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Mapping Words to the World in Infancy: Infants' Expectations for Count Nouns and Adjectives

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Three experiments document that 14-month-old infants' construal of objects (e.g., purple animals) is influenced by naming, that they can distinguish between the grammatical form *noun* and *adjective*, and that they treat this distinction as relevant to meaning. In each experiment, infants extended novel nouns (e.g., "This one is a *blicket*") specifically to object categories (e.g., animal), and not to object properties (e.g., purple things). This robust noun–category link is related to grammatical form and not to surface differences in the presentation of novel words (Experiment 3). Infants' extensions of novel adjectives (e.g., "This one is *blickish*") were more fragile: They extended adjectives specifically to object properties when the property was color (Experiment 1), but revealed a less precise mapping when the property was texture (Experiment 2). These results reveal that by 14 months, infants distinguish between grammatical forms and utilize these distinctions in determining the meaning of novel words.

One of the best-documented landmarks of human infancy is the onset of language. At around 12 months of age, infants produce their first words, the greatest proportion of which refer to objects and object categories (Brown, 1957; Fenson et al., 1994; Gentner, 1982; Macnamara, 1982; Nelson, 1973; Samuelson & Smith, 1999). The period following this fundamental development is marked by impressive linguistic and conceptual advances, and by important interactions between these domains. It is during this period that words come to support increasingly varied types of concepts, as reflected in the establishment of a substantial lexicon that includes words that refer to individual objects, categories of objects, properties of objects, and the actions in which they are engaged. Moreover, this active period of

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development is marked by the child's first efforts to combine different types of words (e.g., nouns, verbs, adjectives) into syntactically complex utterances (Brown, 1973). Thus, studying infants in this age range should provide insight into the evolution of infants' appreciation of the links between words and the world. In the work described here, we focus on a foundational component of this evolution, examining infants' growing capacity to distinguish among words from different grammatical categories and to map these appropriately to meaning.

In previous work, we have offered a proposal to describe the evolution of these word-to-world links. We have argued (a) that infants begin the task of word learning with a broad initial expectation that links novel open class words (otherwise independent of their grammatical form) to commonalities among named objects, and (b) that this initial expectation is subsequently fine-tuned as infants gain experience with the specific correlations between particular grammatical forms and their associated meanings in the native language (Waxman, 1999b, 2002; Waxman & Booth, 2001, in press). Several studies have provided support for this proposal by tracing the early development of expectations for novel words in infants (Waxman, 1999b; Waxman & Booth, 2001, in press; Waxman & Markow, 1995), and in children acquiring languages other than English (Waxman, 1999a; Waxman, Senghas, & Benveniste, 1997).

Most recently, Waxman and Booth (2001, in press) documented the evolving influence of novel words on infants' attention to category-based and property-based commonalities among objects.[1] Infants were familiarized with four objects (e.g., four purple animals) that shared category membership (e.g., animal) as well as a salient property (e.g., purple). Infants participated in one of three conditions. In a no word control condition, the experimenter simply pointed out the objects ("Look at these"); in a noun condition, the experimenter introduced the objects in conjunction with a novel noun (e.g., "These are *blicket*s"); in an adjective condition, the experimenter introduced the objects in conjunction with a novel adjective (e.g., "These are *blickish*"). Following familiarization, infants were presented with a forced-choice word extension test. There were two types of test trials, each designed to examine whether and how novel words influence infants' construal of the objects presented during familiarization. Infants in all conditions were presented with a familiar test object (e.g., a purple horse), and a novel object. Half

[1]Here, and throughout our research program, we use the phrase 'category-based commonalities' to refer to those commonalities that are central to category membership, including both perceptual and conceptual commonalities (See Mandler, 2000; Quinn & Eimas, 2000). Perceptual resemblances include, but are certainly not limited to, object shape. The presence of distinct parts (e.g., eyes, wheels), and the configuration of those parts, can play crucial roles in identifying category membership, particularly when more global categories are considered in which shape plays less of a definitive role. Furthermore, we suspect that in the context of word learning, infants attend to conceptual, as well as perceptual, similarities among objects (Booth & Waxman, 2002; Gelman & Coley, 1990; Gelman & Ebeling, 1998; Gelman & Markman, 1987).

of the infants in each condition received a category test in which the novel object was a member of a novel object category, but embodied the now-familiar property (e.g., a purple plate). The remaining infants received a property test in which the novel object was a member of the now-familiar object category, but embodied a novel object property (e.g., a blue horse).

The results were consistent with the proposal that infants begin the task of lexical acquisition equipped with a general expectation linking novel words (in general) to commonalities among objects.[2] At 11 months, infants extended novel words (either count nouns or adjectives) on the basis of either category- or property-based commonalities (Waxman & Booth, in press). Performance in the no word condition confirmed that these extensions were motivated by the introduction of the novel words. The data also suggested that within just a few months, this general expectation had begun to become more refined (Waxman, 1999b; Waxman & Booth, 2001; Waxman & Markow, 1995). Infants continued to accept a broad range of extension for adjectives under most circumstances, mapping them either to category- or property-based commonalities. Yet their extension of nouns appeared to be more precise: They extended nouns specifically to category-based, and *not* to property-based, commonalities. This evidence suggests (a) that by 14 months of age, the general expectation linking words to commonalities begins to give way to a more specific set of expectations, and (b) that an expectation linking nouns specifically to category-based commonalities emerges earlier than an expectation linking adjectives specifically to property-based commonalities (see Waxman & Booth, 2001, for a discussion). Indeed, a specific expectation linking adjectives to object properties, but not to object categories, does not clearly begin to emerge until approximately 21 months of age (Waxman & Markow, 1998), and it continues to evolve over the preschool years (Gelman & Markman, 1985; Hall, 1994; Hall, Waxman, & Hurwitz, 1993; Landau, Smith, & Jones, 1992; Waxman, 1990; Waxman & Markow, 1998).

The most striking finding from this line of research is this: Although infants' expectations regarding grammatical forms are certainly not as refined as those of more mature speakers, by 14 months, infants do share with mature speakers a sensitivity to the fact that the extension of a novel word is influenced by its grammatical form. The goal of the current experiments is to develop a more rigorous empirical test of the influence of novel nouns and adjectives on 14-month-old infants' construals of the relations among objects.

In particular, while infants' expectations for novel nouns to category-based commonalities have been robust across tasks (Waxman & Booth, 2001; Waxman & Markow, 1995), and indeed quite consistent from infancy into the preschool years (Waxman & Hall, 1993; Waxman & Kosowski, 1990; Waxman et al., 1997),

[2]Here we mean open class words. By 14 months, infants appear to make an initial cut distinguishing open class from closed class words in the speech stream (Shi, Werker, & Morgan, 1999).

a precise characterization of the evolution of infants' expectations for novel adjectives has proven more elusive. Infants' performance has varied somewhat as a function of the stimuli that have been presented (Waxman, 1999b; Waxman & Booth, 2001; Waxman & Markow, 1995) and the task used to assess mappings between grammatical form and meaning (e.g., novelty preference, forced choice). We have interpreted this overall pattern as evidence that 14-month-old infants continue to harbor a general expectation for the grammatical form *adjective*, linking it to either category- or property-based commonalities, but ambiguity remains. For instance, it is unclear whether infants map adjectives to some property-based commonalities more readily than others (Waxman & Booth, 2001). It is also unclear whether they might have a specific expectation for adjectives, but have been unable to demonstrate this competence in the tasks presented to date.

There are also outstanding questions regarding infants' expectations for novel nouns. For example, infants have never been asked to explicitly choose between a category-based and a property-based extension of a novel word. Recall that in Waxman and Booth (2001), each infant was tested either for a category or a property interpretation, never both. Directly pitting these alternative interpretations against each other is a crucial test because infants may often face this sort of circumstance in their early word-learning experiences. For example, imagine an infant who first hears the word *dog* used in reference to a set of furry brown animals. The infant might interpret *dog* in several ways, including an object category (e.g., dogs), an object property (e.g., brown), or a conjunction of the two (e.g., brown dogs). Teasing apart these alternatives requires a task that pits a category-based extension (e.g., a white dog) against a property-based extension (e.g., a brown cat). If infants interpret *dog* as referring to an object category, they should accept only the category-based extension; if they interpret *dog* as referring to a property, they should accept only the property-based extension; if they interpret *dog* to refer to the conjunction, they should accept neither; and if they interpret *dog* as referring broadly to either a category- or property-based extension, they should perform at chance. What remains to be seen is whether infants' tendency to map count nouns specifically to object categories is sufficiently robust to hold up in this more challenging task, in which two competing interpretations of the novel word are pitted against each other at test.

A second serious question regarding infants' expectations for count nouns derives from a careful inspection of the phrasing used to present them in past research. Certain differences in presentation were obligatory to convey grammatical form (e.g., count nouns were always preceded by determiners, but adjectives were not). However, other differences in presentation were artifactual. For example, nouns were presented in the (privileged) phrase final position throughout the procedure, whereas adjectives were presently in the phrase final position during familiarization, but in the penultimate position at test (Waxman, 1999b; Waxman & Booth, 2001; Waxman & Markow, 1995). These differences may have rendered the novel nouns

more salient than the novel adjectives at test, leading to an apparent precocity of infants in the noun condition. In Experiment 3, we examine this issue directly.

In all three experiments, we focus on infants' tendency to select category- versus property-based extensions by pitting these two alternatives directly against each other at test. As in previous work (see Waxman & Booth, 2001), infants in all conditions were first familiarized to four objects sharing both category membership and the same salient property (e.g., color). For two sets, the objects were drawn from the same superordinate category (e.g., four purple animals). For the remaining two sets, the objects were drawn from the same basic level category (e.g., four purple horses). These objects were introduced in conjunction with either a novel noun or a novel adjective. At test, infants were asked to extend the novel word to either (a) a category match: an object drawn from the same category as the labeled target object, but of a different color (e.g., a blue horse) or (b) a property match: an object of the same color as the labeled target object, but drawn from a different category (e.g., a purple chair; see Figure 1). In Experiment 1, color serves as the target property; in Experiment 2, texture serves as the target property.

Unlike in previous research, this design requires infants to weigh the relative strength of a property- versus a category-based extension for each novel word and to explicitly choose between them. If infants map the novel word to category-based, rather than to property-based, commonalities among objects, then they should choose the category match (e.g., blue horse) over the property match (e.g., purple chair). If infants map the novel word to property-based, rather than to

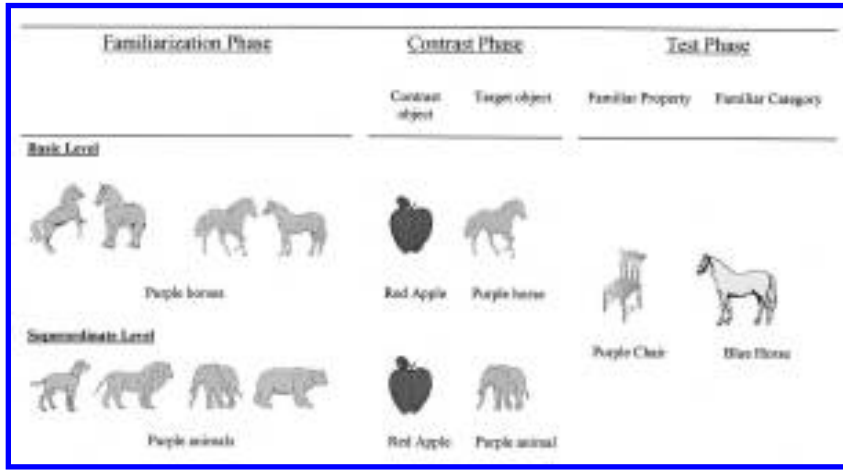

FIGURE 1 An example of one set of stimuli used in Experiments 1 and 3. Pictures represent 3-dimensional objects. A basic level version of the set is illustrated in the top half of the figure. A superordinate level version is illustrated in the bottom half.

category-based commonalities, then they should reveal the opposite pattern, choosing the property match over the category match. Finally, if infants harbor a general expectation linking novel words broadly to either category- or property-based commonalities, they should perform at chance, choosing each of the test objects with equal frequency. In light of previous research, we anticipated that infants' expectations for both novel nouns and adjectives might be more apparent on superordinate, than on basic, level sets (Klibanoff & Waxman, 2000; Waxman & Markow, 1995, 1998).

EXPERIMENT 1

Method

Participants

Thirty-six infants (20 boys; 16 girls) with a mean age of 14.1 months (range = 13.6 to 14.6 months) were recruited from families in the greater Chicago area. All were in the process of acquiring English as their native language. Infants who made clear choices on at least 75% of the word-extension trials (described later) were included in the final sample. Five additional infants were excluded, 2 for failing to reach the criterion of 75% clear choices, 2 due to experimenter error, and 1 (boy) due to a 50% chance of hereditary color blindness (parental report).

Materials

The materials included 48 small commercially manufactured toys, ranging in size on their maximum dimension from 5.5 to 19 cm. These were selected to form four different sets of 12 objects each. See Figure 1 for an example, and Table 1 for a complete list, of stimuli. Each set included eight familiarization objects: four discriminably different objects drawn from the same basic level category (e.g., four horses painted the same shade of purple, but varying in size, posture, and details) and four different objects drawn from the same superordinate level category (e.g., four animals painted the same shade of purple). Objects from both hierarchical levels were included to assess the generality of any effects and because differences in the effect of words on categorization of basic and superordinate level sets have been revealed in previous work with infants and toddlers (e.g., Klibanoff & Waxman, 2000; Waxman & Markow, 1995, 1998). In addition, each set included two contrast objects that were drawn from a different object category, and were a different color than, the familiarization objects. Finally, each set included a pair of test objects including (a) a new member of the familiarization category painted with a novel color (e.g., a blue horse) and (b) a member of a novel category painted with the same color as the familiarization objects (e.g. a purple chair).

TABLE 1
Complete List of Stimuli Used in Experiments 1 and 3

	Familiarization			
Set	*Basic Level*	*Superordinate Level*	*Contrast*	*Test*
1	4 purple horses	4 purple animals: dog, lion elephant, bear	red cup orange carrot	blue horse vs. purple chair
2	4 red apples	4 red fruits: grapes, pear strawberry, tomato	lavender plate straw hat	green apple vs. red hammer
3	4 yellow ducks	4 yellow animals: cat, whale lion, elephant	blue teapot white egg	pink duck vs. yellow banana
4	4 green cars	4 green vehicles: convertible, plane helicopter, truck	red pliers pink rolling pin	black car vs. green frog

Procedure

Infants were tested individually in a laboratory playroom. They sat in an infant-seat, directly across from the experimenter. Parents, who were seated behind their infants, completed the MacArthur Communicative Development Inventory during the experimental session (Fenson et al., 1993). Parents were instructed not to talk to either the infant or the experimenter, or to influence in any way the infant's attention. Sessions lasted approximately 15 min and were videotaped for later coding.

The procedure included three distinct phases (familiarization, contrast, and test phases). These are illustrated in Figures 1 and 2. Each infant completed this procedure with four different sets of objects. Two sets included basic-level familiarization objects (e.g., four purple horses) and two sets included superordinate-level familiarization objects (e.g., four purple animals). Sets were presented in one of two orders, with half of the infants in each condition beginning the procedure with a basic level familiarization set and the remaining infants beginning with a superordinate level familiarization set. Infants were randomly assigned to a noun, adjective or no word (control) condition. In each condition, infants heard infant-directed speech. See Figure 2 for an example of the introductory phrases used in each phase of the experiment, and in each condition. For infants in the noun and adjective conditions, a different novel word was presented with each set.

Familiarization phase. The female experimenter introduced infants to two objects at a time. In the noun condition, the experimenter presented each pair, saying, "These are *blickets*." After 10 sec had elapsed, she pointed to each individual within the pair, saying, "This one is a *blicket* … and this one is a *blicket*." After another 10 sec had elapsed, she removed the first pair, and presented the second, in

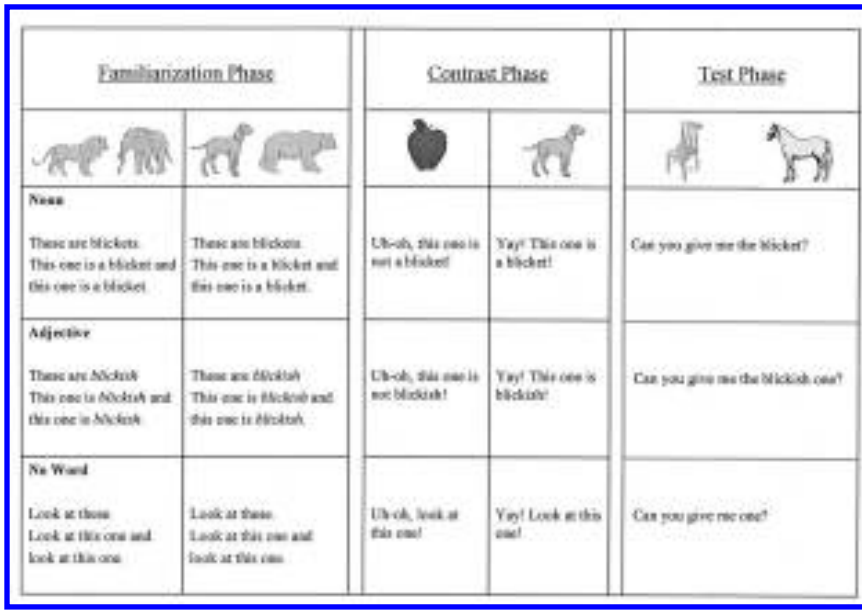

FIGURE 2 An example of the phrases used to introduce the stimuli in each phase of all experiments three experiments.

precisely the same fashion. In the adjective condition, she presented each pair saying, "These are *blickish*." After 10 s had elapsed, she pointed to each individual saying, "This one is *blickish* … and this one is *blickish*." In the no word condition, she presented each pair in the same manner saying, "Look at these" and then after 10 s, "Look at this one… and look at this one." Infants manipulated the objects freely throughout familiarization.

Contrast phase. Next, the experimenter presented a contrast object (e.g., an orange carrot). This object was a member of a contrastive object category and embodied a contrastive object property. She shook her head solemnly, saying "Uh oh! This one is not a *blicket*" (noun condition), or "Uh oh! This one is not *blickish*" (adjective condition), or "Uh-oh! Look at this one" (no word condition). She then reintroduced one of the objects used during familiarization (e.g., a purple horse). This served as the target object. Indicating this target object, she happily exclaimed, "Yay, this one is a *blicket*" (noun condition), or "Yay, this one is *blickish*" (adjective condition), or "Yay, look at this one" (no word condition). She placed the target in front of the infant and immediately outstretched her palm, asking, "Can you give me the *blicket*?" (noun condition), or "Can you give me the *blickish* one?" (adjective condition), or "Can you give me one?" (no word condition).

Test phase. At this point, the experimenter simultaneously introduced the category test object (e.g., blue horse) and the property test object (e.g., purple chair). She placed these easily within the infant's reach, approximately 30 cm apart, and said, "Look at these!" Infants were allowed 20 s of free play with these objects. After retrieving the test objects, the experimenter represented the target, drawing attention to it by pointing and saying, "This one is a *blicket*" (noun condition), or "This one is *blickish*" (adjective condition), or "Look at this one" (no word condition). She then replaced the two test objects within the infant's reach (again approximately 30 cm apart) and said, "Can you give me the *blicket*?" (noun condition) or "Can you give me the *blickish* one?" (adjective condition) or "Can you give me one?" (no word condition).

For each set of objects, infants completed the familiarization, contrast, and test phase. Then, the contrast and test phases were repeated. On this second round, a new contrast object was presented, but the same two test objects were represented, with their left–right placement reversed.

Coding

The videotaped sessions were transcribed with the sound removed to insure that the coders, who were blind to the experimental hypotheses, were also blind to condition assignment. Coders identified each infant's choice of test objects on each trial. A primary coder scored all of the infants. A second coder independently scored 12 infants, 4 per condition. Consistency was computed as the proportion of the trials on which the coders agreed. Agreement was 99%. Disagreements were easily resolved through discussion.

Two dependent measures were derived from these coded data. First, for each hierarchical level, we computed the proportion out of four test trials on which each infant selected the category test object. The probability of doing so by chance alone is .50. Second, we applied a more stringent criterion, examining the proportion out of two sets on which infants consistently selected the category test object on both the first and second test trials. The probability of making consistent category selections (or consistent property selections) is .25 (.50 on Trial 1 × .50 on Trial 2).

Results

Infants made clear selections on 99% of their trials. Only data from these trials were included in the analyses.

Category-based selections. A repeated measures analysis of variance (ANOVA) with condition (noun vs. adjective vs. no word) as a between subject factor, hierarchical level (basic vs. superordinate) as a within subject factor, and the proportion of category-based extensions as the dependent measure, revealed a main ef-

fect for condition, $F(2, 33) = 3.80$, $p < .05$, mediated by a (marginal) interaction with hierarchical level, $F(2, 33) = 3.01$, $p = .06$.[3] To explore this interaction, we examined performance at each hierarchical level independently. On basic level sets (see Figure 3a), infants performed comparably in all three conditions. However, as predicted, on superordinate level sets (see Figure 3b), the influence of both novel nouns and adjectives was apparent. Infants in the no word condition ($M = .56$, $SD = .15$) revealed no preference for either test object, $t(11) = 1.30$, *ns.* Infants in the noun condition were more likely to select the category test object ($M = .71$, $SD = .26$) than were infants in either the no word or the adjctive conditions ($M = .42$, $SD = .12$), LSD ps $\leq .05$. Performance in the noun condition also differed from chance, $t(11) = 1.80$, $p < .05$. In contrast, infants in the adjective condition revealed the opposite pattern of preference. These infants were less likely to select the category test object (and, therefore, more likely to select the property test object) than were infants in either the no word or noun conditions, LSD ps $< .05$. Performance in the adjective condition also differed significantly from chance, $t(11) = 1.80$, $p < .05$.

Consistent category-based or property-based selections. We next asked whether this same pattern of results would hold up when we considered infants' tendency to consistently select the same test object on *both* the first and second trial. To address this question, we performed a multivariate analysis of variance (MANOVA) with infants' proportion of consistent category as well as consistent property selections as dependent variables. This analysis revealed a main effect of condition, $F(4, 64) = 2.81$, $p < .05$, mediated by an interaction with hierarchical level, $F(4, 64) = 2.54$, $p < .05$. On basic level sets (see Figure 4a), infants performed comparably in all three conditions. On superordinate level sets (see Figure 4b) however, the influence of both novel nouns and adjectives was again evident. Focused comparisons on each dependent measure revealed the following pattern of performance. Infants in the no word condition consistently selected the category test object at chance levels ($M = .17$, $SD = .26$). Infants in the noun condition were more likely to consistently select the category test object ($M = .54$, $SD = .25$) than were infants in both the no word and the adjective conditions ($M = .08$, $SD = .40$), LSD ps ≤ 01. Performance in the noun condition also differed from chance on this measure, $t(11) = 3.02$, $p < .01$. The adjective and no word conditions did not differ from each other, although performance in the adjective condition did differ from chance, $t(11) = 2.97$, $p < .01$.

[3]Preceding this and each of the subsequent analyses reported throughout the manuscript, we evaluated our proportional data for violation of assumptions of the ANOVA. The only violation appeared in Experiment 2 for the consistently property-based extension measure. Because these data violated homoskedaticity, we reran the corresponding analysis using an arcsin transform, as recommended by Winer, Brown, and Michels (1991). The pattern of results remained the same. Therefore, we do not report analyses based on transformed data anywhere in the manuscript despite the proportional nature of our data.

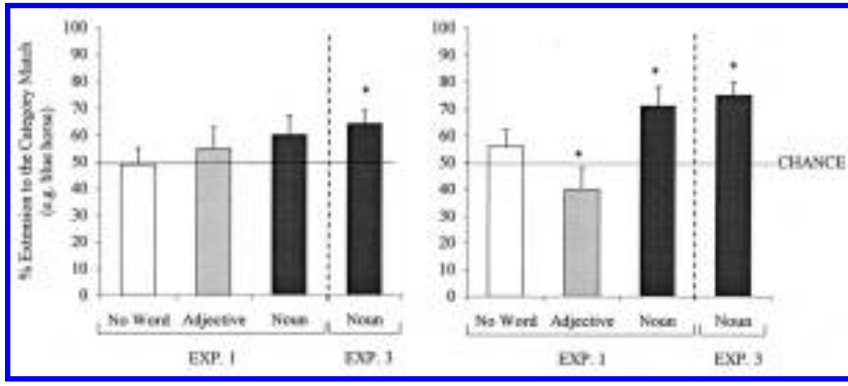

FIGURE 3 The percentages of category match selections made by infants in each condition of Experiment 1 are presented in the left portion of each graph. The right-most bar represents data from Experiment 3. Extensions on basic level sets are represented in the left panel (Figure 3a) and extensions on superordinate level sets are represented in the right panel (Figure 3b). An * indicates a significant difference from chance (50%).

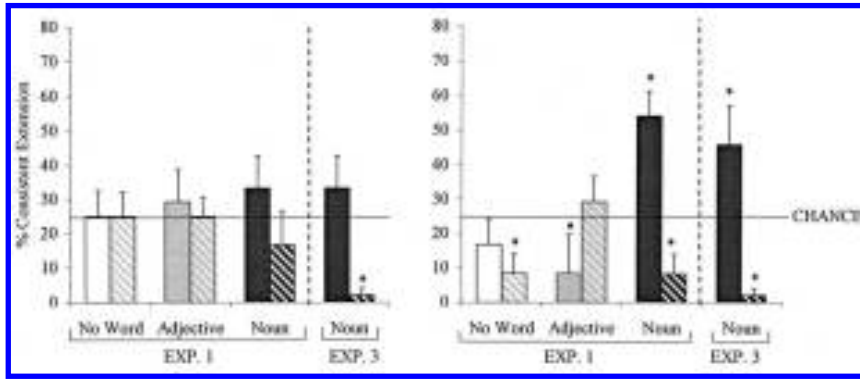

FIGURE 4 The percentages of consistent selections made by infants in each condition of Experiment 1 are presented in the left portion of each graph. The right-most bar represents data from Experiment 3. Solid bars represent consistent selections of the category match whereas striped bars represent consistent selections of the property match. Extensions on basic level sets are represented in the left panel (Figure 4a) and extensions on superordinate level sets are represented in the right panel (Figure 4b). An * indicates a significant difference from chance (25%).

Turning to the consistent property data, notice that infants in the no word condition were less likely to make consistent property selections than would be expected by chance ($M = .08$, $SD = .20$), $t(11) = 2.97$, $p < .01$. Infants in the noun condition revealed precisely the same baseline performance ($M = .08$, $SD = .20$). However, infants in the adjective condition ($M = .29$, $SD = .26$) pulled away from this baseline tendency. Although their consistent property-based selections did not exceed

the chance level, they were more likely to select the property test object than infants in either the noun or no word conditions, LSD *p*s < .05.

Discussion

As predicted, 14-month-old infants extended novel count nouns specifically on the basis of category membership (see also Waxman & Booth, 2001; Waxman & Markow, 1995). The results of the current experiment advance us beyond the results of previous investigations by revealing that when extending a novel noun, infants prefer a category-based interpretation *over* a property-based alternative if the two are pitted against one another. They also suggest that when extending a novel adjective, infants may prefer a property-based interpretation *over* a category-based interpretation when the property in question is color.

Also as predicted, the effects of novel words were demonstrated most clearly on superordinate level sets. We suspect that this outcome is related to interactions between lexical and conceptual development. For example, performance in the noun condition is consistent with reports that infants are reluctant to assign precisely the same meaning to two distinct words. When infants as young as 16 months of age are presented with a novel word for an object for which they already have a name, they tend to assume that the new label refers to something other than the object itself (e.g., another novel object, a part of the familiar object, a property of the familiar object) or to reject the word entirely (e.g., Clark, 1987; Hall & Waxman, 1993; Liittschwager & Markman, 1994; Merriman & Stevenson, 1997; Woodward & Markman, 1991). We suspect that our participants may have found themselves in just this sort of situation when confronted with basic level sets. Although 14-month-olds certainly have a very limited productive vocabulary, many of them comprehend the names for the basic level categories used in this study (86% comprehend "car," 48% "horse," 56% "duck," and 58% "apple"). A much smaller percentage understand the name for even our most common superordinate level category (26.7% comprehend "animal").[4] Although additional research will be necessary to be sure, this discrepancy in existing lexical knowledge could have contributed to the relatively weak effect of novel nouns at the basic level.

Performance in the adjective condition is also consistent with existing evidence. Previous work has documented that, although children readily extend novel adjectives within the context of basic level categories (e.g., red, applied to fire-engines

[4]Percentages based on words checked on the MacArthur Communicative Development Inventory (Fenson et al., 1993) by a normed sample of parents as understood by their infants (Dale & Fenson, 1993). Only this one superordinate level term ("animal") appears in this checklist. We suspect that infants' comprehension of the other superordinate level categories included in the current experiment (e.g., "vehicle," "produce") would be even less frequent.

only), they can also extend adjectives more broadly under certain supportive conditions (Klibanoff & Waxman, 2000; Mintz & Gleitman, 2002; Waxman & Klibanoff, 2000; Waxman & Markow, 1998). For example, Waxman and Klibanoff documented an important role for multiple exemplars in adjectival extension. Their work revealed that when 3-year-old children witness the same adjective (e.g., red) applied to objects from *different* basic level categories (e.g., fire engine, crayon), they go on to map the adjective broadly to objects from diverse categories, but that when that adjective is applied to objects from the same basic level category (e.g., two fire engines), they do not successfully map the adjective beyond the limits of that basic level category (Klibanoff & Waxman, 2000; Waxman & Klibanoff, 2000). The results of the current experiment are entirely consistent with this phenomenon: When infants observed the same adjective being applied to exemplars from a diverse range of basic level categories (e.g., to four different purple animals), they successfully extended the novel adjective beyond the familiarization category; yet when they observed the adjective applied within a single basic level category only (e.g., to four different purple horses), they did not. Although recent work by Mintz and Gleitman (2002) suggested that young learners can take advantage of multiple exemplars only when novel adjectives (e.g., *blickish*) are presented within the context of taxonomically specific head nouns (e.g., *horse* or *animal*), the results reported here indicate an alternative route to success. In our experiment, we have shown that when infants as young as 14 months of age are provided with four exemplars (rather than three, as in Mintz & Gleitman, 2002) during familiarization, and with explicit contrast (in the contrast phase) they successfully extend novel adjectives beyond the familiarization category even in the absence of a taxonomically specific head noun.

In the next experiment, we asked whether the effects of novel nouns and adjectives could be replicated with an object property other than color.

EXPERIMENT 2

The design of this experiment was identical to Experiment 1 with two exceptions. First, we chose sets for which the property-based commonality was texture, rather than color. Second, because the results of Experiment 1 were strongest on superordinate level sets, in Experiment 2 we presented only superordinate level sets in an effort to increase the power for detecting the precise effects of novel nouns and adjectives. Based on the results of the first experiment, we predicted that infants hearing novel nouns would extend novel words on the basis of category-based (and not property-based) commonalities, and that infants hearing novel adjectives would extend novel words on the basis of property-based (and not category-based) commonalities.

Method

Participants

Thirty-six infants (26 boys; 10 girls) with a mean age of 13.9 months (range = 13.6 to 14.4 months) were recruited from the same population as Experiment 1. Four additional infants were excluded for failing to reach the criterion of 75% clear choices.

Materials

The materials were similar to those used in Experiment 1, except that (a) the property-based commonality among the familiarization objects was texture rather than color, and (b) four superordinate level sets were introduced rather than two basic and two superordinate level sets. A complete list of stimuli can be found in Table 2. Notice that the "textures" are both visual and tactile in nature (e.g., blue bumps on green vehicles).

Procedure

The procedure was identical to that of Experiment 1.

Coding

The videotaped sessions were transcribed with the sound removed to insure that the coders, who were blind to the experimental hypotheses, were also blind to condition assignment. A primary coder scored all of the infants. A second coder independently scored 12 infants, 4 per condition. Consistency was computed as the proportion of the trials on which the coders agreed. Agreement was 100%. We derived the same dependent measures as in the previous experiment and considered the same predictions.

Results

Infants made clear selections on 99.7% of their trials. Only these trials were included in the analyses.

Category selections. We submitted the proportion category selections to a repeated measures ANOVA with condition (noun vs. adjective vs. no word) serving as a between subject factor. This analysis yielded a main effect of condition, $F(2, 33) = 3.35$, $p < .05$ (see Figure 5). Performance in the no word condition ($M = .55$, $SD = .10$) did not differ from chance, $t(11) = 2.62$, *ns.* As in Experiment 1, infants in the noun condition revealed a preference for the category test object ($M = .65$, $SD = .12$), selecting it more frequently than infants in the adjective condition ($M = .51$, $SD =$

TABLE 2
Complete List of Stimuli Used in Experiment 2

Set	*Familiarization*	*Contrast*	*Test*
1	4 purple pieces of furniture roughly mottled with yellow sand: bed, chair, table, cabinet	Smooth white seal Smooth pink rolling-pin	Smooth color-blocked purple sofa vs. rough mottled purple boat
2	4 red fruits striped with green ribbing: pepper, pear, strawberry, tomato	Shiny silver pot Burlap purple block	Polka-dotted red apple vs. Ribbed striped red boot
3	4 plush yellow animals: rabbit, bear, butterfly, dog	Smooth blue cup Smooth red wrench	Smooth plastic yellow duck vs. Plush yellow banana
4	4 green vehicles spotted with blue bumps: convertible, airplane, helicopter, truck	Cloth orange carrot Straw hat	Smooth green car vs. bumpy spotted green frog

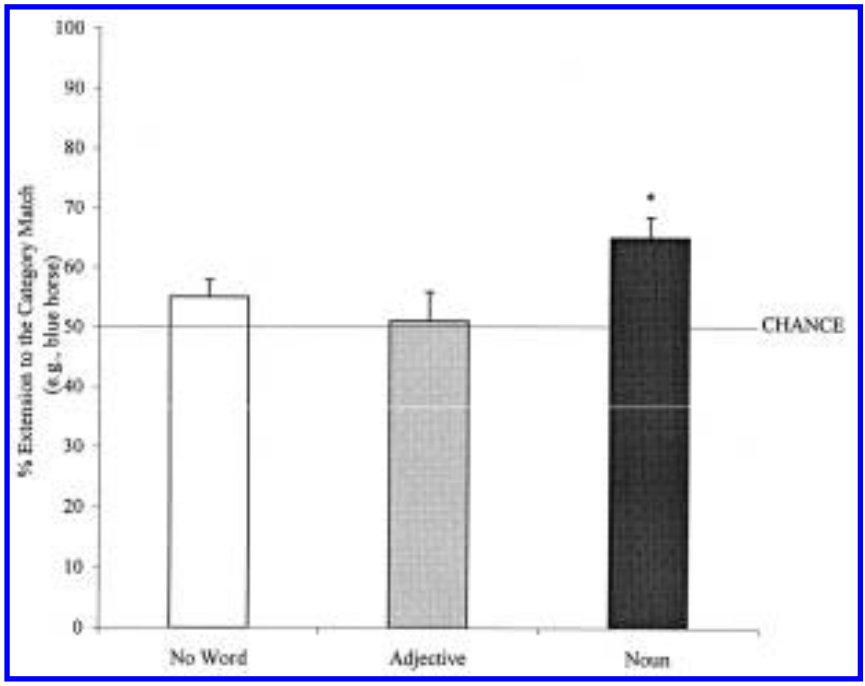

FIGURE 5 The percentages of category match selections made by infants in each condition of Experiment 2 are presented. An * indicates a significant difference from chance (50%).

.17), LSD, $p < .05$, and more frequently than would be predicted by chance, $t(11) = 4.31$, $p < .01$. The difference between performance in the noun and no word conditions was also in the expected direction, but was only marginally significant, LSD $p = .087$. Although performance in the noun condition mirrored that on the superordinate sets in Experiment 1, performance in the adjective condition was less clear-cut. These infants revealed no preference at test. Their performance differed neither from infants in the no word condition, nor from the level expected by chance.

Consistent category-based or property-based selections. When we considered infants' performance on this more stringent measure, the same picture emerged. A MANOVA, with infants' tendency to make consistent category and consistent property selections as dependent measures, revealed a main effect of condition $F(2, 64) = 2.49$, $p = .05$ (see Figure 6). Consider first their tendency to consistently select the category test object. As predicted, infants in the noun condition consistently selected the category test object ($M = .40$, $SD = .17$) more often than did infants in either the no word ($M = .21$, $SD = .18$) or adjective ($M = .19$, $SD = .22$) conditions, LSD $ps < .05$, and more often than would be predicted from

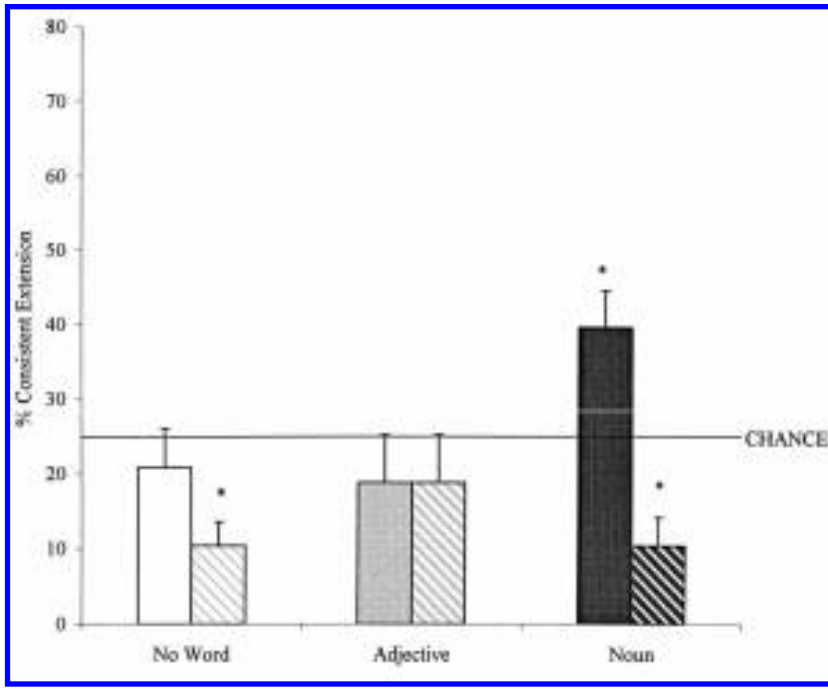

FIGURE 6 The percentages of consistent selections made by infants in each condition of Experiment 2 are presented. Solid bars represent consistent selections of the category match whereas striped bars represent consistent selections of the property match. An * indicates a significant difference from chance (25%).

chance, $t(11) = 3.02$, $p < .01$. The latter two conditions neither differed from each other, or from chance. There were no differences among conditions in the tendency to consistently select the property test object. However, comparisons to chance were instructive. Infants in the no word ($M = .11$, $SD = .13$) and noun ($M = .11$, $SD = .13$) conditions were less likely to make consistently property selections than would be expected by chance, $t(11) = 3.02$, $p < .01$. Infants in the adjective condition revealed no such tendency ($M = .19$, $SD = .22$).

Discussion

The results of this experiment suggest that 14-month-old infants hold a more precise expectation for count nouns than they do for adjectives when the property-based commonality is texture. As in previous experiments, infants extended count nouns specifically to object categories, and not to object properties. However, in contrast to Experiment 1, where infants restricted their extension of novel

adjectives to property-based (color) commonalities on superordinate level sets, infants in Experiment 2 revealed a less specific expectation, showing no clear preference for category-based or property-based (texture) commonalities.

Why were infants' expectations for adjectives in the current experiment less clear than those in Experiment 1? We suspect that this reflects the fact that at 14 months, infants are in a transitional period during which their expectations for adjectives are fragile. During this period, novel adjectives may be mapped more readily to some property-based commonalities (e.g., color; Experiment 1) than to others (e.g., texture; Experiment 2) under various circumstances. We return to this issue in the General Discussion.

In contrast to their apparently fragile expectations for novel adjectives, infants' expectation linking count nouns specifically to object categories appears to be precocious and quite robust. Why might this be the case? One possibility is that this link has a privileged status in the design of human language, and that this link can therefore be extracted with only minimal experience. As we have pointed out, this interpretation accords well with most current theories of language acquisition, which assume that the learner must be able to identify the nouns in the input and map them to entities in the world if they are to discover the other grammatical forms and their links to meaning (Dixon, 1982; Gentner, 1982; Gleitman, 1990; Grimshaw, 1994; Huttenlocher & Smiley, 1987; Maratsos, 1998; Pinker, 1984; Talmy, 1985; Waxman, 1999a; Wierzbicka, 1986). Indeed, the argument is that the acquisition of these other grammatical forms must be grounded in the prior acquisition of nouns.

There is, however, an alternative possibility–that infants' more precocious expectation for count nouns is an artifact of the manner in which the novel words were presented at test. Certain differences in presentation were obligatory to convey the grammatical form of the novel word. For example, in accordance with English grammar, determiners always preceded count nouns, but not adjectives. However, other differences in presentation were artifactual. For example, notice that nouns were presented in the (privileged) phrase final position whereas adjectives were presently penultimately at test. In addition, nouns had variable (and perhaps more interesting) word endings whereas adjectives always ended in the 'ish.' These differences introduce the possibility that infants were simply more likely to attend to the novel nouns than the novel adjectives at test. We designed Experiment 3 to examine this possibility.

EXPERIMENT 3

To examine the contribution of phrasal position and morphological endings in children's extensions of novel nouns, we introduced two modifications to the phrasing used in Experiment 1 in order to bring the presentation of nouns more closely in

line with that of the adjectives. In particular, we presented nouns in the penultimate position at test, and we modified the nouns so that they had fixed endings (all ended in "-et"). If infants' precocious ability to map nouns to object categories is dependent on these artifacts of presentation, then infants should show no preference for the category match in this modified noun condition.

Method

Participants

Twelve infants (6 boys; 6 girls) with a mean age of 14.3 months (range = 13.8 to 14.7 months) were recruited from the same population as Experiments 1 and 2. Five additional infants were excluded for either failing to reach the criterion of 75% clear choices ($n = 2$) or due to experimental error ($n = 3$).

Materials

The materials were identical to those used in Experiment 1.

Procedure

The procedure was identical to the Noun condition of Experiment 1, with two exceptions in the wording used by the experimenter. First, all labels were modified to have the same suffix (blicket, chamet, zapet, daket). Second, during the Contrast and Test Phases, when the experimenter asked infants to return an object to them, they placed the novel noun in penultimate position in their request (Contrast Phase: Can I have the *blicket* now? Test Phase: Can you put the *blicket* here?).

Coding

The videotaped sessions were transcribed with the sound removed to insure that the coders, who were blind to the experimental hypotheses, were also blind to condition assignment. A primary coder scored all of the infants. A second coder independently scored 4 infants. Consistency was computed as the proportion of the trials on which the coders agreed. Agreement was 100%. There were no systematic inconsistencies among coders.

Results

Infants made clear selections on 92.6% of their trials. Although no baseline condition was included in this study, the same materials, procedure, and experimenter were used here as in Experiment 1, thus allowing direct comparisons to that data.

Category selections. Performance in the new medial noun condition did not differ from that in the original noun condition of Experiment 1. Like infants in the original noun condition, those in the new medial noun condition selected the category test object more frequently ($M = .68$, $SD = .12$) than did infants in either the no word, $t(22) = -3.21$, $p < .01$, or the adjective conditions, $t(22) = -3.85$, $p < .01$, of Experiment 1. This rate of extension also exceeded chance, $t(11) = 3.44$, $p < .01$.

Infants in the new medial noun condition performed similarly on both basic and superordinate level sets, $F(1, 11) = .82$, *ns.* Because the effect of Hierarchical Level did not even approach significance in this analysis, we did not perform additional formal analyses at each hierarchical level. However, Figures 3a and 3b reveal that the effect of count nouns presented in phrase medial position was slightly stronger on superordinate level sets.

Consistent category-based or property-based selections. Again, performance in the new medial noun condition did not differ from that in the original noun condition (Experiment 1). First consider consistent category-based extensions. Like infants in the original noun condition, those in the new medial noun condition consistently selected the category test object more frequently ($M = 39.4$, $SD = 26.2$) than did infants in the no word of Experiment 1, $t(22) = 2.22$, $p < .05$. This rate of extension also marginally exceeded that seen in the adjective condition of Experiment 1, $t(22) = 1.94$, $p = .07$, and chance, $t(11) = 1.91$, $p = .08$. Turning to the consistent property-based extension data we see that a somewhat different pattern emerged than that revealed by the original noun condition. Infants in the new medial noun condition were less likely to consistently select the property match ($M = 4.2$, $SD = 9.7$) than were infants in the original adjective condition of Experiment 1, $t(22) = 2.96$, $p < .05$. This rate of extension was also significantly lower than chance, $t(11) = 7.42$, $p < .01$, and marginally lower than that observed in the no word condition of Experiment 1, $t(22) = 1.82$, $p = .08$.

Infants in the new medial noun condition performed similarly on both basic and superodinate level sets, $F(2,10) = .37$, *ns.* Again, because the effect of hierarchical level did not even approach significance in this analysis, we did not perform additional formal analyses at each hierarchical level. However, Figures 4a and 4b reveal that the effects of novel count nouns presented in a phrase medial position were somewhat stronger on superordinate, than on basic, level sets.

Discussion

Infants in this study clearly mapped nouns to categories. In fact, the noun–category linkage appeared somewhat stronger here than in Experiment 1 in that its effect was clearly evident on both the basic and superordinate level sets. This strong performance occurred despite the absence of variability in the count noun endings and despite their phrase medial positioning. Thus, the ability of 14-month-old infants in Experiments 1 and 2 to differentiate between count nouns and adjectives did not

depend critically on either of these factors. Rather, cues intrinsic to grammatical form class are likely to be guiding this differentiation.

General Discussion

An important feature of human language is that words from different grammatical categories (e.g., count nouns, adjectives) highlight different aspects of a given scene (e.g., object categories, object properties). Previous work suggests that by 14 months of age, infants are sensitive to at least some linkages between grammatical form class and meaning. Specifically, they appear to expect count nouns to refer to categories of objects while maintaining less specific expectations for adjectives. Experiments 1 and 2 replicated and extended these early studies by demonstrating that 14-month-old infants not only expect count nouns to refer to object categories, but that they will choose a category-based interpretation of a novel count noun over a property-based alternative when the two are presented in direct conflict with each other. Moreover, Experiment 3 confirmed that these effects were based on infants' ability to distinguish between grammatical form classes, rather than on their sensitivity to artifactual differences in how nouns and adjectives have been presented in previous studies.

Experiment 1 also revealed a tantalizing precocity in infants' expectations for novel adjectives. On superordinate level sets, infants hearing novel adjectives construed objects (e.g., four purple animals) as specifically embodying a salient *object property* (e.g., purple things). Recall that these are the very same objects that were construed as embodying an object category (e.g., animals) by infants in the noun condition. This provides new evidence that by 14 months of age, infants may have an emerging expectation linking adjectives specifically to object properties. However, this expectation was not evident in Experiment 2 (where the property-based commonality was texture rather than color).

This research broadens in several ways our understanding of infants' evolving expectations regarding the mappings for novel words. First, these results document, for the first time, that infants' expectation linking count nouns to object categories is sufficiently robust to hold up in cases in which infants must explicitly decide between a category- versus a property-based extension. This is an important advance: in the normal course of events, infants likely encounter many situations in which such alternatives arise. For example, upon hearing "rabbit" to refer to a fluffy white rabbit, a successful word-learner must recognize that another rabbit, that happens to be brown, is an appropriate extension of the novel word, whereas another white thing, that happens to be a dog, is not an appropriate extension. Although there is strong evidence that social factors (e.g., cues and corrections from caregivers) help to shape early word learning (e.g., Baldwin & Markman, 1989; Baldwin, Markman, Bill, Desjardins, & Irwin, 1996; Tomasello, Strosberg, & Akhtar, 1996), the results of the current experiments document that the infant's own expectations are powerful enough to play a substantial role early in the process of word-learning.

Second, the results of the current experiments suggest that infants' tendency to link adjectives specifically to object properties may emerge earlier than we had previously suspected (Smith, 1999; Waxman, 2002). Although this link is not fully mature at 14 months of age, there are nonetheless circumstances in which infants reveal a preference for property-based over category-based extensions of novel adjectives. This preference was evident when category- and property-based alternatives were pitted directly against each other, and when the property in question was color (Experiment 1), but not texture (Experiment 2). On the basis of the current evidence, we cannot be sure whether this relative difference between color and texture is primarily a perceptual or lexical phenomenon. On the perceptual side, there is strong evidence that infants detect color-based commonalities within the first 6 months of life (Bornstein, Kessen, & Weiskopf, 1976). Although the evidence documenting infants' sensitivity to texture-based commonalities is sparse, we do know that infants' ability to use color to reason about object individuation actually lags behind their ability to use other properties (e.g., pattern) in the same task (Wilcox, 1999). On the lexical side, there is evidence that some properties may be more readily lexicalized as adjectives than others. For example, across languages, color tends to be lexicalized within the adjective system, whereas other properties (e.g., texture) tend to be expressed more variably within the predicate system (Dixon, 1982). It is therefore possible that color might be more readily lexicalized as an adjective than are other properties. At the same time, however, there is reason to suspect that color might be more difficult to lexicalize than other properties: Infants' acquisition of color terms is substantially later than many other property terms (Bornstein, 1985; Dale & Fenson, 1993). This relative delay in the order of acquisition is mirrored in at least one experimental word-extension task (Waxman & Booth, 2001).

In general, we have interpreted infants' unstable performance in the adjective condition as evidence that an expectation linking adjectives to object properties is just beginning to emerge at 14 months and is therefore still fragile. However, a different interpretation is also possible. Perhaps infants have a firm grip of the link between adjectives and object properties, but their ability to express this link is limited by their difficulty (a) determining which property is being named, or (b) identifying the adjectives in the (sparse) frames that we offer. Additional research will be crucial if we are to gain a clear vision of the evolution of infants' expectations for adjectives.

Finally, the results of the current experiments address a lively debate regarding the emergence of the links between grammatical form and meaning in early word learning (Smith, 1999; Waxman, 2002; Waxman & Booth, 2001). We have documented that 14-month-old infants not only distinguish between (at least some) grammatical form classes, but also recruit these distinctions in the process of mapping words to meaning. The fact that these capacities are evident in infants who are just beginning to produce words on their own suggests that they are in place early enough to *guide* the acquisition of the productive lexicon. This challenges the claim that

form-meaning links are acquired rather late in the process of lexical acquisition, only after a substantial productive vocabulary has been established (Smith, 1999).

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REFERENCES

Baldwin, D. A., & Markman, E. M. (1989). Establishing word-object relations: A first step. *Child Development, 60,* 381–398.

Baldwin, D. A., Markman, E. M., Bill, B., Desjardins, R. N., & Irwin, J. M. (1996). Infants' reliance on a social criterion for establishing word-object relations. *Child Development, 67,* 3135–3153.

Booth, A. E., & Waxman, S. R. (2002). Object names and object functions serve as cues to categories in infancy. *Developmental Psychology, 38,* 948–957.

Bornstein, M. H. (1985). On the development of color naming in young children: Data and theory. *Brain & Language, 26,* 72–93.

Bornstein, M. H., Kessen, W., & Weiskopf, S. (1976). Color vision and hue categorization in young human infants. *Journal of Experimental Psychology: Human Perception & Performance, 2,* 115–129.

Brown, R. W. (1957). Linguistic determinism and the part of speech. *Journal of Abnormal & Social Psychology, 55,* 1–5.

Brown, R. (1973). Development of the first language in the human species. *American Psychologist, 28,* 97–106.

Clark, E. V. (1987). The principle of contrast: A constraint on language acquisition. In B. MacWhinney (Ed.), *Mechanisms of language aquisition* (pp. 1–33). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Dale, P. S., & Fenson, L. (1993). LEX: A lexical development norms database. Seattle: University of Washington, Department of Psychology.

Dixon, R. M. W. (1982). *Where have all the adjectives gone?* New York: Mouton.

Fenson, L., Dale, P. S., Reznick, J. S., Bates, E., Thal, D. J., & Pethick, S. J. (1994). Variability in early communicative development. *Monographs of the Society for Research in Child Development, 59*(5, Serial number 242).

Fenson, L., Dale, P. S., Reznick, J. S., Thal, D., Bates, E., Hartung, J., Pethick, S., et al. (1993). *User's guide and technical manual for the MacArthur Communicative Development Inventories*. San Diego, CA: Singular Press.

Gelman, S. A., & Coley, J. D. (1990). The importance of knowing a dodo is a bird: Categories and inferences in 2-year-old children. *Developmental Psychology, 26,* 796–804.

Gelman, S. A., & Ebeling, K. S. (1998). Shape and representational status in children's early naming. *Cognition, 66,* B35–B47.

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., & Markman, E. M. (1987). Young children's inductions from natural kinds: The role of categories and appearances. *Child Development, 58,* 1532–1541.

Gentner, D. (1982). Why nouns are learned before verbs: Linguistic relativity versus natural partitioning. In S. Kuczaj (Ed.), *Language development: Language, thought, and culture* (Vol. 2, pp. 301–334). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Gleitman, L. (1990). The structural sources of verb meanings. *Language Acquisition: A Journal of Developmental Linguistics, 1,* 3–55.

Grimshaw, J. (1994). Minimal Projection and clause structure. In B. Lust & M. Suner (Eds.), *Syntactic theory and first language acquisition: Cross-linguistic perspectives* (Vol. 1, pp. 75–83). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Hall, D. G. (1994). Semantic constraints on word learning: Proper names and adjectives. *Child Development, 65,* 1299–1317.

Hall, D. G., & Waxman, S. R. (1993). Assumptions about word meaning: Individuation and basic-level kinds. *Child Development, 64,* 1550–1570.

Hall, D. G., Waxman, S. R., & Hurwitz, W. M. (1993). How two- and four-year-old children interpret adjectives and count nouns. *Child Development, 64,* 1651–1664.

Huttenlocher, J., & Smiley, P. (1987). Early word meanings: The case of object names. *Cognitive Psychology, 19,* 63–89.

Klibanoff, R. S., & Waxman, S. R. (2000). Basic level object categories support the acquisition of novel adjectives: Evidence from preschool-aged children. *Child Development, 71,* 649–659.

Landau, B., Smith, L. B., & Jones, S. (1992). Syntactic context and the shape bias in children's and adults' lexical learning. *Journal of Memory & Language, 31,* 807–825.

Liittschwager, J. C., & Markman, E. M. (1994). Sixteen- and 24-month-olds' use of mutual exclusivity as a default assumption in second-label learning. *Developmental Psychology, 30,* 955–968.

Macnamara, J. (1982). *Names for things: A study of human learning*. Cambridge, MA: MIT Press.

Mandler, J. (2000). Perceptual and conceptual processes in infancy. *Journal of Cognition and Development, 1,* 3–36.

Maratsos, M. (1998). The acquisition of grammar. In D. Kuhn & R. S. Siegler (Eds.), *Cognition, perception, and language: Volume 2: Handbook of child psychology* (5th ed., pp. 421–466). New York: Wiley.

Merriman, W. E., & Stevenson, C. M. (1997). Restricting a familiar name in response to learning a new one: Evidence for the mutual exclusivity bias in young two-year-olds. *Child Development, 68,* 211–228.

Mintz, T. H., & Gleitman, L. R. (2002). Adjectives really do modify nouns: The incremental and restricted nature of early adjective acquisition. *Cognition, 84,* 267–293.

Nelson, K. (1973). Structure and strategy in learning to talk. *Monographs of the Society for Research in Child Development* (Vol. 149). Chicago: University of Chicago Press.

Pinker, S. (1984). *Language learnability and language development*. Cambridge, MA: Harvard University Press.

Quinn, P. C., & Eimas, P. D. (2000). The emergence of category representations during infancy: Are seperate perceptual and conceptual processes required? *Journal of Cognition and Development, 1,* 55–61.

Samuelson, L. K., & Smith, L. B. (1999). Early noun vocabularies: Do ontology, category structure and syntax correspond? *Cognition, 73,* 1–33.

Shi, R., Werker, J. F., & Morgan, J. L. (1999). Newborn infants' sensitivity to perceptual cues to lexical and grammatical words. *Cognition, 72,* B11–B21.

Smith, L. B. (1999). Children's noun learning: How general learning processes make specialized learning mechanisms. In B. MacWhinney (Ed.), *The emergence of language* (pp. 277–303). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Talmy, L. (1985). Lexicalization patterns: Semantic structure in lexical forms. In T. Shopen (Ed.), *Language typology and syntactic description* (Vol. 3, pp. 249–291). San Diego, CA: Academic Press.

Tomasello, M., Strosberg, R., & Akhtar, N. (1996). Eighteen-month-old children learn words in non-ostensive contexts. *Journal of Child Language, 23,* 157–176.

Waxman, S. R. (1990). Linguistic biases and the establishment of conceptual hierarchies: Evidence from preschool children. *Cognitive Development, 5,* 123–150.

Waxman, S. R. (1999a). The dubbing ceremony revisited: Object naming and categorization in infancy and early childhood. In D. L. Medin & S. Atran (Eds.), *Folkbiology* (pp. 233–284). Cambridge, MA: The MIT Press.

Waxman, S. R. (1999b). Specifying the scope of 13-month-olds' expectations for novel words. *Cognition, 70,* B35–B50.

Waxman, S. R. (2002). Early word learning and conceptual development: Everything had a name, and each name gave birth to a new thought. In U. Goswami (Ed.), *Blackwell handbook of childhood cognitive development* (pp. 102–126). Oxford, England: Blackwell.

Waxman, S. R., & Booth, A. E. (2001). Seeing pink elephants: Fourteen-month-olds' interpretations of novel nouns and adjectives. *Cognitive Psychology, 43,* 217–242.

Waxman, S. R., & Booth, A. E. (2003). The origins and evolution of links between word learning and conceptual organization: New evidence from 11-month-olds. *Developmental Science*, *6*(2), 130–137.

Waxman, S. R., & Hall, D. G. (1993). The development of a linkage between count nouns and object categories: Evidence from fifteen- to twenty-one-month-old infants. *Child Development, 64,* 1224–1241.

Waxman, S. R., & Klibanoff, R. S. (2000). The role of comparison in the extension of novel adjectives. *Developmental Psychology, 36,* 571–581.

Waxman, S. R., & Kosowski, T. D. (1990). Nouns mark category relations: Toddlers' and preschoolers' word-learning biases. *Child Development, 61,* 1461–1473.

Waxman, S. R., & Markow, D. B. (1995). Words as invitations to form categories: Evidence from 12- to 13-month-old infants. *Cognitive Psychology, 29,* 257–302.

Waxman, S. R., & Markow, D. B. (1998). Object properties and object kind: Twenty-one-month-old infants' extension of novel adjectives. *Child Development, 69,* 1313–1329.

Waxman, S. R., Senghas, A., & Benveniste, S. (1997). A cross-linguistic examination of the noun-category bias: Its existence and specificity in French- and Spanish-speaking preschool-aged children. *Cognitive Psychology, 32,* 183–218.

Wierzbicka, A. (1986). Does language reflect culture? Evidence from Australian English. *Language in Society, 15,* 349–373.

Wilcox, T. (1999). Object individuation: Infants' use of shape, size, pattern, and color. *Cognition, 72*, 125–166.

Winer, B., Brown, D., & Michels, K. (1991). Statistical principles in experimental design (3rd edition). New York: McGraw-Hill, Inc.

Woodward, A. L., & Markman, E. M. (1991). Constraints on learning as default assumptions: Comments on Merriman and Bowman's "The mutual exclusivity bias in children's word learning." *Developmental Review, 11,* 137–163.