

## REPORT

# A matter of time: novel nouns mark object categories when delays are imposed

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### Abstract

*In previous work, preschool-aged children have revealed a specific expectation that novel count nouns (but not adjectives) will refer to object categories (but not to object properties or to thematic relations). However, in these tasks, children have been permitted to extend a novel word immediately after it has been introduced. The current experiments test the hypothesis that the noun-category bias is sufficiently robust to hold up even when a delay is imposed between a naming episode and the child's opportunity for extension. To capture this phenomenon experimentally, we imposed delays of 30 s (Experiment 1) and 1 h (Experiment 2). Across both delay conditions, children in a 'novel noun' condition revealed a strong inclination to consistently choose other members of the same object category as the (previously named) target. Children in either a 'novel adjective' or 'no word' condition revealed no taxonomic inclination. These results establish the power of the noun-category bias in situations that more closely approximate some of the very real challenges that children face in mapping and extending novel words.*

Children's natural word learning abilities have been the focus of considerable research interest. The intensity of interest stems, at least in part, from our fascination with children's rapid and successful solutions to the task of mapping words to their meaning. Children's mastery of this complex task certainly involves an intricate interplay between expectations or biases held by the child and support from the environment. In this paper, we focus primarily on the child's expectations in extending novel words, applied ostensibly to discrete objects.

A review of the literature reveals a sharp distinction between children's expectations for novel words presented as count nouns versus those presented as members of other syntactic categories. For example, preschoolers expect that a novel count noun (e.g. flamingo), applied ostensibly to an individual object (e.g. a flamingo), will refer to the whole named object and can be extended to include other members of the same basic or superordinate level object category (e.g. other flamingos) (Markman & Hutchinson, 1984; Waxman & Gelman, 1986; Waxman, 1990, 1991; Waxman & Kosowski, 1990; D'Entremont & Dunham, 1992; Waxman & Markow,

1995). This expectation has been dubbed the *noun-category bias*<sup>1</sup> because by 2 or 3 years of age it appears to be specific to count nouns. Although words from other syntactic categories (e.g. proper nouns, adjectives) can also be applied sensibly to individual objects, children's expectations of novel words in these syntactic contexts are quite different. They interpret a novel adjective as referring to a property of the named individual or to a salient subordinate level distinction within an existing basic level kind (Taylor & Gelman, 1988; Waxman, 1990; Smith, Jones & Landau, 1992; Hall, Waxman & Hurwitz, 1993; Waxman & Markow, 1998); they interpret a novel proper noun as referring specifically to the named individual, and do not extend the term to include other members of its kind (Katz, Baker & Macnamara, 1974; Gelman & Taylor, 1984; Hall, 1994, 1996).

<sup>1</sup>We describe the phenomenon as the *noun-category bias* rather than the *taxonomic bias* (e.g. Markman, 1994) to highlight the fact that the tendency to focus on categories of objects is evident specifically with novel words presented as count nouns.

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Results like these demonstrate that children as young as 2 or 3 years of age expect that particular linguistic forms (e.g. count nouns, proper nouns, adjectives) will refer to particular types of conceptual relations among objects and events in the world (e.g. categories of objects, individual objects, and properties of objects, respectively) (Brown, 1957; Waxman, 1990, 1994; Waxman & Kosowski, 1990; Hall, 1993, 1994, 1996; Hall, Waxman & Hurwitz, 1993; Waxman, Stote & Philippe, 1997b). Moreover, there is now evidence for the noun-category bias in infants on the brink of producing language (Waxman & Markow, 1995; Balaban & Waxman, 1996, 1997) and in children acquiring languages other than English as their native language (Waxman, Senghas & Benveniste, 1997a). Thus, the noun-category bias is evident across languages and is available from infancy. This is consistent with the view that children are biased in their interpretation of novel nouns, and that this bias facilitates the rapid acquisition of both the lexicon and conceptual systems of organization (cf. Markman, 1994; Waxman, 1994).

In this paper, we take as our point of departure the following observation: under naturally occurring circumstances, there are often delays and distractions between the introduction of a novel word at one moment ('Look at the flamingo!') and the child's opportunity to extend it. This delay can range from minutes to hours, and perhaps longer. If the noun-category bias is to facilitate acquisition in these more naturalistic contexts, then it must be sufficiently robust to hold up even when delays are imposed. Unfortunately, in virtually all of the research assessing the noun-category bias, children have been instructed to extend a novel word immediately after it has been introduced.

We redress this limitation by adapting an established paradigm in which children 'read' through a picture book with an experimenter (Waxman & Kosowski, 1990; Waxman *et al.*, 1997a). Each page included five pictures: a target object (e.g. cow), two objects from the same superordinate category as the target (e.g. fox, zebra) and two objects that are thematically related to the target (e.g. barn, milk carton). For children in the 'novel noun' condition, the experimenter pointed to the target and said, for example, 'See this "*fopin*"? Can you find another "*fopin*"?' In the 'novel adjective' condition, she said, for example, 'See this "*fopish*" one? Can you find another one that is "*fopish*"?' In the 'no word' condition, she said 'See this? Can you find another one?' The child and experimenter 'read' through the book twice. On the second reading, the experimenter reminded the children of their first choices and asked them to select another from the remaining (three) alternatives. Notice that this design incorporates two distinct types of

control for the 'novel noun' condition. Performance in the 'no word' control reveals whether children are more likely to direct their attention to object categories in a word-learning task than in a non-linguistic control task. Performance in the 'novel adjective' condition tests whether the phenomenon is specific to novel words presented as count nouns.

In the current experiments, we modified this paradigm in two ways. First, to discover the power of the noun-category bias under circumstances that approximate some challenges of natural word learning, we imposed delays between the experimenter's presentation of the novel name and the child's opportunity for extension. We predicted that, even in the face of such delays, novel nouns (but not adjectives) would direct children's attention to the commonalities between a named object and other category members, but that children hearing novel adjectives or no novel words would fail to reveal this preference. We predicted that providing a novel count noun for an individual object at one moment would highlight category membership and would facilitate identification of other category members at a later point in time.

Second, we tinted the stimuli (which had been presented as black-and-white line-drawings in previous research) as follows. The thematic alternatives were lightly shaded with color to match the target; the taxonomic alternatives were shaded using colors that differed from the target. We predicted that children in the 'novel adjective' condition would prefer the color-matched (thematic) alternatives (Gelman & Taylor, 1984; Prasada, 1992; Waxman, 1995; Hall & Moore, 1997; Waxman *et al.*, 1997b; Waxman & Markow, 1998). We suspected that children in the 'no word' condition would reveal this same preference, for these alternatives are related to the targets in two distinct ways (color and thematic relatedness). This modification provided a strong test of the noun-category bias, for if children in the 'novel noun' condition were to select the taxonomic alternatives, they would have to do so to the exclusion of these color-based thematic alternatives.

## Experiment 1

In this experiment, we imposed a 30 s delay between the introduction of the novel name for the target and the child's opportunity for extension. During the delay, the experimenter engaged children in games (e.g. Simon Says, clapping games). We selected this minimal delay because our primary goal was to explore the feasibility of extending this paradigm to include delays. Moreover,

delays of this duration are common in conversations and in more focused activities (e.g. book-reading), as adults divert their attention momentarily from one child to manage a distraction from another.

### Method

#### Participants

Thirty-six children (mean age 3 years; 9 months, ranging from 3;0 to 4;8) participated. All were enrolled in preschool programs serving racially mixed, middle-class populations in the Greater Chicago area. Approximately equal numbers of males and females were assigned to each condition, for a total of 12 children per condition (see below).

#### Stimuli

Stimuli were tinted line-drawings; each was approximately 4 cm high. See Table 1 for a complete list of stimuli. These were arranged in a book, with five pictures on each page. The center picture on each page served as the 'target'; it was lightly shaded with one or two colors, in a realistic fashion (e.g. the dog was shaded with brown and beige). The four surrounding pictures were 'response' stimuli. Two of these belonged to the same superordinate level category as the target; these were shaded with colors that were realistic but that differed from the target. The remaining stimuli were thematically related to the target; these were shaded with the same colors as the target. There were 12 such pages; each page constituted a trial. The position of the taxonomically and thematically related items on each page was counterbalanced over trials.

**Table 1** Stimuli (Experiments 1 and 2)

Target	Taxonomic responses		Thematic responses	
banana	apple	grapes	monkey	boy
rabbit	skunk	pig	carrot	Easter egg <sup>a</sup>
squirrel	mouse	cat	tree	acorn <sup>a</sup>
bird	butterfly	mouse	tree	nest <sup>a</sup>
fish	bird	toad	fishing rod <sup>a</sup>	fishtank <sup>a</sup>
flowers	tree	houseplant <sup>a</sup>	bee	vase
bee	butterfly	owl	flower	beehive <sup>a</sup>
horse	elephant	giraffe	saddle	jockey <sup>a</sup>
mouse	raccoon	fish	cheese	mousetrap
bread	corn	icecream cone	toaster	knife
dog	deer	bear	bone	doghouse <sup>a</sup>

Note: <sup>a</sup>These items were produced in this laboratory. All others were selected from Snodgrass and Vanderwart (1980).

### Procedure

Children were tested individually, in a quiet undisturbed area of their preschool. Each trial included (1) an introduction phase, (2) a delay phase (with interference) and (3) a test phase. As in Waxman and Kosowski (1990), children were randomly assigned to the 'novel noun', 'novel adjective' or 'no word' condition. Conditions differed only in the introduction phase; the delay and test phases were identical for all conditions. The procedure lasted approximately 15 min.

To begin, the experimenter familiarized children in all conditions to a puppet named Tiki. She explained that Tiki came from another planet and wanted to play with some pictures, but could not speak English and had his own 'special words'. In this way, the puppet provided an opportunity for the experimenter to introduce novel words for the familiar objects depicted on each page. Familiar objects are preferable in tasks like this because children appreciate both the taxonomic and thematic relations among them.

#### Introduction

The experimenter directed the child's attention to the target, but made no mention of the surrounding alternatives. The manner in which the experimenter highlighted the target differed as a function of condition.

In the 'novel noun' condition, the experimenter pointed to each target and labeled it with a novel noun. For example, she said, 'See this? This is a fopin. Can you say that?' Children responded by repeating the novel noun. The experimenter then said, for example, 'Please tell Tiki that this one is a fopin.' Children typically responded with full sentences, saying, for example, 'Tiki, this one is a fopin.'

In the 'novel adjective' condition, novel words were presented within an adjectival context. The experimenter pointed to each target and said, for example, 'See this? This is a fopish one. Can you say that?' Children responded by repeating the novel adjective. The experimenter then said, for example, 'Please tell Tiki that this one is a fopish one.' Children typically responded with full sentences, saying, for example, 'Tiki, this one is a fopish one.'<sup>2</sup>

In the 'no word' condition, no object labels (either familiar or novel) were offered in conjunction with the pictures. On each page, the experimenter pointed to the target and said, 'Do you see this one? Can you point to

<sup>2</sup>Following Waxman and Kosowski, we introduced each novel word twice to provide unambiguous evidence of the novel word's syntactic assignment (Waxman, 1990, 1995; Waxman & Kosowski, 1990; Waxman *et al.*, 1997a).

this one for me?' After the child pointed to the target, the experimenter said, 'That's right! That's the one.'

### Delay

Immediately after each target's introduction, the experimenter imposed a 30 s delay, during which time she engaged children in interference activities such as Follow-the-leader, Simon Says, or clapping games.

### Test

When 30 s had elapsed, the experimenter re-directed the children's attention to the target, asking, 'Do you remember this one? Can you find another one on this page?' The novel word used previously for the target was never repeated during the test phase. Children indicated their choices by pointing. She then elicited a second choice on each page by asking, 'Can you find one more?' She proceeded through all 12 trials in this fashion.

### Scoring

Children's first and second choices were recorded for each page (trial). For a first choice, the probability of choosing taxonomically (or thematically) is 0.50. For a second choice, one must consider the conditional probability of choosing a particular item given the choices that remain after the first selection. The probability of making consistent taxonomic (or thematic) selections on both first and second choices is 0.17 (0.50 for the first choice  $\times$  0.33 for the second); the probability of making a taxonomic choice followed by a thematic choice (or vice versa) is 0.33 (0.50 for the first choice  $\times$  0.67 for the second).

### Results and discussion

Children's expectations were robust even after a 30 s delay. As predicted, children who heard the target labeled with a count noun before the delay revealed a consistent preference for the taxonomic alternatives later at test. Children who heard the target labeled with a novel adjective, and those who heard no novel words, preferred the color-matched thematic alternatives. The mean response patterns for each condition are depicted in Table 2.

We first compared the proportion of trials in which children selected the taxonomic alternatives consistently on both their first and second trials. This provides a strong test of the noun-category bias because it permits us to ascertain when children are selecting all and only

**Table 2** Proportions of (a) consistently taxonomic (tax-tax) and (b) consistently thematic (them-them) responding as a function of condition

Trial	tax-tax		them-them	
	<i>M</i>	SD	<i>M</i>	SD
Experiment 1				
Novel noun	0.59*	0.22	0.06*	0.06
Novel adjective	0.11	0.12	0.56*	0.29
No word	0.16	0.19	0.49*	0.37
Experiment 2				
Novel noun	0.31†	0.21	0.28	0.22
Novel adjective	0.13	0.13	0.55*	0.30

Note: Asterisks and daggers refer to *t* tests against the expected (chance) level of responding: †  $p < 0.05$ , one-tailed; \*  $p < 0.05$ , two-tailed.

the taxonomically related alternatives. A one-way analysis of variance (ANOVA) on this dependent variable revealed a main effect for condition,  $F(2, 33) = 25.03$ ,  $p < 0.0001$ . Children in the 'novel noun' condition were more likely to consistently select both taxonomic alternatives ( $M = 0.59$ ) than were children in either the 'novel adjective' ( $M = 0.11$ ) or the 'no word' ( $M = 0.16$ ) conditions, Tukey honestly significant difference (HSD), both  $p < 0.0001$ . Performance in the last two conditions did not differ. Moreover, children in the 'novel noun' condition selected both category members more often than would be expected by chance (0.17),  $t(11) = 6.69$ ,  $p < 0.0001$ ; performance in the 'novel adjective' and 'no word' conditions did not differ from chance.

The high proportion of consistently taxonomic responses in the 'novel noun' condition is consistent with the prediction that novel nouns focus attention on object categories, even in the face of a delay. However, it is also possible that the novel nouns exerted a more general effect, prompting children to choose consistently across both trials, regardless of the particular type of response. If this were the case, children in the 'novel noun' condition would also exhibit a high proportion of consistently color-matched thematic (them-them) responses. As can be seen in Table 2, this was not the case. Children hearing novel nouns rarely selected both thematic alternatives. An ANOVA based on consistently thematic performance revealed a main effect for condition,  $F(2, 33) = 11.85$ ,  $p < 0.0001$ . Children in the 'novel noun' condition were less likely to consistently select both color-matched thematic alternatives than were children in either the 'novel adjective' ( $M = 0.56$ ) or the 'no word' ( $M = 0.49$ ) conditions, Tukey HSD, both  $p < 0.0001$ . This rules out the possibility that novel nouns elicited a general tendency to make consistent selections in this task. It also indicates that children in

both the 'novel adjective' and 'no word' conditions were drawn to the color-matched thematic alternatives.

Finally, to gain a richer appreciation of performance, we examined each individual child's pattern of response. Children were credited with a *consistently taxonomic* pattern if they selected only taxonomic alternatives (tax-tax) at a rate that both (a) exceeded chance (0.17) and (b) exceeded the rate of consistent thematic responding (them-them) by a 2:1 margin. Children were credited with a *consistently thematic* pattern if they selected only thematic alternatives (them-them) at a rate that both (a) exceeded chance (0.17) and (b) exceeded the rate of consistent taxonomic responding (tax-tax) by a 2:1 margin. Children were credited with an *inconsistent* pattern if neither of the above-mentioned conditions were met. Table 3 reveals that 79% (11/14) of all *consistently taxonomic* children were in the 'novel noun' condition. If the incidence of consistently taxonomic performance had been equally distributed across conditions, we would expect to find 33% (4.6/14) of the consistently taxonomic children in this cell. The distribution of children displaying *consistently taxonomic* versus *consistently thematic* performance varied reliably as a function of condition,  $\chi^2 = 20.91, p < 0.001$ . These individual analyses provide additional evidence that count nouns draw children's attention toward object categories and away from the color-matched thematic alternatives favored by their peers in both the 'novel adjective' and 'no word' conditions.

These results extend previous work in several ways. Children's specific expectation that count nouns (but not adjectives) refer to object categories is robust enough to guide both their first and second sets of choices, even after a delay and even in the presence of color-matched, thematic alternatives. Children hearing novel adjectives and no novel words prefer the color-matched thematic alternatives.<sup>3</sup> It is striking that the novel nouns focused attention specifically on object categories, to the exclusion of these color-based commonalities or thematic relations favored by children in the 'novel adjective' and 'no word' conditions. This suggests that children expect count nouns to map to object categories in particular, rather than to systematic relations more generally.

<sup>3</sup>Note that although performance in the 'novel adjective' condition is consistent with evidence that children expect novel adjectives to refer to properties of objects (cf. color), the results of these experiments do not provide unambiguous evidence for this specific claim, because performance in the 'novel adjective' condition did not differ from that in the 'no word' condition. Children's preference for the color-matched thematic alternatives in the 'no word' condition is probably a consequence of the fact that these were related to the target in two salient and distinct ways.

**Table 3** Number of individual children in each condition revealing consistently taxonomic patterns, no consistent pattern, or consistently thematic patterns of response in Experiment 1 (30 s delay) and Experiment 2 (1 h delay)

Trial	Consistently taxonomic	No consistent pattern	Consistently thematic
Experiment 1			
Novel noun	11	1	0
Novel adjective	1	2	9
No word	2	2	8
Experiment 2			
Novel noun	5	1	3
Novel adjective	1	0	8

We also conducted a subsequent follow-up study, using the same procedure as in Experiment 1, but this time imposing a delay of 60 s between the introduction of the novel word and the child's opportunity for extension. Performance in the 'novel noun', 'novel adjective' and 'no word' conditions revealed the same pattern of results, even with this longer delay.

## Experiment 2

In Experiment 2, we impose a delay of one full hour between the introduction of the novel word and the child's opportunity for extension.

### Method

#### Participants

Eighteen children (mean age 3 years; 9 months, ranging from 3;2 to 4;8) participated. All were enrolled in preschool programs serving racially mixed, middle-class populations in the Greater Chicago area. Approximately equal numbers of males and females were assigned to either a 'novel noun' or a 'novel adjective' condition, for a total of nine children for each condition.<sup>4</sup>

### Stimuli

Identical to those used in Experiment 1.

<sup>4</sup>Because performance in both control conditions (the 'no word' and 'novel adjective' conditions) was at chance in both Experiment 1 (30 s delay) and in the follow-up study (60 s delay), we decided to include only one control condition – the 'novel adjective' condition – in Experiment 2.

### Procedure

The procedure was modified to accommodate the hour-long delay. During a single introduction phase, the experimenter presented and labeled all 12 of the targets, one at a time. Although all four alternatives were present on each page during the introduction phase, the experimenter did not draw attention to these. This introduction was followed immediately by an interference/delay phase, in which children returned to their classrooms to join in the various activities. After a full hour had elapsed, the experimenter brought children back to the testing area, reminding them that Tiki (the puppet) spoke a different language. During the test phase, she directed the children's attention to each target and reminded them that Tiki had his own 'special words', but she was careful not to mention any of these words. (Neither did the children volunteer the specific novel words at test.) On each page, the experimenter pointed to the target and asked, 'Can you find another one on this page?' After the child indicated a choice, the experimenter elicited a second choice for that page. The test phase proceeded in this fashion for all 12 trials.

### Scoring

Identical to Experiment 1.

### Results and discussion

Despite the fact that all novel words had been introduced a full hour before test, children's specific expectations regarding count nouns and object categories held up. See Table 2.

As predicted, children in the 'novel noun' condition ( $M=0.31$ ) were more likely than those in the 'novel adjective' condition ( $M=0.13$ ) to consistently select the taxonomic alternatives, paired  $t(8)=2.56$ ,  $p<0.05$ . Performance in the 'novel noun' condition exceeded the rate expected by chance, using a one-tailed test,  $t(8)=1.96$ ,  $p<0.05$ . Performance in the 'novel adjective' condition did not differ from chance.

We next tested the hypothesis that the high proportion of consistently taxonomic responses in the 'novel noun' condition is a consequence of a specific expectation that count nouns refer to object categories, rather than a more general expectation that count nouns prompt children to choose consistently across trials, regardless of the particular type of response. If this were the case, then children in the 'novel noun' condition would exhibit a high proportion of consistently color-matched thematic (them-them) responses as well.

However, as is evident in Table 3, this was not the case. Children in the 'novel noun' condition consistently selected both color-matched thematic alternatives less often than did their age-mates in the 'novel adjective' condition, paired  $t(8)=2.28$ ,  $p=0.05$ . Children in the 'novel adjective' condition selected these alternatives more often than would be expected by chance,  $t(8)=3.83$ ,  $p=0.005$ ; those in the 'novel noun' condition did not differ from the chance level. Thus, novel nouns (but not adjectives) specifically highlighted the taxonomic (but not the color-matched thematic) alternatives.

Finally, an analysis based on each individual child's response pattern lends additional support for the claim that count nouns direct children's attention toward taxonomic relations and away from the color-matched thematic alternatives favored by their peers in the 'novel adjective' condition. See Table 3. Eighty-three per cent (5/6) of all children displaying a *consistently taxonomic* pattern were in the 'novel noun' condition. The distribution of children displaying *consistently taxonomic* versus *consistently thematic* performance varied reliably as a function of condition,  $\chi^2=4.90$ ,  $p<0.05$ .

In sum, even with an hour-long delay, children revealed a specific expectation that a novel count noun (but not an adjective), applied ostensibly to an individual object, can refer to that object and to other members of the same superordinate level object category. Count nouns did not highlight either color-based commonalities or thematic relations.

### General discussion

The link between count nouns and object categories is not a fleeting phenomenon that fades rapidly over time. Instead, this link is sufficiently robust to hold up even when an hour-long delay has been imposed between a naming episode and the child's opportunity for extension. This is an important theoretical and empirical advance because it reveals the power of the noun-category bias in situations that begin to approximate scenarios in which children are introduced to a novel word at one moment but may not have an opportunity to extend it until later.

To capture this phenomenon experimentally, we introduced children to each target and then engaged them in games (Experiment 1) or returned them to their classrooms to participate in ongoing activities (Experiment 2). Later, during the test period, the experimenter pointed to the target, *but did not re-name it*, and simply asked children to 'find another one'. The

results were clear. Even with delays and distractions lasting an hour, the presence of a novel noun during the introduction phase was powerful enough to influence children to consistently choose other members of the same object category as the (previously named) target. This constitutes a clear replication and extension of previous work documenting preschool-aged children's specific expectation that count nouns (but not adjectives) will refer to object categories (but not to the color-based commonalities or thematic relations favored by children in the other conditions).

The current results reveal the power of the noun-category bias, even in the face of significant delays. Additional work will be necessary to document the processes that underlie this phenomenon. It seems unlikely, particularly after an hour-long delay, that children would retrieve the *specific* novel name used with each target object and then use this name to guide their selections during test. Instead, we suspect that the influence of novel nouns is a consequence of a more abstract link between count nouns and object categories. We suspect (1) that novel nouns highlighted object categories when they were introduced, and (2) that this effect was powerful enough to guide the selection of other category members later, at test. Indeed, we suspect that children will extend novel nouns to include additional category members, even those that are not present when the novel nouns are introduced.

In the natural course of events, children encounter a world filled with novel words, objects, and a vast set of possible mappings between the two. Preschool-aged children reveal a lasting expectation that a novel noun (but not a novel adjective), applied ostensibly to an object, will refer to that object and can be extended to other members of the same object category. They do not extend novel nouns to color-based commonalities or to salient thematic relations involving the named object. The noun-category bias affords a substantial advantage in word learning and category development, for it guides children toward object categories in the context of hearing novel count nouns. This advantage persists well beyond the labeling episode itself.

Most important, these experiments begin to establish the power of the noun-category bias in situations that approximate some of the very real challenges that children face in mapping and extending novel words. In future work, it will be important to examine the impact of the noun-category bias in a still broader range of circumstances, to examine the effects of imposing delays on younger word learners, and to examine how children's expectations involving other syntactic categories fare over time.

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