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Learning Adjectives in the Real World: How Learning Nouns Impedes Learning Adjectives

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Previous studies have documented that children are slow to acquire adjectives into their productive vocabulary. Yet in laboratory studies, even very young children can extend novel adjectives to new instances. Two studies examined the relation between children's acquisition of adjectives and children's emerging knowledge about nouns. In Study 1, the input parents provide to children when talking about properties was examined. The results indicate that the type of input provided in laboratory experiments is infrequent in parent speech to children, and that parents often talk about adjectives using syntax that is ambiguous as to the adjectival status of the words and confusable with nouns. In Study 2 children participated in a training study designed to teach children color words without strong syntactic cues. In Study 3 children participated in a training study designed to teach children color words with syntactic cues that strongly indicated the adjectival status of the word. The results show that younger children who had fewer nouns in their productive vocabulary learned more without strong syntactic cues whereas the older children who had more nouns in their productive vocabulary were more likely to benefit from hearing strong syntactic cues.

Children's learning of English adjectives presents a puzzle. Studies of children's production and comprehension of adjectives shows a protracted and errorful developmental course particularly relative to children's fast and seemingly

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errorless acquisition of object names (see Gasser & Smith, 1998 for review). However, laboratory studies of young children's ability to learn novel adjectives suggest that young children readily "fast map" novel adjectives to appropriate meanings. This paper is about this puzzle.

The central issue concerns the relation between children's knowledge about nouns and their ability to learn new adjectives. On the one hand children's attention toward learning object names might be expected to interfere with learning adjectives. As Mintz and Gleitman (2002) put it: "To the extent that infants are in thrall to 'things,' we see another basis on which to predict that adjective learning should be hard: all candidate lexical items suffer insofar as they are not nouns and do not label whole objects." (p. 270). On the other hand, laboratory studies demonstrating children's early skill in mapping adjectives to appropriate meanings show that children's knowledge of noun meanings (Hall, Waxman & Hurwitz, 1993; Mintz, 2005), the inclusion of linguistic cues that distinguish nouns from adjectives (Smith, Jones, Landau, 1992; Waxman & Booth, 2001), and the explicit mention of a known noun when the novel adjective is presented (Mintz & Gleitman, 2002) all benefit children's mapping of a novel adjective to a property. The puzzle then is this: Given children's sensitivity to these cues in laboratory experiments and despite their well-developed knowledge of nouns, their acquisition of real-world adjectives is nonetheless surprisingly slow. Why is this?

One possibility is that the cues that specify and distinguish adjectives from nouns, although useful in experiments, are not prevalent in the everyday language-learning environment, that is, in parent's speech to children. If this is so, then in the real-world learning task, children may often confuse adjectives with nouns. The experiments that follow provide evidence for this proposal and in so doing, add a new twist on how language learning builds on itself, sometimes making a difficult learning problem even more difficult.

NOUNS ARE EASIER TO LEARN THAN ADJECTIVES

Three lines of evidence indicate the developmental priority of nouns over adjectives. One line concerns the words that comprise children's early vocabularies: Nouns dominate and adjectives are rare (Nelson, 1973; Gentner, 1978; Dromi, 1987; Jackson-Maldonado, Thal, Marchman, Bates, and Gutierrez-Clellen, 1993; Gasser & Smith, 1998; Mintz & Gleitman, 2002). For example in Stern's diary study 78% of the words children produced at 20 months were nouns and 0% were adjectives (Gentner, 1978). In Nelson's study of 18 children, fewer than 7% of the first 50 words were adjectives. Goldin-Meadow, Seligman, and Gelman (1976) found that one to two year old children comprehended and produced many nouns, but few verbs, and no adjectives. These observations are also confirmed by large-scale normative studies of early vocabulary growth. For

example, the MacArthur Communicative Development Inventory (MCDI) is a parent checklist containing words common to the productive vocabulary of young children (Fenson, et al 1991). The English MCDI was developed through extensive normative studies and contains words known by 50% of children learning English at 30 months of age. This MCDI inventory contains 372 nouns but only 70 adjectives.

A second line of evidence concerns children's errors with nominal and adjectival meanings. Children make very few errors in the case of nouns, both in production and comprehension (Huttenlocher & Smiley, 1987, Naigles & Gelman, 1995). In contrast, children make many comprehension errors in the case of adjectives and do so even when they are 3, 4, and 5 years old (Carey, 1982; Maratsos, 1988; Smith & Sera, 1992).

The final line of evidence concerns artificial word learning studies. In these studies experimenters present children with a novel object, label it, and then ask the children to extend that label to other instances. Study after study has shown that when the novel word is presented in a syntactic frame indicative of a count noun, children as young as 13 months extend that name to category members and even remember what they have learned over several days and weeks (Heibeck & Markman, 1987; Woodward, Markman, & Fitzsimmons, 1994; Waxman & Booth, 2001, Bloom, 2000). When the novel word is placed in an adjectival context, (e.g., "this is a daxy one") or specifically contrasted with a known adjective, (e.g., "this is ecru not red"), children as young as 14 months have been shown to map the meaning to a property (Waxman & Booth, 2001) but many other studies have also shown that children as old as 3 years often fail to make the mapping. Indeed, in such tasks, 2, 3, and even 4 year olds sometimes interpret novel adjectives as referring to the whole object rather than to a property (Au & Markman, 1987; Au & Laframboise, 1990; Smith, Jones & Landau, 1992; Imai & Gentner, 1997). Success in teaching children novel adjectives in an experimental task is thus more variable, more context dependent, and much less certain than teaching them novel nouns.

All three lines of evidence point to a noun advantage over adjectives in early lexical learning. Explanations of this noun advantage generally point to the greater perceptual and conceptual coherence of common noun categories. For example, in her natural partition hypothesis, Gentner (1982) proposed that nouns are easily learned because they refer to readily individuated whole objects and because children are endowed with a perceptual system that picks out whole objects. Adjectives, in contrast, appear hard to learn because they refer to selected properties and because children must selectively attend to those properties and perceptually segregate them from the whole object (Smith, Gasser, & Sandhofer, 1997; Gasser & Smith, 1998). Others have suggested that conceptual and linguistic constraints favor noun learning, that young learners assume that labels refer to whole objects and not their parts or properties

(Heibeck & Markman, 1987, and see also Soja, Carey, & Spelke, 1992). In sum, the literature strongly suggests that children are biased to interpret novel labels as nouns. Further, the evidence suggests that this bias may interfere with the learning of adjectives.

CUES THAT SPECIFY ADJECTIVES

However, other evidence suggests that children learn and use cues that distinguish nouns from adjectives, and they appear to be sensitive to these cues quite early. Indeed, Waxman and Booth (2001) showed that even 14-month-old children could exploit these differences in mapping words to potential meanings. In their study children were presented with pairs of objects that matched on a property (e.g., two purple horses). The pair was labeled with either a novel noun (These are blickets) or with a novel adjective (These are blickish). Children in the noun condition generalized the name only to the category (horses) and not to the property (purple things). Children in the adjective condition generalized the name to the property (purple things) and also the category (horses). Thus by 14 months, children know the kinds of categories to which a noun refers and are sensitive to the linguistic differences that distinguish nouns and adjectives. These results leave unspecified just what young children do know about adjectives. It could be that they interpret adjective meanings as spanning possibilities such as "purple" or also "has a nose," an additional property shared by the labeled horses. Alternatively, children's pattern of performance is consistent with the possibility that young children know a great deal about nouns and the cues that specify them but know very little about the cues that specify adjectives and their range of possible meanings (Smith, Jones, & Landau, 1992).

Studies of somewhat older children show that they can map adjectival forms to properties when the task structure provides clarifying information about the noun category. For example, Waxman & Markow (1998) presented 21 month olds with a familiar object (a yellow car) and labeled it with a novel adjective "this is a very blickish one." They found that 21 month olds successfully extended the label to objects with the same property if they were members of the same basic level category, for example to a second yellow car. However the children failed to extend the label to objects with the same property when they were members of a different basic level category, for example, to a yellow airplane. Subsequent work showed that even 3 year olds' adjective extensions were limited to objects in the same basic level category. However, these older children were able to map novel adjectives to properties across different basic-level categories when they were presented with multiple instances (e.g., when children were explicitly told that the adjective labeled both a yellow car and a yellow horse, they were able to map the novel adjective to a yellow airplane).

The findings of a link between children's adjective learning and knowledge of basic level categories fits linguistic analyses of adjective meanings in that these meanings appear highly tied to the modified noun. For example, "red "in context of "red cup" and "red hair" has different meanings and so does "big" in the context of "big cookie" and "big mouth" (Halff, Ortony and Anderson 1976). Thus children may need to know something about the noun category before they can learn adjectives. The basic-level restriction discussed in the literature also fits with general assumptions about learning in that the generalizations appear limited to instances that are similar overall to the original exemplar (Gasser & Smith, 1998). All these hypotheses suggest that knowledge about noun categories plays a positive role in children's learning about adjectives.

Studies by Hall, Waxman, and Hurwitz (1993) and by Markman and Wachtel, 1988) provide further evidence. They show that specific knowledge about the modified noun category helps children learn novel adjectives. In these studies 4-year old children were presented with objects that were labeled with novel words in frames indicating an adjective (e.g., "This is a very wug-ish one.") Even though the object names were not provided by the experimenter, the children were more likely to extend the adjective to a property when the object name was known by the child (e.g., cup) then when it was not (e.g., garlic press). Both Hall et al and Markman and Wachtel suggest that it was children's familiarity with the noun and not familiarity with the objects per se, that determined children's superior performance with mapping novel adjectives in the case of familiar categories (but see Sandhofer & Smith, 2004). More recently, Mintz (2005) found that children's familiarity with a novel word affected their ability to extend novel adjectives differentially depending on whether "one" or "thing" was the pronominal modified and further that unfamiliar objects do not appear to affect children's ability to extend novel adjectives as long as a coherent category label is presented.

Indeed, Mintz and Gleitman (2002) showed that presenting novel adjectives in sentences that included a noun enabled children as young as 2 years old to extend the adjective to other objects with that property and to do so even when the objects were not in the same basic level category. In their task, they presented children with three objects that matched in a property, e.g., a felt block, a felt elephant, and a felt ball. In one experiment they labeled each object in sentence frames that included a novel adjective and the modified noun (e.g., this is a stoof block, this is a stoof elephant, this is a stoof ball). In a second experiment, they labeled the objects in a sentence frame that included the novel adjective but not basic level category name; specifically they labeled each object with the sentence "this is a stoof one." In both experiments children were presented with novel test objects and asked to indicate "the stoof one." When the adjective was introduced in sentences including the modified noun, even the two year olds generalized the label to the test object with the matching property (e.g., a felt car). However,

when the adjective was originally introduced in a sentence with a pronominal, the children failed to generalize the label to the test object with the matching property. In brief, children were better able to map a novel adjective to its intended meaning when the syntactic role of the novel term as an adjective was strongly specified by the sentence frame, that is, when the object labels were explicitly provided in the sentence. In cases in which a noun is not as strongly specified, for example, when an adjective modifies a pronoun, children appear to require something extra such as comparing several instances of the same property in order to succeed in extending novel adjectives (Waxman & Klibanoff, 2005; Mintz, 2005). These results again provide evidence of a strong dependency between children's interpretation of adjectives and their knowledge about adjectives as modifiers of nouns.

RATIONALE FOR THE PRESENT STUDY

In summary the extant evidence clearly indicates that nouns are learned earlier than adjectives and that adjective learning is dependent on knowledge of nouns and noun categories. Mintz and Gleitman's (2002) results also suggest that given clear information about the syntactic role of a novel adjective in a sentence—as a modifier of an object name—even two-year-olds interpret the novel adjective as referring to a property of the object rather than the object itself. Adjective learning also appears to be helped by familiarity with the basic-level category and by the explicit labeling of multiple instances. All this tells us that quite young children can learn novel adjectives as labels for properties and do so when the proper cues are provided. Why then if children are sensitive to the relevant cues do children have such difficulty in learning adjectives in their everyday life? Could it be that the way parents typically talk about adjectives, specifically the syntax parents use when talking about adjectives, does not provide children with strong syntactic cues? We addressed this question in Study1.

Study 1

The goal of this study is to examine the sentence frames used by parents when they label the properties of objects. We were specifically motivated by the Mintz and Gleitman finding that sentences that strongly specify the role of the adjective as a modifier of an object name enhance children's interpretation of the adjective as a label for a property. Our question was this: Do parents present property terms in sentence frames that strongly specify those terms as modifiers of object names? To answer this question, we needed parents to talk about object properties. Analyses of parent-child conversations from the CHILDES database (MacWhinney, 2000) suggest that parents rarely talk about the properties of objects

(e.g., Sandhofer, Smith & Luo, 2000), a possible reason for the slow acquisition of adjectives in and of itself. However, the parent child interactions available through the CHILDES database were collected for a variety of purposes and the contexts may not have been conducive to talk about object properties. More importantly for our purposes, the parent child interactions in the CHILDES database do not specify the objects and referents that parents are talking about, and although the referents are sometimes recoverable from context, this is not always the case.

Accordingly, our goal in this study was to collect naturally occurring parent-child conversations in a context in which talking about the properties of things was likely. To this end, we selected sets of toys—teddy bears, cups, and stacking rings—that were the same or different on the kinds of properties that seemed relevant to parents and children: color, size, and texture. In this way we offer parents the opportunity to use adjectives to make with-in basic level category comparisons (a fluffy bear and a scratchy bear) and to use adjectives to make between-kind comparisons (a red bear and his red cup).

The data were collected from parents and children who were participating in a longitudinal language study. We selected children at an age in which they would already know some language, but be unlikely to be sophisticated users of adjectives. Thus children began the study at 24 months and ended at 30 months of age. During each of 8 visits to the laboratory over a 6 -month period, parents and children were given time alone in a play room with just these toys available and parent speech to the children was recorded. In this way, we obtained a broad sample of naturalistic speech about properties of things.

Method

Subjects

Twelve children (7 male and 5 female) and their primary caregivers (11 mothers and 1 father) participated. One additional child began the study but dropped out after the second session. Children and parents visited the lab at three-week intervals beginning when the children were 24 months of age (mean = 24.2, *SD* = 0.6, range 23.3–25.4) and ending when children were approximately 30 months of age (mean 29.7, *SD* = 0.5, range 28.8–30.6) for a total of 8 sessions. Children averaged 300 words in their productive vocabulary (range 6–521 words) at the start of the study, as assessed by the MacArthur CDI: Words and Sentences— a parental inventory of the 680 words known by 50% of children by 30 months of age. All children came from English-only speaking families and were recruited from a subject database.

Materials

Free play. Children and parents were given a box of toys to play with. The box of toys consisted of six sets of stacking rings, four sets of nesting cups, eight

teddy bears and three "touch and feel books." The toys contained examples of objects that were the same and different in colors, textures, and sizes.

Comprehension test. At the conclusion of each free play session children were shown picture cards and asked to select the card that presented a specific color, texture, number, or size. The four color cards showed pictures of red, blue, yellow, or green balloons. The four size cards showed big (17 cm), medium (10 cm), little (5 cm), or tiny (2 cm) flowers. The four number cards showed pictures of one, two, three, or four buttons. And the four texture cards showed bumpy, furry, scratchy, and sticky circles.

Procedure

Free play. Each session was 20 minutes long. The goal of the sessions was to observe the language input that parents provided to their children. However parents were not told that parental input to the child was the primary goal of the study and were instead only told that we were interested in children's language development. Parents were instructed to play with their child the way they normally would at home, with the exception that if the child was playing quietly the parent should encourage conversation. The sessions were videotaped and no observers were present in the room during the play sessions. Parents were not told to play with specific toys nor with multiple instances of any one kind and were free to use (or not use) any of the toys in the toy box.

Comprehension test. In the comprehension test, children were presented with three pictures at a time and asked to select one by its property label, for example, "Where's a red balloon." Color, number, size, and texture questions were presented in blocks, but the order of the blocks was randomly determined, and the order of questions within blocks was randomly selected.

Coding

Six coders who were blind to any hypotheses of the study transcribed and coded videotapes. Twenty percent of all transcripts were crosschecked for reliability. Reliability of all transcribed speech between transcribers was 99%. Transcripts were then segmented into utterances. Table 1 provides an example of the utterances in a typical interchange between a parent and child talking about a yellow nesting cup. As can be seen utterances are often not full sentences.

Utterance change was defined by three criteria: (1) A new utterance starts when there is a change in who was speaking. That is, if the mother was speaking and the child responded, the child's response would count as a new utterance. An example of this can be seen in the change from utterance 1 to utterance 2 in Table 1. (2) A new utterance starts when there is a pause of greater than 2 seconds. For

TABLE 1
Example of a Parent Child Exchange

Utterance number	*Parent Says*	*Child Says*
1	what color is this? (points)	
2		yellow
3	yellow!	
4		mhmm
5	Yeah (14 second pause while parent twirls cup around finger)	
6	Should I put this on my head? (points)	
7		mhmm
8	Is it green? (points)	
9		mhmm
10	No (shakes head) it's not green.	
11	Do you like my hat?	

example, if the parent paused for greater than two seconds in her speech, the pre pause speech would count as one utterance and the post pause speech would count as another utterance. An example of this can be seen in the change from utterance 5–6 in Table 1. (3) A new utterance starts when there is the completion of a sentence. An example of this can be seen in the change from utterance 10 to utterance 11 in Table 1. The reliability between coders for utterance segmentation was 99%.

All utterances referring to color, texture, and size were then selected. We chose to focus on these because these terms use a perceptual property as the referent. In addition we did not focus solely on syntactic criteria to define an adjective (e.g., counting a word as an adjective only if it modifies a noun) because we wanted to determine how property terms were used in real world situations by parents and we wanted to examine the possibility that perceptual properties were not always labeled with adjectival syntax. For example, "green" would be counted as an adjective even when it appeared in syntax that specifies a noun (e.g., "Give me a green.") or verb (e.g., "You greened me.") Utterances were analyzed for the following three characteristics. First, utterances were analyzed for the sentence frame in which the adjective occurred. Second, utterances were analyzed for the number of objects referred to. Third utterances were analyzed for basic level categories and whether when multiple objects were the referents, the objects were from the same or different basic level categories. All three characteristics were coded by naïve coders. Reliability between coders was 95.3% for sentence frames, 97.8% for number of objects referred to, and 94.6% for which objects were referred to.

The five types of sentence frames—in which the property terms occurred, are listed with examples in Table 2. One frame consists of the adjective and object name (e.g., "red bear.") Mintz and Gleitman's analyses and results suggest that

TABLE 2
Examples of the 5 Types of Adjective Construction

Type of adjective construction	*Example utterance*
Modifying object	This is a red bear.
Modifying pronominal	This is a red one.
Ambiguous non-modifying	This is red.
Alone	Red!
Noun construction	This is a red.

this type of construction ought to provide strong support for learning adjective meaning. A second frame consists of the adjective modifying a pronominal (e.g., "red one", a commonly used frame in experiments on artificial word learning with children, but one that, according to Mintz and Gleitman (2002) provides weaker evidence as to the syntactic category of the term and its meaning as a modifier that distinguishes instances within a noun category. The third frame parents used, "This is ___," (e.g., "This is red") also does not provide the object name and is ambiguous with respect to syntactic categories of the property term. Although this construction is consistent with an interpretation of the term as an adjective, it is also consistent with an interpretation as other form classes including proper nouns (although not count nouns). Fourth, parents sometimes used the property terms alone saying such things as "Red!" This type of construction also provides no cue as to the adjectival status of the word. Fifth parents sometimes framed the property term as a noun, marking it with articles such as "a" or "the" (e.g., "This is the red." Or "Here is a blue".) In this type of construction the property term was unambiguously treated as a noun.

RESULTS AND DISCUSSION

There were a total of 24,415 utterances. Of these 4785 (19.4%) included mention of color, texture, or size words. Thus, as found in previous studies, (Nelson, 1973; Gentner, 1978; Goldin-Meadow, Seligman, & Gelman, 1976; Dromi, 1987; Fenson et al, 1991; Jackson-Maldonado, Thal, Marchman, Bates, and Gutierrez-Clellen, 1993) parents use property terms when talking to their children only infrequently. Although the proportion is relatively small, the absolute frequency of utterances, 4758, was sufficiently large to provide information on the types of contexts in which children hear property terms used.

Table 3 shows the mean number correct on the first and last sessions of the comprehension tests. Interestingly, children showed significant improvement only on the size comprehension test, $t(11) = 3.19$, $p < .01$, but there was no significant increase or decrease on the other three comprehension tests. Given that

TABLE 3
Mean Scores on the First and Last Sessions of the Comprehension Tests (Standard deviations are in parentheses)

Comprehension test	*1st session*	*8th session*
Color	2.42 (1.08)	3.17 (1.27)
Size	1.83 (1.27)	3.08 (1.00)
Number	1.17 (1.03)	1.25 (1.14)
Texture	2.50 (1.17)	3.25 (.97)

one example of each property was queried at each session, it is not possible to determine from this test whether children accurately "know" a specific word (for example, whether children "know" the property of red). Rather, the comprehension test gives a general view about how children improved in comprehension over the course of the six-month study.

Changes Over the Course of the Study

Unless noted, for all measures reported below there were no changes over the course of the study as the children increased in age from 24 to 30 months. Therefore we first report analyses combined across ages in the six-month study. Subsequently we report measures of the stability of these results over the six-month period.

Sentence Frames

The mean number of these five constructions in parent's speech to children is given in Table 4 for the color, size, and texture terms. The parents present a fair amount of variability in the frequency with which they use a particular syntactic frame, although much of this is accounted for by the frequency with which parents talked about color, size, and texture overall, i.e., the correlation between the number of color, size, and texture utterances and the number of object modifying syntactic frames is high ($r = .624$, $p < .05$). The relative percentage of each construction combined across the three classes of words is also shown. As can be seen about a quarter of the time, parents use these terms as adjectives that modify an object name, the most informative sentence frame. However, 55% of the time, parents use these frames in the three most ambiguous and least informative constructions: either as a noun, alone or in an ambiguous non-modifying context. These were the dominant construction for all parents. In brief, children do not mostly hear property terms—terms such as red, big, and fuzzy—that we think of as adjectives in sentence frames that clearly mark them as modifiers of nouns.

TABLE 4
The Adjective Status of the Parent Utterances for Color, Size and Texture
(Data for word class are presented as means and relative percentages, ranges are in parentheses)

	Word class							
	Color		*Size*		*Texture*		*Overall*	
Adjective construction	*Mean*	*Rel. %*	*Mean*	*Rel %*	*Mean*	*Rel %*	*Mean*	*Rel %*
Modifying object	49.6 (10–95)	21.9%	30.6 (8–48)	38.3%	15.1 (3–33)	16.0%	95.3 (44–157)	24.0%
Modifying pronominal	57.9 (32–175)	12.8%	17.0 (4–62)	21.3%	5.8 (0–30)	6.3%	80.8 (41–245)	20.3%
Ambiguous non-modifying	53.0 (9–115)	25.6%	19.3/ (4–40)	24.1%	48.0 (21–122)	51.6%	120 (69–259)	30.2%
Alone	44.8 (7–87)	19.8%	10.7 (0–48)	13.4%	22.1 (2–69)	23.8%	77.5 (24–164)	19.4%
Noun Construction	20.6 (3–64)	9.1%	2.4 (0–10)	3.0%	2.0 (0–8)	2.2%	25.0 (6–67)	6.3%

Further, parents sometimes actually use these terms as nouns. This is particularly the case for color terms, the most frequent property term used by parents. Here in 9% of the utterances, the color term was explicitly marked as a noun. Moreover, all twelve of the twelve parents used a property term as a noun at least once. This may well be a contributing factor to children's difficulty in learning color terms (Soja, 1994). There is some cross-linguistic evidence for this idea. Waxman, Senghas, and Benveniste (1997) show that in languages such as Spanish in which constructions like "a blue," are grammatical, children are more likely to extend novel adjectives to pictures that share taxonomic similarity than children learning languages in which constructions like "a blue" are ungrammatical. Further, experimental studies of children's artificial adjective learning suggest that children can succeed in mapping adjectives when provided with information specifying the noun category. The reason children have trouble learning property terms, then, may be that the learning environment does not present children with strong syntactic support for interpreting adjectives as something different from nouns.[1]

Object Labels within Discourse

One possibility is that although the object label does not appear in many of the utterances containing adjectives, the objects in question may be explicitly labeled in surrounding utterances in such a way that the child can look across utterances and recover the antecedent, for example the referent of "one," thus rendering the sentence frame unambiguous. To determine the proximity between the object label and the object being modified in the ambiguous sentences, we looked for the object label in the four adjective constructions in which the object label is not contained within the sentence frame: modifying pronominal, ambiguous nonmodifying, alone, and noun construction. For each transcript we counted back from the adjective to the point in which object being modified was last labeled. Of the 3642 adjective occurrences without an object label, the object was labeled at some prior point during the transcript 1226 times (33.6%), the object was never labeled prior to the adjective 2359 times (64.7%), and whether or not the object was labeled within the transcript was unclear in 57 cases (1.6%). There

[1]It would be of interest to determine how well parent input correlates with children's comprehension scores. However, because this data was collected for other purposes, this type of analysis is not possible using our dataset. The results of Study 2 and Study 3 suggest that the type of sentence frame presented is important for children who have high vocabularies, but not for children who have smaller vocabularies. In our set of twelve children, only four fall into the high vocabulary category (and only two into the low vocabulary category), and although the four high vocabulary children show a high correlation between comprehension score and the percentage of parent speech that modifies an object label, the analysis is questionable once eight of the twelve children are removed and the sample size is reduced to four.

TABLE 5
The Distance (in Utterances) Between the Object Label and the Adjective

Number of utterances before adjective	*Total number of occurrences*
1	163
2–4	332
5–7	121
8–10	54
10–128	556
Never appears	2359

was a good deal of variation in the distance between the object label and the adjective modifying the object in the 1226 instances in which the object label appeared in the transcript. The median distance between the object label and the adjective was 5 utterances, but the mean distance was 13.3 (*SD* = 19.9). Table 5 shows the distribution of the distances. Thus it appears that although the object label may be recoverable from the immediate discourse in some situations, in the majority of situations the object label is not proximal to the adjective.

How Many Objects and What Objects

We also analyzed the number of objects referred to by a particular property name between and within utterances. Although parents did not name the object in most of the sentences in which they presented the property term, the objects parents talked about all had names familiar to children and indeed all of the objects were labeled with a noun in some of the utterances. Arguably, then, children could use this information to infer the meaning of the term (but see Sandhofer & Smith, 2004).

Although hearing or knowing the label for one object may be helpful in some circumstances, numerous studies have shown that presenting and labeling multiple instances of a property, for example, pointing out a red cup and a red bear or a red cup and another red cup aids children in correctly extending new words in laboratory experiments (e.g., see Waxman & Klibanoff, 2000). However, our results suggest parents rarely talk about the properties of multiple instances. We examined the degree to which parents emphasized multiple instances in their speech by examining the frequency with which parents labeled multiple instances with labels referring to a property (or properties) on a single dimension within the same utterance or within a two utterance range. We did so separately for statements and questions. For parental statements, if parents labeled a property, e.g., “this is a red bear” and then within two utterances later labeled the same

dimension either pointing out a another instance of the same property "this is a red cup," or a contrasting example of the same dimension "this is a blue bear," we credited the parent with labeling multiple instances on the same dimension. We treated utterances in which parents asked questions and made requests as separate from utterances in which parents made statements because, in situations in which parents present children with several objects and ask questions such as "Which one is red?" the question (or request) implicitly suggests a comparison among multiple objects. That is, to answer the parent's question children would have to compare among several objects in order to find the requested property. Appendix 1 presents examples of these categories of utterances. The reliability between coders for determining whether parents referred to single or multiple instances was 97.8%.

Table 6 shows that for each of the different kinds of properties, parents predominantly talk about one property of one object. That is, parents overwhelmingly talk about one object at a time. When parents do talk about multiple objects, they tend to talk about objects within the same basic category that differ on a single dimension, e.g., a red bear and a blue bear, and less than 10% of the time do parents make comparisons across basic level categories, e.g., a red bear and a red cup. Thus, when parents do talk about multiple instances, they overwhelmingly talk about instances from the same basic level category. This is consistent with findings from an artificial strategy selection study (Manders & Hall, 2002) in which parents are asked to select which one of two cards they would use if they were to teach their child about a novel property, They found that when the objects depicted in the cards differ on a single dimension (e.g., red vs. blue) parents state a preference for a card that depicts objects within the same basic category. In laboratory settings, children successfully extend a novel adjective to other objects sharing the property if the objects are all members of the same basic-level category, but not when the objects are members of different basic level categories settings (e.g., Waxman and Markow, 1998). Thus when parents talk about multiple instances they may be providing the type of support that is advantageous for learning adjectives. However, other laboratory studies suggest

TABLE 6
The Frequency of Multiple Instances of Labeling a Property in Parent Speech

	Questions			*Statements*			
	Multiple exemplars	*Single exemplar*	*Total*	*Multiple exemplars*	*Single exemplars*	*Total*	*Total*
Color	154	520	674	158	1815	1973	2647
Size	131	55	186	208	592	800	986
Texture	16	198	214	38	855	893	1107

that children learn adjectives more readily when presented with multiple instances that span across basic-level categories (Mintz & Gleitman, 2002). Perhaps any situation that provides multiple comparisons may help children acquire adjectives more readily than situations that provide a single exemplar. The data from the present study, however, suggest that in real-world situations the advantageous cue of labeling multiple instances of a property may not be frequent in parental input to children.

Stability of Frequencies Across Sessions

Because children and parents participated in multiple sessions across a six-month time frame we asked whether parents' labeling behavior changed during the course of the study as a function of children's increasing age and knowledge level.

There was a slight decline in the number of utterances containing adjectives from the first to the second half of the study. In the first half of the study parents made a total of 2695 utterances (M = 225, SD = 102) in which color, size, or texture were mentioned at least once. In the second half of the study this declined to 2090 utterances (M= 174, SD = 38). There was a strong correlation between the amount parents talked about the properties in the first and second half of the study, $r^2 = .72$, $p < .01$. The same toys were presented at each session, nevertheless parents talked less about the immediate perceptual properties of the objects (e.g., "see the little bear") as the study progressed and engaged in more creative forms of play (such as hosting pretend tea parties). We also asked whether the distribution of syntactic frames in parents' speech when talking about adjectives changed over the course of the study. Table 7 presents the proportion of adjective constructions used by parents in the first versus the last half of the study. T-tests conducted on the proportions of modifying pronominal, ambiguous non-modifying, adjective alone, and noun construction syntactic frames in the first versus

TABLE 7
The Proportion of Adjective Constructions in Parents' Speech in the First and Second Half of the Study

	Half of study	
Adjective construction	*First*	*Last*
Modifying object	.21	.28
Modifying pronominal	.22	.18
Ambiguous non-modifying	.31	.29
Alone	.21	.18
Noun Construction	.06	.07

last half of the study were non significant. However a t-test conducted on the proportions of modifying object syntactic frames in the first versus last half of the study revealed a marginal difference, $t(11) = -2.048$, $p = .065$, suggesting that there may have been a tendency for parents to use proportionally more frames in which an adjective modified a noun in their speech to children during second half of the study (*M* first half = .21, *M* second half = .27) although there was no difference in the absolute number of syntactic frames in which an adjective modified a noun in the first and second half of the study, $t(11) = -23$, n.s.

Discussion

The goal of this study was to examine the sentence frames used by parents in semi-naturalistic settings to label the properties of objects. The results show that the syntax immediately surrounding adjectives may not provide the types of linguistic cues that lead to successful acquisition of adjectives in laboratory experiments. Specifically, parents use property terms as modifiers of nouns, the syntactic context Mintz and Gleitman showed to benefit children the most in their adjective learning task, in less than a quarter of all utterances. Parents also use frames with pronominals such as "this is a __ one" the frame most commonly used in experimental studies of early adjective learning and one that Mintz and showed to benefit children the least in their adjective learning task. Together these two frames characterize less than 50 % of parent's use of property terms. Perhaps more problematic are the other frames that parents use. These frames are ambiguous at best and misleading at worst as to the adjectival status of the word. All invite the potential confusion of the property term with a noun.

Moreover it does not appear to be the case that the noun label appears in the speech immediately preceding the adjective. Indeed in the majority of ambiguous utterances the noun label did not ever precede the adjective within a session. It is likely, however, that the noun label occurs at other points within the study, either some time after the adjective is uttered or in preceding sessions. While parent's use of pronomials is likely to make sense within a larger discourse, and indeed is likely to make sense to the child, we are concerned specifically with the syntactic frame parents provide children. Our reasons for doing so are twofold. First, the syntactic frame has been identified as a key factor in how children interpret adjectives and other parts of speech, e.g., nouns (Samuelson & Smith, 1999). Second, we expect that all of the objects in the study have labels that are familiar to children, e.g., "cups" and "bears". Thus, while labeling an object at some point in time may help children learn the name for the object, it does not provide children with syntactic support.

It is important to note that we are not arguing that the ambiguous syntactic frames present no information that points to the adjective status of the word. Rather we are suggesting that the ambiguous frames may provide a less clear

indication of the adjectival status of a word than frames in which the adjective clearly modifies a noun. What may be confusable to novice language learners may not pose the same confusion for highly sophisticated language learners. That is, adults may find no problem with inferring that in the frame "the X one," X must refer to an adjective. However, children just starting to work out what words refer to may find the difference between "the X" and "the X one" to be less striking than adults do. Parents may be attuned to the idea that syntactic frames can be potentially confusing for children and modify their speech accordingly. There is some evidence that this may be the case. For example, parents talk about adjectives differently than proper nouns in artificial laboratory situations even though both could be labeled using the same kind of syntactic frame (Hall, Burns, & Pawluski, 2003).

The way in which parents talk about properties of objects to children may offer an explanation for the disconnect between children's early sensitivity to linguistic cues indicating adjectives in the laboratory and children's typically slow course of learning English adjectives. Children might not show the same success in laboratory task if the presentations of property terms in the laboratory were to match the proportions of types of input children receive in the real world. However, in the real world children hear many more instances of adjectives being labeled by parents than even the most extensive long-term laboratory tasks (e.g., Rice, 1980), and thus any difficulty that might arise from hearing adjectives with object labels in only a quarter of all instances may be mitigated by the absolute frequency of adjective labels. Further, as children gain more experience, the role of syntactic frames may take on less importance as children begin to consider a broader discourse context for interpreting words. We discuss what changes may account for children's ability to interpret adjectives as they gain more experience with language, and the type of input that may be most effective for teaching children about adjectives for children with more versus less language experience in the General Discussion.

STUDY 2

In this study, we ask, what is the developmental relation between knowledge about noun categories and the learning of adjectives? The data in the literature suggest that knowledge about nouns helps children learn adjectives. Because adjectives modify nouns, any cues (linguistic or conceptual) that makes the noun and its role clear, should help the child interpret the adjective as a property term. If this is the case, one would expect children's facility in learning adjectives to progress as noun learning progresses. And, specifically, as children learn the linguistic cues that specify nouns, they should become increasingly able to learn adjectives.

The results of Study 1, however, raise another possibility. Parents often use adjectives in sentence frames that are ambiguous. As children first learn more about nouns, these ambiguous cues may increasingly lead children to expect nouns in their input and thus be led astray. As a result, the more children know about nouns, the more nouns dominate children's learning biases, the greater their difficulty may be in learning adjectives. It is this second possibility that motivates the counterintuitive idea behind Study 2.

In this study, we attempt to teach children property terms. We use a matching task that in and of itself provides clear and unambiguous information about the referents of the terms. However, during training the terms are presented in sentence frames that, like those used by parents, are ambiguous with respect to the noun versus adjective status of the term. If these frames become increasingly problematic the *more* that children know about nouns, then younger children might learn the trained terms better than older children. That is, the ambiguous sentence frames should cause greater interference for children who know more about nouns than children who know less about nouns.

To test this hypothesis we presented property terms in the ambiguous sentence frames that are commonly used by parents: "this is a __ one", "this is __", and the adjective alone (e.g., "red"). We never used the term explicitly as a noun, despite the fact that parents sometimes do this. Because children have difficulty learning adjectives as a whole, we expect that children's performance in laboratory tasks should be similar for any set of property terms. The property terms that we attempted to teach children were color terms. We chose to teach color terms because these are the properties that parents talked most about and because there is a long tradition of attempts to teach these terms, often with little success (e.g., Rice, 1980; Bornstein, 1985). In addition, the literature suggests considerable individual differences in when children learn color terms. Although color terms are typically learned late in the preschool years, there are some children who appear to acquire them as young as 18 or 24 months (Mervis, Bertrand, Pani, 1995; Shatz, Behrend, Gelman, & Ebeling, 1996), raising the possibility that these terms might be more easily learned by children with smaller noun lexicons. This is the key prediction.

The learning task—although using ambiguous sentence frames—was structured to present unambiguous information about the meaning of the color terms. To this end, and unlike the parents in Study 1, we included in the training task comparisons of objects that both matched and differed in color and that came from the same or different basic level categories.

We tested two groups of children, those early in productive vocabulary growth who had fewer than 50 nouns and those more advanced in vocabulary growth who had more than 150 nouns. We asked whether children who had smaller vocabularies and less knowledge about nouns and noun syntax would do better in a task in which the syntax was relatively ambiguous as to the adjectival status of a label.

Method

Subjects. Twenty-eight children ranging in age from 18.4 to 34.5 months (mean = 23.6) participated in this study. Children were tested individually in local preschools during class hours. Children were first screened for participation by completing a color pre-test and only children who did not comprehend color words were invited to participate in training sessions.

Vocabulary groups. Children were divided into two groups based on their productive vocabulary as assessed by the MacArthur CDI: Words and Sentences.

Children in the low vocabulary group produced 47.43 total words on average (range 9–102 words) and 27.25 nouns on average (range 6–69 nouns). Children in the high vocabulary produced 483.9 total words on average (range 320–680 words) and 270.15 nouns on average (range 160–359 nouns). The children in the two vocabulary groups also differed by age. Not surprisingly the children in the low vocabulary group were younger, (mean = 20.64 months, range 18.04–25.99) than children in the high vocabulary group (mean = 26.61 months, range 20.92–34.57). The number of children in the two vocabulary groups who were excluded because of prior knowledge of the colors terms did not differ: 5 children in the under 50 noun groups and 7 children in the over 150 noun group.

Materials and procedure. Children completed a pretest, training task, and posttest. Although the order of tasks did not vary, the order of trials within tasks was randomly determined.

Pretest. Prior knowledge of color words was assessed by performance on a 6 trial pretest. In each trial children were presented with three fabric swatches, a red swatch, a green swatch, and a yellow swatch. Children were asked to identify the color by pointing to the swatch requested by the experimenter, e.g., “Show me where red is.” Each color was queried twice, and between trials the order of the swatches was randomly resorted. Children who scored over 50% were not included in the study and the pretest stopped once a child had misidentified the color on three trials.

Training. The training session began by presenting children with a red, a green, and a yellow plastic toy dinosaur. The experimenter labeled each dinosaur using the three ambiguous adjective frames, i.e., “this is a red one,” “this is red,” and “red!” Children were then handed three objects (one red, one green, and one yellow) from a different basic level category, for instance a red cup, a green cup, and a yellow cup and the children were asked to put red with red, green with green, and yellow with yellow. For example the experimenter would point to the

red dinosaur and say "This is red, where's another red one? Find red." If the child selected the wrong color, the experimenter showed the child the correct match and helped the child to place it in front of the dinosaur and then proceeded to the next color. Thus the probability of a correct response increased during a trial. The training trials proceeded in this manner with the experimenter encouraging the child to make the correct responses, providing feedback, and repeating exemplar labels. The training procedure was specifically designed to be encouraging and to minimize errors as a means of keeping the children in the task. Previous pilot work showed that training procedures that required the child to make errors in order to receive corrective feedback rapidly became frustrating. There were 15 training trials, five for each of the three colors using the following objects: cups, cars, balls, blankets, and blocks. Immediately after training trials were the test trials.

Test trials. The test trials were similar to the training trials in that children were presented with the three colored dinosaurs and asked to put red with red, green with green, and yellow with yellow, e.g., "this is red, find a red one." The test trials differed from the training trials in that no feedback was provided and the objects were replaced and reshuffled after each selection. Thus, the probability of a correct response remained at .33 throughout the testing trials. There were 9 test trials. Three for each of the three colors, using the following objects: houses, thimbles, and knobs.

Results

Figure 1 shows the mean number of correct color selections children from the low and high vocabulary groups made in the posttest. As can be seen, the

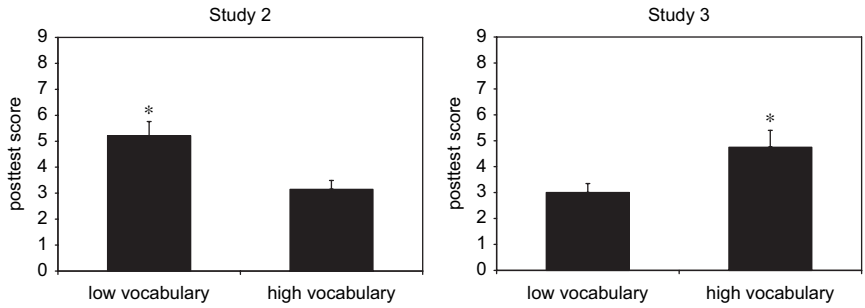

FIGURE 1 Mean posttest score for children in the low and high vocabulary groups from Study 2 and Study 3.

number of correct selections on the posttest was higher for children in the low vocabulary group than children in the high vocabulary group. A *t*-test confirms that children in the low vocabulary group performed significantly better on the posttest than children in the high vocabulary group, $t(26) = 3.05$, $p < .01$. We find no differences in children's performance based on gender. We next compared children's selections on the posttest to chance. If children responded randomly they would be expected to make correct selections in 3 of the 9 trials. The results showed that children in the low vocabulary group made more correct selections than expected by chance $t(13) = 3.45$, $p < .01$ whereas children in the high vocabulary group did not perform above chance on the posttest, $t(13) = -.46$ n.s.

We also examined individual children's performance on the posttest in the two vocabulary groups. Using the binomial probability, children who chose the appropriate color on 6 or more of the 9 posttest trials made more correct selections than expected by chance. Using this criterion, 8 of the children in the low vocabulary group and 1 of the children from the high vocabulary group performed above chance. A chi-square analysis confirmed that more children from the low vocabulary group than the high vocabulary group performed above chance on the posttest ($X2\ (1) = 10.89$, $p < .01$).

Because our hypothesis concerns how knowing nouns may interfere with learning adjectives we also examined the possibility that it is age and not knowledge of nouns that is driving these effects. That is, one possibility is that older children who have not yet achieved a sizeable noun lexicon may be qualitatively different from younger children who have not have not yet achieved a sizeable noun lexicon in ways that, for example, affect their speed of learning new color words. To address this possibility we selected children ranging between 20 and 26 months from the high and low vocabulary groups. The resulting groups of seven low- and seven high-vocabulary children were nearly identical in age (high vocabulary: mean = 23.29, range 20.26–25.99; low vocabulary: mean: 23.28, range 20.26–25.99). A paired t-test between the high and low vocabulary age matched groups indicated that the advantage for the low vocabulary group in the adjective training task was present for the subset of children who were equated by age $t(6) = 2.55$, $p < .05$. Thus as a whole the results suggest that children who have larger noun vocabularies, did not learn many adjectives during the experiment. In marked contrast, children who know fewer nouns and most likely know less about the syntactic cues for adjectives learned more adjectives in the experiment.

Discussion

Whenever younger children with less knowledge about language perform better than older children with more advanced knowledge, it is notable. We

predicted this outcome in the present case not because greater knowledge about nouns in and of itself is a detriment to adjective learning, but because the sentence frames typically used by parents are ambiguous and thus likely to lead learners with greater knowledge about nouns to assume that the words in these frames are nouns and thus be led astray. The central difference between the less and more advanced children given this training procedure may be that the less advanced children did not attend to the ambiguous linguistic information, were not led astray, and thus learned the categories, whereas the older children did attend to the ambiguous information, were led astray by the information, and as a result tried to find a noun-like meaning for the terms. This interpretation is consistent with Soja's (1994) previous finding that presenting color categories as proper names—a syntactic frame that is understood—enables children to remember a specific object that can be distinguished from other objects only by its color whereas presenting the terms as adjectives—a sentence frame that is not understood—does not. Soja (1994) showed that when two year old children were provided with a proper name label for an object, e.g., "This is Emily" they were able to select the object from a set of similarly shaped but differently colored objects, whereas when children were provided with a property term label, e.g., "This is red," children were unable to select the correctly colored object. This suggests that two-year old children can use linguistic cues that accompany labels (in this case, a familiar proper name) but only when the cues are transparent.

In sum, the problem for adjectives seems to be that the every-day linguistic cues that mark property terms do not strongly indicate the adjectival status of the word, creating a possible confusion about the intended referent, a confusion that may (temporarily) increase as children's knowledge about nouns increases. If this is the case, then providing high vocabulary children with input that is clearly marks the adjectival status of the word should help children succeed.

STUDY 3

Method

Subjects

Twenty-four children ranging in age from 18.6 to 32.9 months (mean = 24.0) participated in this study. Children were tested individually and were first screened for participation by completing a color pre-test and only children who did not comprehend color words were invited to participate in training sessions.

Vocabulary Groups

As in Study 2, children were divided into two groups based on their productive vocabulary as assessed by the MacArthur CDI: Words and Sentences.

Children in the low vocabulary group produced 49.1 total words on average (range 9–93 words) and 29.0 nouns on average (range 3–61 nouns). Children in the high vocabulary produced 475.6 total words on average (range 343–597 words) and 272.3 nouns on average (range 190- 347 nouns. The children in the two vocabulary groups also differed by age. Not surprisingly the children in the low vocabulary group were younger (mean = 20.6 months, range 18.6–25.5) than children in the high vocabulary group (mean = 26.0 months, range 21.1–32.9).

Materials

The materials were identical to those used in Study 2.

Procedure

Pretest. The Pretest procedure was identical to that used in Study 2.

Training. The training procedure was identical to that used in Study 2 with two important changes. First the syntactic frame used to label the color clearly modified an object. That is, the experimenter queried each color by saying "Can you give me the red cup? Find the red cup."

Second, following Mintz and Gleitman's (2002) and Klibanoff and Waxman's (2000) procedure, children were provided with two examples of each object from different basic level categories. For example, a red blanket was placed next to the red dinosaur and children were told, "This is the red dinosaur and this is the red blanket," before being queried to find the red cup.

As before, if the child selected the wrong color, the experimenter showed the child the correct match and helped the child to place it in front of the dinosaur and then proceeded to the next color. Thus the probability of a correct response increased during a trial.

Test trials. The test trial procedure was identical to that used in Study 2 with one important exception. In Study 2 adjectives were presented with syntactic frames that were ambiguous to the adjectival status of the word, e.g., "This is red, find a red one." In the present study children were provided with syntactic frames that more clearly indicated the adjectival status of the word, e.g., "This dinosaur is very red. Find a red house."

Results

Contrary to the results of Study 2, we find that when children were presented with adjectives in a condition in which the input highlighted the adjective status of the word, the children in the high vocabulary group score higher than children in the low vocabulary group. Figure 1 shows the mean number of correct color selections children from the low and high vocabulary groups made in the posttest. A *t*-test confirms that children in the high vocabulary group performed significantly better on the posttest than children in the low vocabulary group, $t(22) = 2.37$, $p < .05$. We find no differences in children's performance based on gender. We next compared children's selections on the posttest to chance. If children responded randomly they would be expected to make correct selections in 3 of the 9 trials. The results showed that children in the high vocabulary group made more correct selections than expected by chance $t(11) = 2.68$, $p < .05$ whereas children in the low vocabulary group did not perform above chance on the posttest, $t(11) = 0$.

We also examined the possibility that age and not knowledge of nouns is driving these effects. To address this possibility we selected children ranging between 20 and 26 months from the high and low vocabulary groups. A *t*-test confirmed that the resulting groups of eight low- and eight high-vocabulary children did not differ in age, $t(14) = .931$, n.s. (high vocabulary: mean = 23.88, range 21.13–26.78; low vocabulary: mean: 22.95, range 20.8–25.46). An independent t-test between the high and low vocabulary age matched groups indicated that the advantage for the high vocabulary group in Study 3 was marginally present for the subset of children who were equated by age $t(14) = 2.08$, $p = .056$. Thus, although knowledge of nouns is associated with children's age, it seems likely that effect we see here are the result of noun learning.

Discussion

In Study 2, the children in the high vocabulary condition performed below chance when the adjective was presented with a syntactic frame that was ambiguous as to the adjectival status of the word. In Study 3 when children were presented with syntactic frames that clearly specified the adjectival status of the word, as well as multiple comparisons, children in the high vocabulary group succeeded in the adjective-mapping task. This would suggest that the difficulty children experience with learning adjectives is due to the type of input children may experience when learning adjectives.

We find the opposite pattern for children in the low vocabulary group. Whereas in Study 2 when children in the low vocabulary succeeded when the adjectival status of the word was ambiguous, in Study 3 children in the low vocabulary group did not perform above chance levels when the adjectival status

of the word was more strongly indicated. This suggests that input that clearly marks the adjectival status of a word is not sufficient to help children extend adjectives to new instances, but rather the input children hear interacts with what children already know. That is, the type of input that most helps children succeed in the adjective matching task depends on what words the child has already learned.

What led children in the low vocabulary group to succeed in Study 2 but not in Study 3? In Study 2, children were not provided with a strong noun for the adjective to modify e.g., "This is red—find another red one—find red. " However, in Study 3, children were provided with a strong noun, for example "This is the red dinosaur" "Find the red cup." We hypothesized that children in the low vocabulary group succeeded in Study 2 because they were not relying on the syntactic frames to determine the meaning of the word. In Study 3 while the addition of a strong noun increases the syntactic cues to the meaning of the word, it also potentially makes the task harder in three ways. First the number of content words increases. In Study 2, children may have heard only one content word e.g., "red," within a trial. In Study 3, children would have heard at least three content words "dinosaur," "cup," and "red," within a trial. Second, in Study 3 children were provided with multiple comparisons. One possibility is that the multiple comparisons provided in Study 3 may have overwhelmed the children in the low vocabulary group and distracted their attention away from the adjective, but at the same time the multiple comparisons may have improved performance for the high vocabulary group. That is, the children's performance in Study 3 may not be a result of changes in syntax, but rather a result of changes in the number of objects presented. Third, providing children with a strong noun moves the word "red" out of the utterance-final position. Previous work has suggested that hearing a word in the utterance-final position may aid in isolating and remembering the word (Aslin, 1993; Golinkoff & Alioto, 1995). As a whole this pattern of results suggests that for children with lower vocabularies the most effective type of input may be input that aids children in isolating and attending to a single new word, whereas for children with higher vocabularies the most effective type of input may be input that provides strong syntactic support.

GENERAL DISCUSSION

Past work on children's extension of novel adjectives has sought to identify the conditions under which children can and cannot extend novel adjectives in the laboratory. For example, Mintz and Gleitman (2002) demonstrated that when adjectives modify a strong noun, as opposed to a pronominal, children are more likely to extend the novel adjective to new instances. But parents do not typically provide a strong noun when talking about properties. As a whole, the linguistic

frames parents use when talking about adjectives are commonly ambiguous as to the adjectival status of the words and lead to a situation in which adjectives are readily confusable with nouns. The studies presented here suggest that, at an early stage of adjective learning, the input parents provide in a free play situation does not match the type of input found to be most likely to benefit children's adjective learning in Mintz and Gleitmans' laboratory task. However, the conditions that are optimal for learning adjectives may change with advancement in children's language learning levels.

Developmental psychologists often infer—given children's remarkable facility in learning words—that the input children hear is ideal for language learning. While it is possible that this is true for language as a whole, it seems unlikely to be true for adjectives (see Goldin-Meadow et al, 1994 for evidence that even children without exposure to conventional language input can invent nouns, verbs, and adjective categories). Adjectives are linguistically different from other types of words in both their semantic and syntactic variability across languages. Indeed, some languages do not contain any adjectives and/or very few property terms. For example, in the Siouian languages of North America, the Muna language of Sulawesi, and the Achanese language of Sumatra, concepts that would be expressed by an adjective in English are coded by stative verbs (Durie, 1985; van den Berg, 1989). Other languages like Cooper Island Aleut do not have a syntactic category of adjectives and express attributes as nouns in the possessed form (Golovkkol & Vaxtin, 1990). Perhaps, the variability one sees across languages in terms of how object properties are talked about also characterizes how speakers think about properties—as a property of a thing or as a noun-like entity (see Waxman, Senghas, & Benveniste, 1997).

Another possibility has to do with the here-and-now nature of parents' conversations with their children. Recently, analyses of parent speech to children (Laakso & Smith, 2004; Pine, Lieven & Rowland, 1998; Childers & Tomasello, 2001) suggest that the most common nouns in parent speech are pronouns—accounting for 50% of all nouns. As in adult-to-adult conversations, parents do not appear to explicitly name things when the referent is recoverable from context. In brief, the input to children has the properties it does for a variety of reasons—constrained by the parents' own psychology and the pragmatics of conversation. All together the input may well be optimal for children to learn language, but the results of Study 1 clearly suggest that language input to children is not always optimal for all of the components of language that need to be learned.

This raises the larger question of just what is optimal input for learning adjectives? Is the input children receive in laboratory experiments the optimal input for learning adjectives in the real world? Here the answer becomes obscured by the different types of laboratory procedures that lead to effective word learning and different language levels of the children. Hearing the word "red" in isolation may be an effective way to present adjectives for children with smaller lexicons,

but may be less effective for children with larger lexicons. Naigles (1996), for example, showed that older children benefit from hearing a verb in multiple sentence frames, which would seem to match the type of adjective input children are hearing in naturalistic settings. The studies presented here suggest that the optimal input for learning adjectives changes as the child gains more experience with word learning and fits with a larger literature that indicates that the processes that children use to learn language changes with language experience. The present results also suggest that the ambiguous cues that parents do provide become more confusable the more children know about nouns. This makes sense. In order for children to confuse the linguistic cues of adjectives with the linguistic cues of nouns children must first be sensitive to the linguistic cues in the speech in their environment. Much evidence suggests that children learn to attend to linguistic cues as a process of learning words (Bloom, 2000; Smith, et al., 2002). Thus, we would expect that the older children who know more words would be more likely to attend to the linguistic cues surrounding adjectives than younger children who know fewer words. Because the older children are more likely to be attending to the linguistic cues and the linguistic cues are ambiguous as to the noun or adjective status of the words, the older children may be more likely to interpret the new word as a noun and as a result have a harder time learning adjectives than their younger counterparts. That possibility is supported here. We find that the older children who know more nouns are less likely to learn to map color words to the appropriate properties of objects than younger children who know fewer words.

We suspect that learning adjectives in the real world (that is, with ambiguous linguistic cues) follows a curvilinear trend: easier when children who know few nouns because the ambiguous cues do not confuse them, harder when children have learned many nouns and the ambiguous cues help push them to a perhaps very strong noun attractor, and, finally, easier once again after children have learned more about language, about subtler linguistic distinctions, and also possibly about pragmatics in naming properties. The data presented in Study 1 suggest that parents may be attuned to this type of change in how children come to understand adjectives. Parents used relatively more syntactic frames in which adjectives modify nouns in the second half of the study than in the first half of the study. Further, utterances such as “This is a red one” become less confusable with nouns the more children know about the properties of language, and indeed adults would seldom become confused by this type of syntactic frame. Recent work by Mintz (2005) supports this idea. In this study, older children (three year olds) but not younger children (two year olds) were likely to interpret “one” as referring to a basic level category. Thus, as children’s knowledge about the linguistic cues that specify adjectives versus nouns increases, children should no longer be confused by ambiguities in the input.

Further, the finding in Study 2 that younger children who knew fewer nouns learned color terms better from the training than did more advanced children offers a potential resolution of a puzzle in the literature concerning the learning of color words. Although color terms are notoriously hard for most children to learn, they also seem readily and rapidly acquired by some children. Thus in the literature we have a contrast between studies where children learn color terms slowly versus quickly. In Rice's (1980) study 33-month-old children required between 600–2000 training trials to learn 3 color terms but in Mervis, Betrand, and Pani's (1995) diary study 18 month old Ari quickly mastered color words. Why do some children readily learn color words and others seem to have such difficulty? The present results suggest two possible answers. First, some children may learn color words early—before their increasing knowledge of nouns interferes. Given that young children may be more likely to learn color words than older children, why don't more children acquire color terms at younger ages? While we expect that many children do acquire color terms at a younger age, we also suspect that many parents do not emphasize color terms to their child until the child has mastered a good number of object labels. Indeed, several studies have now reported that parents do not correct children's semantic errors until children have demonstrated some knowledge of the label (Mervis & Mervis, 1988; Ankowski & Sandhofer, 2006). Second, some parents may provide more effective linguistic information than others.

The present results may also help us understand some discrepancies in the artificial adjective learning literature. In particular, studies of 14 month old children (Waxman & Booth, 2001) have shown that the children discriminate the difference between "a blicket" and "a blickish one," taking the shape match when the experimenters specify a noun category but not when the experimenters specify an adjective category. At the same time, studies of children older than 3 years of age (e.g., Smith, Jones & Landau, 1992) have shown that the children misinterpret the novel adjectives in both of these sentence frames as referring to an object category. The results of Study 2 suggest that as children learn more and more nouns, their interpretations of syntactic frames such as "a blickish one," frames that share considerable surface similarity to frames used to name objects, may be increasingly pulled to the noun interpretation by children who know something about nouns.

The present results also raise the question of whether adjective learning *has* to be hard for children or whether the difficulty might be largely due to the ambiguity of linguistic cues in English syntax. The suggestion we are making here is that the difficulty children encounter when learning color words (and other property terms) is learning to sort out the linguistic cues that explicitly mark properties strongly enough to overcome competing biases from object labels. Thus, in languages that mark the property status of a word (e.g., Japanese and Korean which commonly label color as an adjective using a color marker, red-colored, blue-colored,

green-colored), children should more readily learn to label objects by color. In contrast, in languages in which properties and objects commonly share identical markers (e.g., Spanish, una rosa = a red; el blanco = the white), children should take longer to learn to label objects by color. Indeed, Waxman, Senghas, and Benveniste (1997) reported that Spanish speaking children were less likely to extend an adjectives term to another taxonomic category match than children learning other languages such as French, a language in which the property terms are ambiguously marked or highly confusable with nouns, children may have to look toward other cues to sort out what aspect of an object a new word refers to.

As a whole, these results suggest that children's ease at learning adjectives is fundamentally determined by children's prior knowledge of nouns. Not only do nouns indicate something more about the property than the adjective alone could—in the way that red hair and red cars are different reds—but knowing the very specific linguistic cues that do and do not accompany nouns is critical to learning when a word indicates a property as opposed to a whole object. Much research has pointed toward children's tendency to interpret new words as referring to whole objects (Heibeck & Markman, 1987; Markman, 1990) and children appear to learn the cues that signify nouns and objects early. The results reported here on how parents talk to children about adjectives suggest that, for English learners, the language environment itself does little to help young language learners sort adjectives out. The linguistic cues that specify adjectives are ambiguously confusable with nouns and thus it is not surprising that children have difficulty interpreting these cues at least temporarily.

One possibility is that children's difficulty with learning adjectives has little to do with the learnability of the properties themselves. Learning property categories such as red may – in principle – be just as easily learned as noun categories such as dog. The noun bias over adjectives could be a product of the number of nouns children learn early; and as a result competition from nouns and whole objects crowds out adjectives. Mintz and Gleitman (2002) characterized children during this time "as being in thrall to things." We suggest that children's thrall with things is a product of learning. Children may begin equipotent to interpret new words as referring to whole objects, properties, or other aspects of the world. Indeed children's very early lexicons contain words such as "up" and "more" that do not refer to whole objects. But, in the course of learning words, children learn that whole objects matter and become increasingly likely to interpret new words as referring to things. The second possibility is that learning of object categories is from the start easier for children than learning property terms, an idea consistent with most theoretical accounts of the noun advantage (Gentner, 1982; Gleitman et al., 2005). However, the noun advantage over adjectives may increase with development, causing increasing difficulties for adjective learning as children learn more nouns. This seems especially likely to be so given the ambiguous frames in which property terms are often heard.

Eventually, however, children do sort out the ambiguous cues that often accompany adjectives even without the help of cleverly conceived laboratory experiments that provide children with the optimal learning conditions. What changes account for children's ability to interpret adjectives as they grow older? We suggest three factors. First children become more experienced with linguistic cues (Hirsh-Pasek & Golnikoff, 1996; Huttenlocher et al, 2002). As children gain more experience with language, the linguistic markers that indicate nouns become more distinguished from those that indicate adjectives. Children may become increasingly selective about the cues that indicate noun status. As a result, the ambiguous cues that mark adjectives may no longer meet children's increasingly stringent requirements to be interpreted as a noun. This bias to interpret words as referring to objects, to attend in specific to the cues that signify nouns may be less well formed by children than once thought. Consequently, children may initially only broadly learn what nouns are and are not, and may take many years to sort out all the intricacies of nouns. Second, children may become better at reading the contextual social cues that connect across discourse (Baldwin & Tomasello, 1998; Bloom, 2002). Whereas when children fist start to learn adjectives in the real world they may benefit from direct comparison along with a strong noun to learn property terms, as children become more accustomed to following longer streams of discourse, they may be able to connect the strong noun "cup" with the property term "red" even if the two words do not co-occur within the same sentence. Thus, due to children's developing memories and facility with conversation, the optimal environment for learning adjectives may expand in such a way that a larger percentage of parent's speech provides children with favorable input for learning adjectives. Finally, we suggest that merely spending more time hearing adjectives used in input may be required for children to learn adjectives. Although the input parents provided in the present study was commonly ambiguous, in 20% of the utterances, the adjectives parents used modified a strong noun. To the extent that children require clearly specified input to learn adjectives, given time, the input children are hearing in the real world should add up, leading to adjective learning. This process may take a while and children may spend a longer period of time unclear about how exactly adjectives work. As a result, children may appear to understand adjectives in forced choice laboratory tasks, but may continue to have pockets of uncertainty that interfere with the acquisition of adjectives in the real world.

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APPENDIX 1

Examples of multiple property referents in Parents' Speech.

a. These are both red.
b. The bear is big and his cup is big.
c. These are both furry.
d. This is red but this is blue.
e. They're different because one is bumpy and one is smooth.
f. This is bigger than that.
g. Which one of these cups is red?
h. Where's the bumpy one?

Examples of single property referents in Parents' Speech.

a. This is red.
b. The bear is big.

c. This is furry.
d. Blue!
e. It’s bumpy.
f. This cup is little.
g. Is this bear big?
h. Does this one feel scratchy?