's word learning is sensitive to multiple factors in the context. Early superordinate word acquisition is particularly influenced by both the presence of multiple exemplars from different basic-level categories and comprehension of the nature of object representations. With an emphasis on these factors, the present studies demonstrated the potential to explore the specific parameters in the developmental context that contribute to children's early word learning.

Third, the present results in combination with those of Golinkoff et al. (1995; Experiment 5) suggest a progression in superordinate word learning from groups of objects to single objects in the preschool years. The use of two exemplars in combination with 3-D objects in the present study provides the first clear evidence that children as young as 3 years of age can learn and extend a novel word at the superordinate level. Given that these children are hardly word-learning novices, this finding suggests that acquiring and extending superordinate words is not an easy task. Being presented with two dissimilar objects in different basic-level categories that share the same novel label, and being able to manipulate the objects, apparently helped children to bring the common, nonperceptual superordinate taxonomic membership of objects to the foreground.

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