Red Bluebirds and Black Greenflies: Preschoolers’ Understanding of the Semantics of Adjectives and Count Nouns

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Three experiments explored preschoolers’ and adults’ understanding of the distinctive semantic functions of adjectives (i.e., to name properties) and count nouns (i.e., to name object kinds). In Experiment 1, we modeled a familiar adjective (e.g., “blue”) syntactically as either an adjective (e.g., “This is a blue one”) or a count noun (e.g., “This is a blue”) and applied it to a target object (e.g., a blue creature). In Experiments 2 and 3, we marked the adjective phonologically as either an adjective (e.g., “This is a blue bird”) or a part of a count noun (e.g., “This is a bluebird”) and applied it to a target object (e.g., a blue bluebird). In all experiments, participants then had to extend the expression they heard to either an object of a different kind with the same property as the target (e.g., a different creature or bird colored blue) or an object of the same kind with a different property (e.g., the same creature or bird colored red). Four-year-olds and adults, but not 3-year-olds, who heard the adjective version were more likely than those who heard the count noun version to choose the object with the same property. Thus, by the age of four years, children treated a word’s lexical category, cued syntactically or phonologically, as a powerful cue to its meaning.

We can describe any solid object (e.g., a brown dog) using either a count noun (e.g., “This is a dog”) or an adjective (e.g., “This is brown”), but the

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ADJECTIVES AND NOUNS semantics of count nouns and adjectives differ in important ways. A count noun (e.g., “dog”) names a kind that provides conditions of individuation and identity, picking out an object as an enduring individual. In contrast, an adjective (e.g., “brown”) does not name a kind and provides neither of these conditions, instead labeling an object as possessing a possibly transient property (see Gupta, 1980; Macnamara, 1986; Macnamara & Reyes, 1994).

Do children understand the distinctive semantics of adjectives and count nouns? Recent evidence suggests that very young word learners may not; they often appear to interpret words from either lexical category, when applied to an object, as naming a kind of object. For example, several experiments have shown that 1-year-olds (Waxman & Markow, 1995) and 2-year-olds (Hall, Waxman, & Hurwitz, 1993) will extend both novel count nouns and novel adjectives from a labeled object to other members of the same object kind. (For related evidence that young children will, under some object-labeling conditions, interpret novel words from various categories as naming kinds of objects, see Hall, 1991; Markman, 1989; Soja, 1992.)

Despite the fact that young children often seem to interpret novel adjectives and count nouns indistinguishably, at least two lines of research indicate that preschoolers rapidly acquire an appreciation that words from these lexical categories differ fundamentally in their semantics. One of these lines of research has followed from adult work examining the inferences that are promoted by words from the two categories. Markman (1989) has demonstrated that adults expect a count noun to promote more inferences about a labeled object than an adjective. In one study, she asked adults to list the properties of objects referred to by either count nouns (e.g., “bicycle”) or adjectives (e.g., “henpecked”). Subjects listed more information (e.g., in terms of number of properties) for the objects referred to by the count nouns than for those named by the adjectives. In another study (conducted with E. Smith), Markman gave adults a label for a person using either an adjective (e.g., “Suppose the person is intellectual”) or an equated count noun (e.g., “Suppose the person is an intellectual”). Participants were then asked what else might be commonly believed about the person, given that information. Adults provided more attributes for count nouns than for adjectives. Thus, adults drew more inferences about an object when a label applied to it was modeled as a count noun than when it was presented as an adjective.

More recently, Gelman and Coley (1990) have shown that young preschoolers assume that familiar count nouns, but not familiar adjectives, promote inferences about labeled objects’ non-perceptible properties, regardless of the objects’ outward appearance. Two-year-olds saw a target object (e.g., a bluebird), along with (among other choices) a dissimilar-looking object from the same kind (e.g., a dodo—another bird) and a similar-looking object from a different kind (e.g., a pterodactyl—a dinosaur). If the target and the dissimilar-looking object received a common count noun label (“bird”) that differed from the count noun applied to the similar-looking object (“dino-
saur’’), then children extended a non-obvious property (‘‘lives in a nest’’) from the target to the dissimilar-looking object. However, if the target and the dissimilar-looking object shared an adjectival label (‘‘wide awake’’) that differed from the adjective applied to the similar-looking object (‘‘sleepy’’), then children extended the same property from the target to the similar-looking object. Children thus used count nouns but not adjectives as a basis for drawing inferences about non-perceptible properties shared by dissimilar-looking objects.

A second line of research documenting children’s understanding of the distinctive semantics of adjectives and count nouns has focused on patterns of word extension, exploring their understanding of the fact that adjectives name properties whereas count nouns name kinds of objects (in the adult language). This work has revealed that, starting roughly at the age of two years, children will extend novel adjectives and novel count nouns from a target object to new objects in different and appropriate ways. For example, children will extend a novel word presented as an adjective from a target object to another object that shares a salient property with the target, whereas they will extend a novel word modeled as a count noun to another object of the same kind as the target (Markow & Waxman, 1996; see also Hall et al., 1993; Prasada, 1996; Smith, Jones, & Landau, 1992; Taylor & Gelman, 1988; Waxman, 1990; Waxman, Senghas, & Benveniste, in press; for evidence of the development of an understanding of other semantic differences between adjectives and count nouns using word extension tasks, see Gelman & Markman, 1985).

In the preceding research demonstrating preschoolers’ appreciation of the distinctive semantics of adjectives and count nouns, the words modeled as adjectives or count nouns have usually been nonsense syllables, about which children have had no prior knowledge. Yet if children know the semantics of these two categories and realize that a word’s lexical category is, by itself, an important clue to its meaning, then they should understand that any word modeled as an adjective names a property, whereas any word presented as a count noun names a kind of object. For example, they should appreciate that a word already known as an adjective naming a property (e.g., ‘‘blue’’ naming the property of being blue) should be interpreted differently—as naming a kind of object—if it is modeled in a count noun context (e.g., in the syntactic frame, ‘‘This is a blue’’) rather than a normal adjective context (e.g., in the syntactic frame, ‘‘This is a blue one’’). We suggest that the words used in past work do not provide a stringent test of children’s understanding of this fact. To establish this point, we designed a new word extension task.

In our task, we labeled a target object with an adjective that (we verified) was familiar to children (i.e., it had a known property interpretation) and that was applicable to the object (i.e., it named a property that the object possessed). For one group, we modeled the term in a context that called for an adjective interpretation. For another group, however, we presented the same
term in a context that implied the word should be treated as a count noun. In other words, we transformed the familiar adjective into a count noun. We subsequently asked all participants to extend the label they had heard to either a new object of a different kind than the target (distinguished mainly by a different shape and perceptual features) that possessed the same property, or the original object (i.e., the same kind as the target) that now lacked the property. If children understood the semantics of adjectives and count nouns and relied on a word’s lexical category to infer its meaning, then they should have interpreted the adjective version as naming the familiar property, extending it to the new object with that property. In contrast, children should have interpreted the count noun version as naming a kind of object, and so they should have extended it to the target object (because it was the same kind), even though it did not have the property. In other words, cues to a word’s lexical category membership (adjective or count noun) should have led children to assign it a particular interpretation (property or kind of object, respectively), independent of any other interpretation of the word children might have known.

In order to reveal their understanding of the distinctive semantics of these two lexical categories, children need cues to inform them when a term is being presented as an adjective and when it is serving as a count noun. This research explored children’s sensitivity to two ways of marking the same word as an adjective or a count noun: through syntax and through phonology. In Experiment 1, we focused on syntax. The previously-mentioned studies exploring children’s extensions of novel words modeled as either adjectives or count nouns have signaled membership in the two categories through syntactic (and sometimes also morphological) cues. Those studies have obtained evidence that preschool children are more likely to extend a novel word (e.g., “zav’”) from a named object to another one sharing a property if it is modeled in a syntactic context appropriate for an adjective (e.g., “This is a zav one’”) than if it is presented in a syntactic environment suitable for a count noun (e.g., “This is a zav’”). In contrast, children show a greater tendency to extend a novel word to an object sharing the same kind if it is presented syntactically as a count noun than if it is given syntactically as an adjective (e.g., Hall et al., 1993; Markow & Waxman, 1996; Smith et al., 1992; Taylor & Gelman, 1988; see also Gelman & Markman, 1985, and Prasada, 1996, for further differences in children’s assumptions about the interpretation of adjectives and count nouns inferred from syntactic cues).

Using our new task, we asked whether preschoolers (i.e., 3-year-olds, 4-year-olds), along with adults, would show an understanding of the distinctive semantics of adjectives and proper names, by interpreting them appropriately when the difference between them was marked syntactically. We applied a familiar adjective (e.g., “blue’”) with a known property interpretation (e.g., being blue) to an appropriate target object (e.g., a blue novel creature). For half the participants, we modeled the term in an adjective syntactic frame
(e.g., ‘This is a blue one’); for the other half, however, we presented the same adjective in a syntactic frame reserved for count nouns (e.g., ‘This is a blue’). We then asked whether participants would extend the label in a forced choice task either to a new object of a different kind possessing the property (e.g., a novel creature of another kind colored blue) or to the same object (i.e., the same kind) now lacking the property (e.g., the target creature colored red). If participants understood the semantics of adjectives and count nouns and used the syntactic clues to interpret the words, then they should have been more likely to pick the object with the same property (e.g., the different creature colored blue) after learning an adjective (which names a property) than after learning a count noun (which names a kind of object).

In Experiments 2 and 3, we pursued this investigation of people’s tendency to rely on a word’s lexical category (adjective, count noun) as a clue to its meaning, but we focused on their ability to identify words from the two lexical categories when they were marked through phonology rather than through syntax.

**EXPERIMENT 1**

**Method**

**Participants.** Ninety-six participants were included in the final sample, 32 3-year-olds, 32 4-year-olds, and 32 adults. Among the 3-year-olds, 16 were assigned to the Adjective condition ($M = 3$ years, 7 months; $Range = 3:0$ to $3:11$) and 16 were assigned to the Count Noun condition ($M = 3$ years, 7 months; $Range = 3:0$ to $3:11$). Among the 4-year-olds, 16 were assigned to the Adjective condition ($M = 4$ years, 9 months; $Range = 4:0$ to $5:4$) and 16 were assigned to the Count Noun condition ($M = 4$ years, 10 months; $Range = 4:0$ to $5:4$). There were roughly equal numbers of boys and girls in the two conditions at each age. The adults were undergraduates: Sixteen were assigned to the Adjective condition, and 16 were assigned to the Count Noun condition. An additional six 3-year-olds were tested but excluded from the final sample for failing the post test (see below).

Children were recruited through local preschools and were tested individually in the classroom or in an adjoining room during the regular school day. Adults were recruited through a university psychology department subject pool and received course credit for taking part; they were tested individually or in small groups (of up to 4) in the laboratory.

**Stimuli.** The stimuli were four sets of three black-and-white line drawings of novel creatures, colored using coloring pencils and mounted on 3 inch by 5 inch cards. Each set contained a target drawing (labeled at the beginning of a trial) and two test drawings (between which children had to choose at the end of each trial). The target drawing depicted a novel creature of a particular color (e.g., a blue novel creature). One of the test drawings was the property match: It showed a novel creature of a different kind than the
target but the same color (e.g., a novel creature of a different kind colored blue). The other test drawing was the object kind match: It showed the same creature (i.e., the same kind as the target) but a different color (e.g., the target creature colored red). Figure 1 shows a sample triad. Table 1 lists all the stimulus triads. We also used a puppet to introduce the labels to children.

Procedure. The following describes the procedure used with preschoolers. We followed the same procedure with adults, except that we omitted the puppet (and we did not give adults stickers for participating).

The child sat at a table across from the experimenter. The experimenter
introduced the child to the puppet and told the child that the puppet was very shy. The child heard that the puppet would now go away and hide where he couldn't see or hear anything but would come back to ask the child for help a bit later. The experimenter hid the puppet and then told the child that they were going to play a game in which the child was going to hear some stories. The experimenter asked the child to remember that the puppet would come back and ask questions a bit later and so to listen carefully.

Each child received four trials. We will describe one trial, using the first stimulus set (see Figure 1 and Table 1) as an example. The experimenter brought out the set of three drawings and placed the target drawing (a blue novel creature) in front of the child. In the Adjective condition, children heard a familiar adjective ("blue") modeled syntactically as an adjective. The experimenter said, "Look! Do you see this? This is a blue one." In the Count Noun condition, children heard the same adjective modeled syntactically as a count noun. The experimenter said, "Look! Do you see this? This is a blue." In both conditions, the experimenter repeated the label and then asked the child to repeat it.

In both conditions, the experimenter then pointed out three perceptible features of the target object. The experimenter said of the blue novel creature, "It's got points on its head, a bubbly nose, and a square body." This information was included to draw children’s attention to the distinguishing physical traits of the named object, because we wanted to be sure that children would differentiate it from the contrasting novel creature that they would see a bit later in one of the test drawings. This information thus supplemented the information available from simply observing the drawings of the objects from the two kinds used on each trial. Table 2 lists the sets of three features we described for each target object.
TABLE 2
Featural Descriptions Used in Experiments

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Stimulus set</th>
<th>Object</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>set 1</td>
<td>creature 1</td>
<td>points on head, bubbly nose, square body</td>
</tr>
<tr>
<td></td>
<td></td>
<td>creature 2</td>
<td>points all over body, round nose, tall body</td>
</tr>
<tr>
<td></td>
<td>set 2</td>
<td>creature 3</td>
<td>flat head, pointy nose, pointy feet</td>
</tr>
<tr>
<td></td>
<td></td>
<td>creature 4</td>
<td>points on head, round nose, round feet</td>
</tr>
<tr>
<td></td>
<td>set 3</td>
<td>creature 5</td>
<td>spikes on head, wide eyes, 3 toes on feet</td>
</tr>
<tr>
<td></td>
<td></td>
<td>creature 6</td>
<td>points on head, tall eyes, 1 toe on feet</td>
</tr>
<tr>
<td></td>
<td>set 4</td>
<td>creature 7</td>
<td>round body, points on head, pointy feet</td>
</tr>
<tr>
<td></td>
<td></td>
<td>creature 8</td>
<td>tall body, flat head, 3 toes on feet</td>
</tr>
<tr>
<td>2</td>
<td>bird</td>
<td>bluebird</td>
<td>short neck, small nose, short legs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>heron</td>
<td>long neck, big nose, long legs</td>
</tr>
<tr>
<td></td>
<td>fly</td>
<td>blackfly</td>
<td>round body, short legs, 2 pairs of wings</td>
</tr>
<tr>
<td></td>
<td></td>
<td>whitefly</td>
<td>long body, long legs, 1 pair of wings</td>
</tr>
<tr>
<td></td>
<td>bug</td>
<td>greenbug</td>
<td>round body, long legs, 1 point on tail</td>
</tr>
<tr>
<td></td>
<td></td>
<td>earwig</td>
<td>long body, short legs, 2 points on tail</td>
</tr>
<tr>
<td></td>
<td>fish</td>
<td>redfish</td>
<td>big mouth, thin tail, big eye</td>
</tr>
<tr>
<td></td>
<td></td>
<td>swordfish</td>
<td>small mouth, wide tail, small eye</td>
</tr>
<tr>
<td>3</td>
<td>bird</td>
<td>redbird</td>
<td>pointy head, short nose, wide tail</td>
</tr>
<tr>
<td></td>
<td>fly</td>
<td>oyster catcher</td>
<td>round head, long nose, thin tail</td>
</tr>
<tr>
<td></td>
<td>bug</td>
<td>blue bug</td>
<td>hairy legs, big head, small eyes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>pillbug</td>
<td>long legs, round body, short whiskers</td>
</tr>
<tr>
<td></td>
<td>fish</td>
<td>blackfish</td>
<td>sharp points on back, small mouth, big eye</td>
</tr>
<tr>
<td></td>
<td></td>
<td>salmon</td>
<td>smooth back, big mouth, small eye</td>
</tr>
</tbody>
</table>

The experimenter then said, “Okay, well, now listen closely to my story. One day, the blue one (the blue) was out walking through the woods. And you know what? It fell into some yucky red stuff. So then it looked just like this.” At this point, the experimenter removed the target drawing and brought out the first test drawing, the object kind match (the target creature colored red). “Then it kept on walking until it met this one. Look here.” At this point, the experimenter brought out the second test drawing, the property match (a novel creature of a different kind colored blue). Half the time (in a balanced fashion), the property match was placed to the left of the object kind match; half the time it was put on the right. The experimenter at this point drew the child’s attention to the three features of the property match that contrasted with those that were described for the target object. For the new blue novel creature, the experimenter said, “It’s got points all over its body, a round nose, and a tall body.” See Table 2 for a complete list of these sets of features. The experimenter always presented the object kind match before the property match because we felt that this kept the story most straightforward and easy to follow.
The experimenter continued: ‘‘Well, now my puppet is coming out of hiding to ask you a question. So listen carefully.’’ The puppet came out from behind the experimenter’s back and said, ‘‘Hello. I need your help. Listen carefully. Will you point to the blue one (the blue)?’’ The experimenter looked directly at the child until the child made a choice and then recorded that choice. The puppet then thanked the child and went back into hiding. This procedure was repeated on each of the four trials. The order in which the four stimulus sets were presented was counterbalanced across children.

After the fourth and final trial, we administered a brief post test. It was important to be sure that children knew adjectives for all the colors used in the task. We showed children patches of each of the colors in the same shades we had used in the task and asked them to name them (i.e., ‘‘Can you tell me what color that is?’’). All children included in the final sample passed this post test. Any child who failed to give the correct name for every color was excluded from the final sample. The entire procedure lasted about 10 minutes. At the end, the child received a sticker for participating.

Results

Our analyses focused on participants’ drawing selections. We predicted that the tendency to select the property match would be greater in the Adjective condition than in the Count Noun condition, because we expected that participants would take the familiar adjective (naming a known property) modeled as an adjective to name that property and so would extend it to objects having that property. In contrast, we anticipated that participants would take the same adjective presented as a count noun to name a kind of object and so would extend it to objects of the same object kind, even if they lacked the property.

The mean proportions of property match choices in the two conditions appear in Table 3. We submitted these mean proportions to a 2 (Condition: Adjective, Count Noun) by 3 (Age: 3-year-olds, 4-year-olds, adults) between-subjects ANOVA. As predicted, there was a main effect of Condition, $F(1,90) = 14.28, p < .005$, indicating more property match choices in the Adjective condition than in the Count Noun condition. There was also a main effect of Age, $F(2,90) = 48.87, p < .0001$. We computed a linear trend contrast on this Age effect. The contrast was significant, $F(1,90) = 95.01, p < .0001$, indicating that with increasing age, participants were less likely to select the property match. There was also a significant Condition by Age interaction, $F(2,90) = 3.15, p < .05$. Simple effects tests established that the effect of Condition (the tendency to make more property match choices in the Adjective condition than in the Count Noun condition) was significant among the adults ($p < .001$) and the 4-year-olds ($p < .005$) but not among the 3-year-olds ($p > .50$).

We then analyzed the Condition effect within each age group, treating stimulus sets rather than participants as a random effect. We conducted these analyses to determine whether the effects observed within each age group
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TABLE 3
Results of Experiments

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Condition</th>
<th>Age</th>
<th>Mean proportion (SD) of property match choices</th>
<th>Number of property choosers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Adjective</td>
<td>3-year-olds</td>
<td>0.97 (0.09)</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4-year-olds</td>
<td>0.86 (0.30)</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Adults</td>
<td>0.37 (0.50)</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Count Noun</td>
<td>3-year-olds</td>
<td>0.95 (0.14)</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4-year-olds</td>
<td>0.52 (0.49)</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Adults</td>
<td>0.00 (0.00)</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>Phrase</td>
<td>3-year-olds</td>
<td>0.67 (0.36)</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4-year-olds</td>
<td>0.67 (0.47)</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Adults</td>
<td>0.66 (0.40)</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Compound</td>
<td>3-year-olds</td>
<td>0.72 (0.35)</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4-year-olds</td>
<td>0.37 (0.41)</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Adults</td>
<td>0.08 (0.25)</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Phrase</td>
<td>4-year-olds</td>
<td>0.87 (0.27)</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Compound</td>
<td>4-year-olds</td>
<td>0.45 (0.47)</td>
<td>6</td>
</tr>
</tbody>
</table>

Note. N = 16 per condition.

held up across all our stimulus triads. Despite the small number of sets, the pattern of significant effects was the same as in the preceding analyses. The results from the adults were categorical, and so no statistic was computed. The effect was significant for the 4-year-olds (paired-\(t(3) = 19.05, p < .0005\)) but not for the 3-year-olds (paired-\(t(3) = 0.53, p > .50\)).

We next compared the tendency to pick the property match in the two conditions within each age group to chance (where chance was 0.50). Among adults, the tendency was at chance level in the Adjective condition (\(t(15) = 1.00, p > .25\)); but adults never chose the property match in the Count Noun condition (and so we did not compute any statistic). For the 4-year-olds, the tendency was significantly above chance in the Adjective condition (\(t(15) = 4.76, p < .0005\)), but at chance level in the Count Noun condition (\(t(15) = 0.13, p > .50\)). Among 3-year-olds, the tendency was significantly greater than chance in both the Adjective (\(t(15) = 21.96, p < .0001\)) and the Count Noun (\(t(15) = 13.33, p < .0001\)) conditions.

We then performed analyses based on participants’ overall patterns of selections across the four trials. We classified any participant who made 3 or 4 (out of 4) property match selections a Property Chooser. The resulting numbers appear in Table 3. These numbers provide information about the consistency of individual children’s performance across the four trials. We compared the number of Property Choosers in the two conditions (Count Noun, Adjective) at each age. Confirming our previous findings, we found that there was a significant and predicted difference among both adults
(χ²(1,N = 32) = 5.13, p < .05, corrected for continuity) and 4-year-olds (χ²(1,N = 32) = 5.24, p < .05). However, there was no difference between the number of Property Choosers in the two conditions among 3-year-olds; no statistics were computed.

In sum, the results showed that adults and 4-year-olds, but not 3-year-olds, were more likely to choose the property match in the Adjective condition than in the Count Noun condition. The findings suggest that adults and 4-year-olds appreciated the distinctive semantics of adjectives and count nouns and relied strongly on syntactic cues to infer appropriately that a familiar adjective (with a known property interpretation) modeled as an adjective named that property, but that the same adjective presented as a count noun named a kind of object (and, strikingly, did not name the property).

Discussion

The results of Experiment 1 support the hypothesis that adults and 4-year-olds appreciate the distinctive semantics of adjectives and count nouns and rely heavily on syntactic evidence to interpret words from these two categories appropriately. If a familiar adjective with a known property interpretation (e.g., ‘blue’ naming the property of being blue) was modeled syntactically as an adjective (e.g., ‘a blue one’) and applied to an appropriate object (e.g., a blue novel creature), then adults and 4-year-olds often seemed to take it as naming that property, extending it to another object having the property (e.g., a novel creature of a different kind colored blue). In contrast, if the same adjective was presented syntactically as a count noun (e.g., ‘a blue’) and applied to the same object, then adults and 4-year-olds appeared more likely to construe it as naming a kind of object, extending the word significantly more often to an object of the same kind, even though it lacked the property (e.g., the same creature colored red).

The finding that adults and 4-year-olds appeared to use syntactic evidence to interpret the same word appropriately as an adjective or a count noun is consistent with a growing body of experimental evidence showing preschoolers’ reliance on syntactic cues to lexical category in drawing inferences about meaning. The result extends previous findings by demonstrating that 4-year-olds and adults will rely on syntactic cues implying that a word should be interpreted as a count noun naming a kind of object, even if the word also has a known property interpretation (when it is used as an adjective) that must be disregarded in order for children to extend it appropriately. Hearing a familiar adjective (naming a known property) presented syntactically as a count noun thus appears to have led them to interpret the word as a homonym of the adjective (naming a kind of object). By the age of four years, children thus relied heavily on syntactic markers indicating that a word was an adjective or a count noun as a clue to its meaning.

Participants performed differently in the three age groups. Adults showed a significant reliance on syntactic information as a clue to the meaning of the
familiar adjective. They never chose the property match in the Count Noun condition, indicating a powerful tendency to use the syntactic information telling them that a familiar adjective should be interpreted as a count noun. In contrast, if they heard the target labeled with an adjective in the Adjective condition, they were significantly more likely to select the property match. Surprisingly, however, adults did not always select it. We had predicted that they would interpret the familiar adjective in the Adjective condition as an adjective, and thus we had expected them to pick the property match most or all of the time. We can, however, think of at least three reasons why the proportions of property match selections were not at ceiling in the Adjective condition. First, choosing the object kind match in the Adjective condition was technically not an error, because it was plausible to infer that the object still maintained its original property underneath the "yucky stuff" that covered it. Second, choosing the object kind match involved selecting an object that had been previously labeled, making it in some sense the safer choice to make. Third, we actually mentioned three features of the target object after initially labeling it, perhaps making it more likely that they would look for those features when interpreting the word and so choose the object kind match. Thus, it is perhaps not surprising that adults' tendency to choose the property match was not higher in the Adjective condition.

Four-year-olds behaved similarly to adults, in that they relied significantly on the syntactic information when interpreting the familiar adjective. Unlike adults and 4-year-olds, however, 3-year-olds appeared to interpret the familiar adjective as an adjective, regardless of whether they heard it modeled as an adjective or a count noun (i.e., in both conditions, they tended to choose the property match). Why did 3-year-olds fail to use the syntactic cues to draw different and appropriate interpretations of the adjective? Three-year-olds appeared to find the task engaging, so it is unlikely that their failure reflected inattention. It is possible that 3-year-olds were simply not sensitive to the syntactic cues we provided to distinguish count nouns from adjectives. This would be surprising if it is true, however, because children younger than three years of age have previously been shown in other tasks to be sensitive to the syntactically-cued distinctions between count nouns and adjectives that we used in this experiment (e.g., Markow & Waxman, 1996; Taylor & Gelman, 1988).

Another possibility is that 3-year-olds were sensitive to the syntactic cues we used to mark the two categories but were blocked from revealing their understanding by some other requirement(s) of our task. There have been several demonstrations that children’s sensitivity to links between a word’s lexical category cued through syntax and its meaning may be greater under some labeling conditions than under others (e.g., sensitivity may be greater if the object is familiar, i.e., previously labeled, than if it is unfamiliar, i.e., previously unlabeled; Hall, 1991; Hall et al., 1993; Markman, 1989). In the Count Noun condition of this experiment, we required participants to set up a new count noun interpretation (i.e., a kind of object) of a word that was a
familiar adjective with a known property interpretation (and the labeled object possessed that property). This demand to establish a homonym of the familiar adjective under these conditions may simply have been too difficult for 3-year-olds (see Peters & Zaidel, 1980; but see also Backscheider & Gelman, 1995).

Experiment 2 enabled us to explore further the possibility that 3-year-olds’ ability to interpret adjectives and count nouns distinctively and appropriately in Experiment 1 was blocked by some requirement(s) of our task. We again used our task to examine how they interpreted adjectives and count nouns, but we now explored children’s and adults’ ability to use phonological cues to make an appropriate interpretation of a familiar adjective presented as an adjective or as a count noun. Previous research has indicated that both children and adults can use phonological cues to distinguish between words from different lexical categories (for a review, see Kelly, 1992). For example, both adults and preschoolers are sensitive to a correlation between syllable number and lexical category, expecting that an increase in the number of syllables in a word will be related to an increase in the likelihood that the word is a noun rather than a verb (Cassidy & Kelly, 1991). Adults are also sensitive to a correlation between stress pattern and word category, showing knowledge, for example, that disyllabic words with stress on the first syllable are more likely to be nouns than verbs (e.g., ‘recórd’ is a noun), and that disyllabic words with stress on the second syllable are more likely to be verbs than nouns (e.g., ‘recórd’ is a verb) (see Kelly, 1988).

We examined a phonologically-marked distinction between adjectives and count nouns in English. An adjective (e.g., ‘blue’) can function as an adjective within a noun phrase by giving the expression phrasal stress, that is, by stressing the head count noun (e.g., ‘blue bõrd’). The same word can be presented as a part of a count noun compound by giving the same expression compound stress, that is, by giving the non-head element primary stress (e.g., ‘bluèbird’) (see Adams, 1973; Bloomfield, 1933). As evidence that the same adjective functions as an adjective within the noun phrase but as a part of a count noun within the compound, notice the following. First, consider paraphrase. The noun phrase may be paraphrased as a description that picks out an object of the kind named by the head count noun, having the property named by the modifier adjective; for example, a ‘blue bird’ is simply a bird that is blue. This suggests that the term ‘blue’ within the noun phrase functions to name a property, as do all adjectives. In contrast, the count noun compound may be paraphrased as a description that picks out an object of a specific kind; for example, a ‘bluèbird’ is simply a member of the species kind, Sialis sialis. This suggests that the term ‘blue’ within the compound functions as a (part of a) name for a particular object kind, as do count nouns. (For evidence that preschoolers understand that count noun compounds name object kinds at the subordinate or species level, see Clark, Gelman, & Lane, 1985, and Gelman, Wilcox, & Clark, 1989.) Second, consider a piece of syntactic evidence. Adverbs (like ‘very’) can premodify adjectives, but not
count nouns. Thus, the sentence “I saw a very bright bird” (with “very” functioning as an adjective within the noun phrase) should be and is grammatical; but the sentence “I saw a very blýebird” (with “blýe” functioning as a part of the count noun compound) should be and is ungrammatical.

We asked whether 3-year-olds, 4-year-olds, and adults would show an understanding of the distinctive semantics of adjectives and count nouns, by interpreting expressions from these two categories appropriately when we marked membership in the categories through phonological cues. To do so, we applied a familiar adjective (e.g., “blue”) with a known property interpretation (e.g., being blue) to a drawing of an appropriate object (e.g., a blue bluebird) and modeled it phonologically either as an adjective in a noun phrase (e.g., “This is a blue bird”) or as a part of a count noun compound (e.g., “This is a bluebird”). We subsequently asked participants to extend the label in a forced choice task to either a new object of a different species kind possessing the same property (e.g., a bird of another kind that was blue—a blue heron) or the original object (i.e., the same kind) lacking the property (e.g., a red bluebird). If participants knew the distinctive semantics of adjectives and count nouns and relied on the phonological cues, then they should have been more likely to pick the new object with the same property after hearing the noun phrase (where the adjective functioned as an adjective naming a property) than after hearing the compound (where the adjective served as a part of a count noun naming a kind).

We were particularly interested in any age differences in performance on the task. Three-year-olds’ failure in Experiment 1 to interpret count nouns and adjectives appropriately may have reflected a difficulty in meeting some demand(s) of our task (e.g., in disregarding a known property interpretation of a familiar adjective in order to set up a new interpretation of the same word, when the referent object possessed that property). If it did, then we expected that 3-year-olds would fail to use the phonological information provided in Experiment 2 to interpret the adjective (noun phrase) and count noun (compound) structures distinctively and appropriately, just as they had failed to use the syntactic information to do so in Experiment 1.

**EXPERIMENT 2**

**Method**

**Participants.** Ninety-six participants were included in the final sample, 32 3-year-olds, 32 4-year-olds, and 32 adults. Among the 3-year-olds, 16 were assigned to the Phrase condition ($M = 3$ years, 7 months; Range = 3: 2 to 3: 11) and 16 were assigned to the Compound condition ($M = 3$ years, 6 months; Range = 3: 0 to 3: 11). Among the 4-year-olds, 16 were assigned to the Phrase condition ($M = 4$ years, 7 months; Range = 4: 0 to 5: 3) and 16 were assigned to the Compound condition ($M = 4$ years, 7 months; Range = 4: 0 to 5: 3). There were roughly equal numbers of boys and girls in the
two conditions at each age. The adults were undergraduates: Sixteen were assigned to the Phrase condition, and 16 were assigned to the Compound condition. An additional five 3-year-olds were tested but excluded from the final sample for failing the post test. Children and adults were recruited and tested under the same circumstances as in Experiment 1. No participant had taken part in Experiment 1.

Stimuli. The stimuli were four sets of three black-and-white line drawings of animals, colored using coloring pencils and mounted on 3 inch by 5 inch cards. Each set was composed of a target drawing (labeled at the beginning of a trial) and two test drawings (between which children had to choose at the end of each trial). The target drawing depicted an animal of a particular color (e.g., a blue bluebird). One of the test drawings was the property match: It showed an animal from a different species kind than the target but the same color (e.g., a blue bird of a different kind—a blue heron). The other test drawing was the object kind match: It showed the same animal (i.e., the same species kind as the target), but in a different color (e.g., a red bluebird). Figure 2 shows a sample triad. Table 1 lists all the stimulus triads. We also used the same puppet as in the previous experiment.

Procedure. The procedure was the same as the one we used in Experiment 1, with the following exceptions, which we describe using the “blue bird”/“bluebird” stimulus set (see Figure 2 and Table 1). First, when labeling the target drawing in the Phrase condition, the experimenter used phrasal stress, saying “Look! Do you see this? This is a blue bird.” In the Compound condition, the experimenter used compound stress, saying “Look! Do you see this? This is a bluebird.” Second, in telling the story, the experimenter continued to use the same expression to refer to the target, either “blue bird” (Phrase condition) or “bluebird” (Compound condition). Third, when the puppet came out from behind the experimenter’s back, it asked for “the blue bird” (Phrase condition) or “the bluebird” (Compound condition). Fourth, we audio-taped all the sessions in order to conduct an independent assessment of the experimenter’s speech (i.e., to ensure that phrasal stress had been used throughout the Phrase condition and that compound stress had been employed throughout the Compound condition). Fifth, we made minor modifications to the story according to the kind of animal that was involved (e.g., instead of “walking through the woods one day”, the bird was “flying around one day”, the fish was “swimming around one day”, and the bug and fly were “buzzing around one day”). Sixth, at the end of each trial, the puppet asked, “Can you tell me what this is?” for both the test drawing that the child had chosen and also the test drawing that the child did not select. We elicited children’s own labels for the drawings in order to gather further information about how they had interpreted the label used by the experimenter. Seventh, we replaced the color brown (that we used in Experiment 1) with the color black, because it was easier for us to devise a stimulus triad involving a count noun compound containing that color term.
Results

Experimenter’s speech. We first analyzed the experimenter’s speech to each participant to determine whether phrasal stress had been used in the Phrase condition and compound stress had been employed in the Compound condition. To do this, we adapted a procedure followed by Kelly and Bock (1988). We excised each of the experimenter’s productions of an intended phrase or compound from the tape of each test session, eliminating adjoining words. We then re-recorded the excisions onto new master tapes. Each master tape contained, in a random sequence blocked by stimulus set, all the produc-
tions from two test sessions, one from each condition within each age group (e.g., from subject 1 in the Phrase condition and from subject 1 in the Compound condition). (Note that the same experimenter always conducted corresponding test sessions in the two conditions.) We kept for our scoring purposes a record of the order in which the intended phrases and compounds were recorded onto each master tape. In this way, we created 16 master tapes for the 3-year-olds, 16 for the 4-year-olds, and 16 for the adults.

To assess differences in stress patterns associated with the intended phrases and compounds, we used the perceptual judgments of two naive adult raters. As noted by Kelly and Bock (1988), there is evidence that adults’ perceptual judgments of stress patterns provide similar results to those based on acoustic analyses (e.g., an examination of whether stressed syllables have a longer duration and a higher pitch compared to unstressed syllables; Cooper & Eady, 1986). We asked our raters to judge whether each expression was spoken with phrasal stress (e.g., “blue bird”) or compound stress (e.g., “bluebird”). As training, we gave raters a different stimulus (i.e., “soft ball” and “soft-ball”) as an example along with feedback about which versions were to be labeled “phrasal” and “compound”. Raters then listened to the master tapes and recorded their judgments on scoring sheets. We asked them to guess if they were unsure.

Raters found the distinction very easy to detect, and their judgments closely matched the intended productions in both conditions. Of the total of 384 trials that were judged (4 trials per participant, 32 participants per age group, 3 age groups), 376 (97.9 %) contained a perfect match between raters’ perceptual judgments and the intended productions (i.e., all intended phrases were scored as having phrasal stress, and all intended compounds were coded as having compound stress). The remaining 8 (2.1 %) trials (3 from the 3-year-olds, 5 from the 4-year-olds, and none from the adults) all contained one mismatch between the perceptual judgment and the intended production. Of these 8 mismatches, 6 involved one rater only (2 involved rater A; 4 involved rater B), and 2 involved both raters. Breaking the mismatches down another way, we noted that 2 of the 8 involved calling an intended compound a phrase; 6 involved labeling an intended phrase a compound.

To be conservative, we excluded the trials on which one or both of our raters perceived a single production of the label as being different than the intended production from subsequent analyses of participants’ drawing choices. We thus conducted these analyses using choices from 376 out of 384 trials. The results we obtained based on the 376 trials did not differ at all in terms of significance from the results based on all 384 trials.

Drawing selections. As in Experiment 1, our main analyses focused on participants’ drawing selections. Our prediction was that participants in the Phrase condition would be more likely than those in the Compound condition to choose the property match. This prediction derived from the hypothesis that a familiar adjective naming a known property and modeled as an adjective
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(in the Phrase condition) would be interpreted as naming that property and so would be extended to objects having the property. However, we reasoned that the familiar adjective modeled as a part of a count noun (in the Compound condition) would be interpreted as (a part of) a name for a kind of object and so would be extended to objects of the same kind, even if they lacked the property.

The mean proportions of property match choices in the two conditions appear in Table 3. We submitted these mean proportions to a 2 (Condition: Phrase, Compound) by 3 (Age: 3-year-olds, 4-year-olds, adults) between-subjects ANOVA. As predicted, there was a main effect of Condition, $F(1,90) = 12.59, p < .001$, indicating more choices of the property match in the Phrase condition than in the Compound condition. There was also a main effect of Age, $F(2,90) = 6.10, p < .005$. A linear trend contrast on the Age effect was significant, $F(1,90) = 12.19, p < .005$, indicating that with increasing age, participants were less likely to select the property match. However, there was also a significant Condition by Age interaction, $F(2,90) = 5.55, p < .01$. Simple effects tests established that the effect of Condition (the tendency to make more property match selections in the Phrase condition than in the Compound condition) was significant among the adults ($p < .001$) and the 4-year-olds ($p < .05$) but not the 3-year-olds ($p > .50$).

We also analyzed the Condition effect within each age group, treating stimulus sets rather than participants as a random effect. We conducted these analyses to determine if the effects within each age group held up across all our stimulus trials. Despite the small number of sets, the pattern of significant effects was the same as in the preceding analyses. The effect was significant for the adults (paired-$t(3) = 10.83, p < .005$) and the 4-year-olds (paired-$t(3) = 6.81, p < .01$) but not for the 3-year-olds (paired-$t(3) = 1.81, p > .15$).

We next compared the tendency to pick the property match in the two conditions within each age group to chance (where chance was 0.50). Among adults, the tendency was above 0.50 but at chance level in the Phrase condition ($t(15) = 1.58, p > .10$); it was significantly below chance in the Compound condition ($t(15) = 1.46, p > .15$). For the 4-year-olds, the tendency within the Phrase condition was also above 0.50 but at chance level ($t(15) = 1.23, p > .20$). Among 3-year-olds, the tendency within the Phrase condition was above 0.50 but still at chance level ($t(15) = 1.90, p < .10$), whereas the tendency within the Compound condition was significantly above chance ($t(15) = 2.59, p < .05$).

We then performed analyses based on participants’ overall pattern of selections across the four trials. We classified any participant who made 3 or 4 (out of 4) property match selections a Property Chooser. (We used a criterion of 2 or 3 out of 3 for those participants with an excluded trial.) The resulting numbers appear in Table 3. They offer a measure of the consistency of individual participants’ performance across the set of trials. We compared
the number of Property Choosers in the two conditions (Phrase, Compound) at each age. Confirming our previous findings, we found a significant and predicted difference among both adults ($\chi^2(1, N = 32) = 11.22, p < .001$) and 4-year-olds ($\chi^2(1, N = 32) = 4.50, p < .05$). However, there was no significant difference between the number of Property Choosers in the two conditions for the 3-year-olds, $\chi^2(1, N = 32) = 0.14, p > .50$.

In sum, adult and 4-year-old participants (but not 3-year-olds) were more likely to choose the property match in the Phrase condition than in the Compound condition. This finding suggests that 4-year-olds and adults appreciated the distinctive semantics of adjectives and count nouns and used phonological cues to interpret a familiar adjective (with a known property interpretation) within a noun phrase appropriately as an adjective naming that property; however, they used the cues to interpret the same word within a compound appropriately as a part of a count noun naming a kind of object (and, strikingly, not the property).

Labels for drawings. Our final analyses focused on participants’ answers to our requests for their own labels (“Can you tell me what this is?”) for each test drawing. We conducted these analyses to obtain evidence from a different source about whether participants in the Phrase condition who chose the property match did indeed tend to interpret the familiar adjective as an adjective within a noun phrase, and whether those in the Compound condition who selected the object kind match did tend to interpret it as a part of a count noun.

First, we located all trials on which participants labeled the chosen drawing with the expression the experimenter had provided for the target object (e.g., on the bird trial, after choosing either the blue heron or the red bluebird, they labeled it with “blue” followed by “bird”). Second, from among these trials, we focused specifically on those on which participants’ selection was in accord with the prediction for their condition (i.e., trials in the Phrase condition where they selected the property match; trials in the Compound condition where they selected the object kind match). For our analyses, we examined the labels provided on those trials for the unchosen alternative.

If participants within the Phrase condition chose the property match and labeled it with the expression that the experimenter had given to the target, then we predicted that they would label the unchosen alternative with an (appropriate) color word followed by a count noun. We made this prediction because we hypothesized that the labels participants gave on these trials for the chosen drawings were really noun phrases containing adjectives, and that participants would interpret the labeling request as calling for a noun phrase containing an adjective for the unchosen object. For example, if they chose the blue heron in the Phrase condition and labeled it with “blue” plus “bird”, we expected they would label the unchosen red bluebird with the phrasal label “red” plus “bird”.

In contrast, if participants within the Compound condition selected the object kind match and labeled it with the expression originally given to the
target, then we predicted that they would label the unchosen alternative with a species-kind count noun. We made this prediction because we expected that the labels participants gave for the chosen object on these trials were actually count noun compounds naming species kinds, and that participants would interpret the labeling request as calling for a count noun for the species kind of the unchosen object. For example, if they chose the red bluebird in the Compound condition and labeled it with the expression ‘‘blue’’ plus ‘‘bird’’, we expected they would tend to label the unchosen blue heron with a species-kind count noun, such as ‘‘heron’’. We also hypothesized that participants who selected the object kind match in the Compound condition might show a tendency to say ‘‘I don’t know’’ for the unchosen object, because they might often be unfamiliar with count nouns for the particular species kinds (e.g., they might not know words like ‘‘heron’’). As a result, our full prediction for participants in the Compound condition who chose the object kind match was that they would either give a count noun for the species kind or say ‘‘I don’t know’’ when asked to label the unchosen object.

For each participant, we computed the proportion of trials on which they labeled the unchosen object with an (appropriate) color word plus count noun, as well as the proportion on which they labeled it with a count noun for the species kind (or ‘‘I don’t know’’), based on the total number of trials on which they (1) labeled the chosen drawing with the exact expression the experimenter had provided for the target, and (2) made a selection that was consistent with the prediction for their condition. Note that these computations involved fewer than 16 per condition in each age group, because some participants had no trials on which they both provided the appropriate label for the chosen drawing and also made a consistent selection. A total of 52 participants (out of a possible 96) were thus included in the following analyses (19 adults, 17 4-year-olds, and 16 3-year-olds).

The results supported both our predictions. First, consider labels of the unchosen drawing that were an (appropriate) color word plus count noun. As predicted, the proportion was significantly higher for those in the Phrase condition who chose the property match (overall $M = 0.87$; $SD = 0.29$) than those in the Compound condition who chose the object kind match (overall $M = 0.23$; $SD = 0.36$), $t(50) = 7.10$, $p < .0001$. Moreover, the effect held up in each age group: for the 3-year-olds: $t(14) = 3.76$, $p < .005$; for the 4-year-olds: $t(15) = 5.11$, $p < .0001$; and for the adults: $t(17) = 3.96$, $p < .001$.

Second, consider labels of the unchosen drawing that were a species-kind count noun or ‘‘I don’t know’’. Also as predicted, the proportion was significantly higher for those in the Compound condition who chose the object kind match (overall $M = 0.59$; $SD = 0.40$) than those in the Phrase condition who picked the property match (overall $M = 0.07$; $SD = 0.23$), $t(50) = 5.68$, $p < .0001$. Again, the effect held up for each age group: for the 3-year-olds: $t(14) = 2.75$, $p < .05$; for the 4-year-olds: $t(15) = 3.30$, $p < .005$; and for the adults: $t(17) = 3.60$, $p < .005$. 
These supplementary analyses provide additional evidence that participants’ interpretation of the same adjective differed strikingly depending on their condition and their drawing selection, consistent with the hypothesis that the adjective within the noun phrase extended to the property match was taken to be an adjective naming a property, but the same word within the compound extended to the object kind match was taken to be a part of a count noun naming a kind of object. One noteworthy result is that all age groups, including 3-year-olds, reliably showed the predicted effects. Recall that, overall, 3-year-olds appeared to interpret the familiar adjective in the same way in both Phrase and Compound conditions (i.e., as an adjective), as judged by their tendency in both conditions to select the property match. These supplementary analyses suggest that, at least within the subset ($N = 16/32$) who had at least one trial on which they provided the original label for the chosen object and chose a drawing in accord with the prediction for their condition, even 3-year-olds who heard the adjective modeled inside the noun phrase and extended it to the property match tended to take it as an adjective; but those who heard it presented inside the compound and extended it to the object kind match tended to view it as a part of a count noun.

**Discussion**

The results of Experiment 2 support the hypothesis that adults and 4-year-olds appreciate the distinctive semantics of adjectives and count nouns and can use phonological evidence to interpret words from these two categories appropriately. If a familiar adjective (e.g., “blue”) with a known property interpretation (e.g., the property of being blue) was modeled phonologically as an adjective within a noun phrase (e.g., “a blue bõ”), adults and 4-year-olds often seemed to take it as naming that property, extending the expression to another object having the property (e.g., a bird of a different kind colored blue). In contrast, if the same adjective was modeled phonologically as a part of a count noun compound (e.g., “a blu ebird”) and applied to the same object, adults and 4-year-olds often appeared to construe it as naming a kind of object, extending the expression significantly more often to an object of the same kind, even though it lacked the property (e.g., the same bluebird colored red).

These findings are noteworthy because they provide a new demonstration that both adults and 4-year-olds appear to use phonological evidence to interpret the same word appropriately as an adjective or a (part of a) count noun. In the Phrase condition, we modeled the word as an adjective inside a noun phrase by using phrasal stress (i.e., we stressed the head count noun); in the Compound condition, we modeled the word as a part of a count noun by using compound stress (i.e., we stressed the non-head adjective). Four-year-olds’ and adults’ use of these phonological cues to interpret the same word in two distinctive and appropriate ways thus indicates another link between
phonology and lexical category to which both preschoolers and adults are sensitive (see Kelly, 1992).

As in Experiment 1, participants performed differently in the three age groups. Adults showed the strongest sensitivity to the phonological information as a cue to interpreting the familiar adjective. They almost never chose the property match in the Compound condition, suggesting a heavy reliance on the phonological information telling them that the adjective within the compound should be treated as (a part of) a count noun. In contrast, they were significantly more likely to select the property match in the Phrase condition, where they heard the target labeled with the adjective modeled as an adjective inside a noun phrase. However, they did not always select the property match in the Phrase condition. We had predicted that they would interpret the adjective within the noun phrase in the Phrase condition as an adjective, and thus had expected them to pick the property match most or all of the time. As discussed for the Adjective condition in Experiment 1, however, there are several reasons why participants in the Phrase condition might plausibly have failed to choose the property match at ceiling levels.

Four-year-olds performed similarly to adults, in that they used the phonological cues appropriately when interpreting the familiar adjective. Four-year-olds’ tendency to distinguish appropriately between the adjective and count noun constructions on the basis of these cues was not, however, as strong as adults’. In contrast to both adults and 4-year-olds, however, 3-year-olds appeared to interpret the familiar adjective as if it were an adjective, regardless of hearing it modeled as an adjective or as a (part of a) count noun (i.e., in both conditions, they tended to select the property match). Three-year-olds thus failed to exploit the phonological cues to lexical category in order to make distinctive and appropriate inferences about meaning. The reason for 3-year-olds’ failure to do so is not entirely clear. As in Experiment 1, 3-year-olds were attentive throughout the task. It is possible that they were not sensitive to the phonological cues we used in the experiment. It is also possible, however, that they were sensitive to the phonological information but were unable to rely on it because of some other demand(s) of our task. As noted earlier, previous evidence indicates that 3-year-olds will, under some conditions, rely on the syntactic cues we used in Experiment 1 to mark adjectives and count nouns (e.g., Markow & Waxman, 1996; Taylor & Gelman, 1988); however, 3-year-olds did not rely on them in our task. Thus, in Experiment 2, 3-year-olds may have been unable to meet our specific task requirement to make a new count noun interpretation of a word (a name for a kind of object) when the word was a familiar adjective (a name for a property), and the labeled object possessed the property named by the adjective (i.e., they may have been blocked from establishing a homonym of the familiar adjective under these conditions; see Peters & Zaidel, 1980; but see also Backscheider & Gelman, 1995).

Experiment 3 was an attempt to obtain further evidence that, at the age of
four years, children appreciate the distinctive semantics of adjectives and count nouns and can rely on phonological cues to interpret words from these two categories appropriately. The results of Experiment 2 provided a first demonstration of preschoolers’ reliance on phonological cues in interpreting a familiar adjective as either an adjective within a noun phrase or a part of a count noun compound, and so we wanted to try to replicate it. We also sought to demonstrate that 4-year-olds’ apparent tendency in Experiment 2 to treat the count noun compounds as naming kinds of objects did not reflect their prior knowledge of the specific compounds we used (e.g., “blackfly”, “bluebird”). To address these issues, we ran Experiment 3, using two different groups of 4-year-olds. The procedure was the same as in Experiment 2, but we split the four modifier adjectives (e.g., “black”) used in Experiment 2 from the four head count nouns (e.g., “fly”) and recombined them to form four new expressions, each of which could be presented either as a noun phrase (e.g., “blackfish”, “greenfly”) or as an (actual) count noun compound (e.g., “blackfly”, “greenfly”).

**EXPERIMENT 3**

**Method**

*Participants.* Thirty-two 4-year-olds took part. Sixteen were assigned to the Phrase condition ($M = 4$ years, 8 months; Range = 4: 0 to 5: 4) and 16 were assigned to the Compound condition ($M = 4$ years, 7 months; Range = 4: 1 to 5: 4). There were roughly equal numbers of boys and girls in the two conditions. Children were tested under the same conditions as in Experiments 1 and 2. No child had taken part in either previous experiment.

*Stimuli.* The stimuli were four sets of three black-and-white line drawings of animals, colored using coloring pencils and mounted on 3 inch by 5 inch cards. Each set was composed of a target drawing (labeled at the beginning of a trial) and two test drawings (between which children had to choose at the end of each trial). By separating the adjective modifiers from the head count nouns used in Experiment 2 and then recombing them, we were able to come up with four new adjective-count noun phrases, along with four new (and actual) count noun compounds. The *target* drawing in each set depicted an animal of a particular color (e.g., a red redbird; “redbird” is another name for bird species such as cardinals, bullfinches, and tanagers). One of the test drawings was the *property match,* showing a new animal from a different kind than the target, but the same color (e.g., a red bird of a different kind—a red oyster catcher). The other test drawing was the *object kind match:* It showed the original animal (i.e., the same kind as the target) in a different color (e.g., a green redbird). Figure 3 shows a sample triad. Table 1 lists all the stimulus triads. We also used the same puppet as in the previous experiments.

*Procedure.* The procedure was the same as it was for the 4-year-olds in Experiment 2.
FIG. 3. Sample stimulus triad from Experiment 3.

Results

Experimenters' speech. As in Experiment 2, we first analyzed the experimenter's speech to each child to determine whether the experimenter had spoken with phrasal stress on the trials in the Phrase condition and with compound stress on the trials in the Compound condition. We followed the same procedure as in Experiment 2, using the same two raters.

In this experiment, neither rater's stress pattern judgments were at odds with the intended production on any of the 128 trials (4 trials per child, 32 children). We inferred from these results that the experimenter's intended
productions were perceived accurately by blind adult raters to be either phrases or compounds on all trials. As a result, we conducted our analyses using data from all trials.

**Drawing selections.** We next analyzed children’s drawing selections. Recall that our prediction (the same as in Experiment 2) was that the tendency to select the property match would be greater in the Phrase than in the Compound condition.

The mean proportions of choices of the property match in the two conditions appear in Table 3. We submitted these mean proportions in the two conditions (Phrase, Compound) to a *t*-test. As predicted, it was significant, *t*(30) = 3.12, *p* < .005, indicating more selections of the property match in the Phrase condition than in the Compound condition. This effect held up when we treated stimulus sets, rather than subjects, as a random effect, paired-*t*(3) = 27.52, *p* < .0001. In addition, the tendency to choose the property match was significantly above chance level (chance being 0.50) in the Phrase condition (*t*(15) = 5.48, *p* < .001), but it was at chance in the Compound condition (*t*(15) = 0.40, *p* > .50).

Finally, we conducted analyses based on participants’ overall pattern of selections across trials. We called any participant who made 3 or 4 (out of 4) property match selections a Property Chooser. The resulting numbers appear in Table 3. These numbers provide an index of the consistency of individual participants’ performance across trials. There were significantly more Property Choosers in the Phrase condition than in the Compound condition, χ²(1, *N* = 32) = 8.53, *p* < .005.

In sum, these results replicate the finding from Experiment 2 that the tendency among 4-year-olds to select the property match was greater in the Phrase than in the Compound condition. The results suggest that 4-year-olds appreciated the distinctive semantics of adjectives and used phonological information to interpret a familiar adjective with a known property interpretation appropriately as an adjective when modeled within a noun phrase (i.e., as naming that property), but appropriately as a part of a count noun when modeled within a count noun compound (i.e., as naming a kind of object, not the property). The fact that Experiment 3 replicates Experiment 2 also indicates that the effects obtained in Experiment 2 were not attributable to knowledge of the specific count noun compounds we used in that study.

**Labels for drawings.** Our final analyses focused on the answers children provided to our requests to label the test drawings (“Can you tell me what this is?”). As in Experiment 2, we sought evidence from a different source that participants in the Phrase condition who chose the property match tended to interpret the familiar adjective as a part of a noun phrase containing an adjective, but those in the Compound condition who chose the object kind match tended to interpret it as a part of a count noun compound. We followed the same procedure for analyzing these answers as in Experiment 2. We again
predicted that if participants within the Phrase condition chose the property match and labeled it with the expression used by the experimenter, they would label the unchosen alternative with an (appropriate) color word plus a count noun. In contrast, we predicted that children within the Compound condition who chose the object kind match and labeled it with the expression provided by the experimenter would label the unchosen object with a species-kind count noun or would say “I don’t know” (because they did not know a species-kind count noun).

For each participant, we again calculated the proportion of trials on which they labeled the unchosen object with an (appropriate) color word plus count noun, as well as the proportion on which they labeled it with a count noun for the species kind (or “I don’t know”), based on the total number of trials on which they (1) labeled the chosen drawing with the label the experimenter had provided for the target object, and (2) made a selection that was consistent with the prediction for that condition. A total of 16 out of 32 4-year-olds met these two criteria on at least one trial and so were included in the analyses.

As in Experiment 2, the results supported both our predictions. First, consider labels of the unchosen drawing that were an (appropriate) color word plus count noun. As predicted, the proportion was significantly higher for those in the Phrase condition who chose the property match ($M = 0.50; SD = 0.50$) than those in the Compound condition who chose the object kind match ($M = 0.06; SD = 0.17$), $t(14) = 2.51, p < .05$. Second, consider labels of the unchosen drawing that were a species-kind count noun or “I don’t know”. Again as predicted, the proportion was significantly higher for those in the Compound condition who chose the object kind match ($M = 0.69; SD = 0.43$) than those in the Phrase condition who chose the property match ($M = 0.14; SD = 0.24$), $t(14) = 3.03, p < .01$. These results thus confirm that children’s interpretations of the same adjective differed clearly depending upon their condition and their drawing selection, consistent with the hypothesis that the adjective within the noun phrase extended to the property match had been taken to be an adjective naming a property, but the same word within the compound extended to the object kind match had been construed as a part of a count noun naming a kind of object.

Discussion

The results of Experiment 3 replicated those from Experiment 2, providing further support for the hypothesis that 4-year-olds appreciate the distinctive semantics of adjectives and count nouns and can use phonological evidence to interpret words from these two categories appropriately. Children appeared to use phonological information to interpret a familiar adjective (e.g., “red”) with a known property interpretation (e.g., being red) and applied to an appropriate object (e.g., a red redbird) as naming that property if it was modeled phonologically as an adjective within a noun phrase (e.g., “a red
bird’). The reason for making this suggestion is that they typically extended the expression to another object sharing the property (e.g., a bird of a different kind colored red). In contrast, they appeared to be more likely to construe the same adjective applied to the same object as naming a kind of object if it was presented phonologically as a part of a count noun compound (e.g., ‘‘a rédbird’’), because they extended it significantly more often to an object of the same kind, even though it lacked the known property (e.g., the same redbird colored green). The findings also suggest that the results of Experiment 2 were not attributable solely to children’s knowledge of the specific count noun compounds we used in that experiment.

One difference between the results of Experiments 2 and 3 was in the mean proportion of property match selections in the two conditions. In Experiment 2, the mean proportions for the 4-year-olds were at chance levels in both Compound and Phrase conditions, although the two proportions differed significantly from each other. In Experiment 3, the proportions again differed significantly from each other; however, they were at chance level in the Compound condition but above chance level in the Phrase condition. It is not clear why the proportions (in both conditions) were higher in Experiment 3.

GENERAL DISCUSSION

In each of three experiments, participants heard a familiar adjective with a known property interpretation applied to a drawing of a target object that possessed that property. In one condition of all experiments, the adjective was presented in a construction that called for an adjectival interpretation. Specifically, it appeared either as an adjective on its own (e.g., ‘‘This is a blue one’’ applied to a blue novel creature) or as an adjective within a noun phrase (e.g., ‘‘This is a blue bird’’ applied to a blue bluebird). In the other condition, the same adjective was presented in a context that called for a count noun interpretation. Specifically, it was offered either as a count noun on its own (e.g., ‘‘This is a blue’’ applied to a blue novel creature) or as a part of a count noun compound (e.g., ‘‘This is a bluebird’’ applied to a blue bluebird). Participants then learned that the property of the target object named by the familiar adjective was (superficially) lost. We then asked them to extend the label they had heard either to an object of a different kind possessing the property (e.g., a novel creature of another kind that was blue, or a bird of another kind that was blue) or to the target object now appearing to lack the property (e.g., the original creature colored red, or the original bluebird colored red).

Adults and 4-year-olds (but not 3-year-olds) who heard the adjective modeled as an adjective were more likely than those who heard it presented as a count noun (or a part of a count noun) to extend it to the new object that possessed the property. Adults and 4-year-olds thus appeared to understand that a familiar adjective (naming a known property) names that property when
modeled as an adjective and so should be extended to objects sharing the property; but the same adjective names a kind of object when modeled as a count noun (or a part of a count noun) and so should be extended to objects of the same kind, even if they lack that property. By the age of four years, children thus showed a clear appreciation of the distinctive semantics of adjective and count nouns and a powerful tendency to rely on cues to a word’s lexical category in drawing an inference about its meaning.

Experiment 1 showed that adults and 4-year-olds, but not 3-year-olds, used syntactic information to interpret the same word (e.g., “blue”) appropriately as either an adjective (e.g., “a blue one”) or a count noun (e.g., “a blue”). This observed sensitivity to a link between syntactic cues to a word’s lexical category and its meaning is consistent with previous research on preschoolers’ understanding of adjectives and count nouns (e.g., Hall et al., 1993; Markow & Waxman, 1996; Smith et al., 1992; Taylor & Gelman, 1988). The current results extend earlier findings by suggesting that by the age of four years, children assume that words presented syntactically as either adjectives or count nouns differ in their interpretations (i.e., adjectives name properties; count nouns name kinds), regardless of any previous interpretation known in association with the words. In these studies, adults and 4-year-olds treated a word known previously as an adjective naming a property as a name for a kind of object simply because it was modeled in a syntactic context appropriate for a count noun.

Experiments 2 and 3 revealed that adults and 4-year-olds, but again not 3-year-olds, used phonological information to interpret the same word appropriately as either an adjective or a (part of a) count noun. Specifically, adults and 4-year-olds made an appropriate interpretation of a word if it was presented either as an adjective within a noun phrase (where we used phrasal stress) or as a (part of a) count noun compound (where we used compound stress). This link between phonology and lexical category is not perfect; for example, some count noun compounds (composed of an adjective and a count noun) may be pronounced with phrasal stress, as in “best mán” or “old hánd” (see Adams, 1973). However, the relation between being a disyllabic count noun compound and receiving primary stress on the first (non-head) element appears to be reliable enough to be known by both adults and children as young as four years of age. These results thus suggest an addition to the list of links between phonology and lexical category to which both adults and children have previously been shown to be sensitive (Kelly, 1992).

Unlike adults and 4-year-olds, 3-year-olds did not use either syntactic or phonological cues to make distinguishable and appropriate interpretations of the familiar adjective presented as an adjective or as a (part of a) count noun. Three-year-olds tended to select the test drawing that suggested a property interpretation of the adjective (i.e., the property match) to the same extent, regardless of how the word was modeled, consistent with their having tended
to interpret it as being the familiar adjective. (Recall that we included only those who understood and could correctly produce all the familiar adjectives in our post test.) Because previous results indicate that 3-year-olds are sensitive at least to the syntactic cues that we used (e.g., Markow & Waxman, 1996; Taylor & Gelman, 1988), it is possible that their failure to interpret adjectives and count nouns distinctively and appropriately, regardless of how we marked them, reflects (at least in part) a difficulty to satisfy some demand(s) of our task. For example, 3-year-olds may have been unable to meet our requirement in the Count Noun (or Compound) condition to disregard a known interpretation of a familiar word that was true of an object labeled with the word (e.g., the familiar word “blue”, naming the property of being blue, applied to a blue object) in order to set up a new and different interpretation of the same word (i.e., as a name for a kind of thing, or a part of such a name). This inability may have reflected a default assumption that 3-year-olds could not overcome, disallowing multiple interpretations of the same word (i.e., blocking the establishment of homonyms) under labeling conditions like those used in our task (see Peters & Zaidel, 1980; see also Backscheider & Gelman, 1995). As a result, 3-year-olds may have ignored cues to lexical category membership upon which they would have relied under other labeling conditions.

Four other features of these studies deserve discussion. First, although the count nouns used in Experiment 1 were presumably novel to participants (i.e., they named novel kinds of object), we did not manipulate (or even assess) participants’ prior familiarity with the count noun compounds (naming real object kinds) used in Experiments 2 and 3. It is, however, possible that familiarity with the count noun compounds for the object kinds affected the results. For example, children (or adults) who knew the compounds may been more likely than those who did not to view the specific kinds that they named as potential interpretations of the labels; as a result, they may have been more reliant on lexical category cues indicating that a label should be taken as a count noun compound naming a kind. In future extensions of this work, it would be interesting to assess (and manipulate) participants’ prior familiarity with count noun compounds for the object kinds, especially among 3-year-olds, to determine if it plays any role in participants’ overall willingness (or unwillingness) to extend such expressions to other objects of the same kind (i.e., to the object kind matches).

Second, we focused only on animals as target objects. We did so because previous research suggests that both children and adults tend to believe that living kinds are more likely than artifacts to possess a hidden core (or “essence”) distinct from any surface properties (e.g., Gelman, Coley, & Gottfried, 1994; Keil, 1989); and in these experiments, we were interested in maximizing our chances of having children construe a word presented in a count noun construction as naming an underlying kind (distinct from a familiar surface property). However, it would be interesting to extend
this work by exploring children’s patterns of projecting count noun compounds for other kinds as well. For example, it would be revealing to examine children’s extension patterns when the target is an animal (e.g., there can be green blackbirds) as well as when it is an artifact (e.g., there can be green blackboards). The results of such additional work would reveal whether children differ in their willingness to extend count noun compounds to objects of the same kind, depending upon the domain of the labeled object.

Third, we focused only on the property of color. We did so not only because color is salient and familiar to young children (e.g., Baldwin, 1989), but also because there are numerous animal count noun compounds that contain color words as the first (modifier) element (see, for example, the list of stimuli used in Experiments 2 and 3). However, there are idiosyncrasies associated with the acquisition of color terms (e.g., Landau & Gleitman 1985; Soja, 1994), and so it would be interesting to extend this research to examine other types of properties. For example, several other sorts of adjectives can appear inside count noun compounds, such as those naming texture (e.g., “soft ball” versus “softball”) or size (e.g., “long boat” versus “longboat”). If children understand that adjectives within count noun compounds are a part of names for object kinds, not names for properties, then they should extend count noun compounds to other objects on the basis of object kind, regardless of the type of property picked out by the adjectives (e.g., color, texture, size).

Finally, we focused on only one type of transformation, in which a target object’s property was changed by covering the object with material (yucky stuff) having a contrasting property. Following this type of transformation, our adult and 4-year-old participants more readily extended a count noun than an adjective to the target. It would, however, be interesting to extend this work by exploring the effect on word extensions of increasing the severity of the transformation. After a more radical transformation than the one used in these experiments (e.g., one in which an object’s property were definitively lost rather than just covered up), we might observe an increased tendency in our task to extend a familiar adjective, modeled as either an adjective or a count noun, from the target to a different object with the same property. For the word modeled as an adjective, this increase might reflect a weaker tendency to believe that the target’s named property could remain hidden underneath the object kind match. For the word presented as a count noun, the increase might represent a weaker tendency to believe that the object’s kind could be preserved following a permanent loss of the property; however, judgments of the loss of object kind following the loss of a property likely depend on the specific type of property in question (e.g., loss of color may not be seen as leading to loss of species kind, regardless of how enduring it is).
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