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24-Month-Old Infants’ Interpretations of Novel Verbs and Nouns in Dynamic Scenes

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Abstract
Recent evidence reveals that infants share with mature language users an expectation that different kinds of words (e.g., nouns, adjectives) refer to different aspects of a scene (e.g., object categories, object properties). Infants’ expectations for nouns and adjectives have been demonstrated, but the developmental trajectory underlying infants’ discovery of verbs has been more elusive. Although infants begin to produce verbs spontaneously by roughly 24 months, they show surprising verb-learning difficulties in experimental tasks, many of which persist well into the preschool years. The goal of these two experiments was to clarify the breadth and precision of 24-month-old infants’ mappings of novel verbs and nouns. We presented dynamic scenes (e.g., a man waving a balloon), and asked a) whether infants could construe these scenes flexibly, noticing the consistent action (e.g., waving) as well as the consistent object (e.g., the balloon) and b) whether their construals would vary with the grammatical form of the novel word used to describe the scene. Results revealed that infants successfully mapped novel nouns to object categories and novel verbs to event categories. Moreover, infants’ representations of word meaning were sufficiently abstract to permit them to extend novel verbs and nouns appropriately beyond the precise scenes on which they had been taught.

Keywords: language acquisition, word learning, concept development
24-Month-Old Infants’ Interpretations of Novel Verbs and Nouns in Dynamic Scenes

How do infants discover that there are distinct kinds of words (e.g., nouns, verbs, adjectives) and that each brings with it a distinct set of semantic consequences? Speaking broadly, they must somehow discover that nouns refer to categories of objects, adjectives to properties of objects and verbs to categories of events and relations. At the onset of word learning, infants do not yet concern themselves with these distinctions. Instead, they enter the process with a broad initial expectation that links words in general (independent of their grammatical form) to a wide range of candidate meanings (including, for example, individual objects (e.g., Mommy, Fido), categories of objects (e.g., bottles, balls), properties of objects (e.g., soft, hot), and relations or actions in which they are engaged (e.g., holding, running) (Waxman & Booth, 2003; Waxman & Lidz, in press).

From the perspective of the learner, this initially broad expectation offers an important developmental advantage: because different languages make use of different sets of grammatical categories and because they use these to carve up semantic space in slightly different ways (Baker, 2001; Croft, 1991; Frawley, 1992; Gentner & Goldin-Meadow (Eds.), 2003; Imai & Haryu, 2004; Lucy & Gaskins, 2001), it is to the learner’s advantage to begin with the most general of expectations, one that highlights a range of commonalities and enables the learner to break into the system of word learning in the first place. But it is also to the learner’s advantage to fine tune these general expectations in accordance with their native language. The evidence suggests that by 14 months of age, this fine tuning has begun, and that at this developmental point, infants have begun to tease apart the nouns from other grammatical forms (e.g., adjectives) and map them specifically to object categories and not their surface properties (e.g., color, texture) (Booth & Waxman, 2003; Waxman, 1999; Waxman & Booth, 2003; Waxman & Braun,
2005; Waxman & Markow, 1995). However, at this same point, infants maintain a broader expectation for words from other grammatical categories. For example, 14-month-old infants interpret novel adjectives quite broadly, mapping them to either object categories or object properties (Booth & Waxman, 2003; Waxman, 1999). By roughly 21 months, infants have successfully carved out a more precise expectation for adjectives, linking them specifically to properties (and not categories) of objects (Mintz, 2005; Mintz & Gleitman, 2002; Waxman & Markow, 1998). Thus, over the second year of life, infants’ initially broad expectation linking words to meaning becomes increasingly refined as infants discover which grammatical forms are represented in their native language and how each is recruited to convey meaning.

The evidence for this developmental progression is now robust. However, the research to date has focused on a limited range of grammatical forms. Although considerable attention has been devoted to documenting the evolution of infants’ expectations for nouns and adjectives, the developmental trajectory underlying infants’ discovery of another fundamental grammatical form – verb – has been more elusive (e.g., Bloom, Tinker, & Margulis, 1993; Bloom, 2000; Booth & Waxman, 2003; Gasser & Smith, 1998; Gleitman, Cassidy, Nappa, Papafragou, & Trueswell, 2005; Golinkoff et al., 2000; Hall & Belanger, 2005; Hall & Lavin, 2004; Hall & Waxman, 2004; Hollich, Hirsch-Pasek, & Golinkoff, 2000; Mintz & Gleitman, 2002; Waxman & Booth, 2001; Waxman & Braun, 2005; Waxman & Lidz, in press; Woodward & Markman, 1998; Xu, 2002). As a result, it is still unclear whether infants’ specific expectations for verb meaning emerge early (as is the case for nouns) or evolve more slowly (as is the case for adjectives). Because verbs are universally represented across languages, and because they play a pivotal role in grammatical knowledge, it is often assumed that infants’ expectations for verbs emerges early, as is the case for nouns.
However, a review of the theoretical literature suggests that this might not be the case. First, despite the universality of the category verb, languages differ substantially in the particular aspects of events that are lexicalized within the verb system (Berman & Slobin, 1994; Navarro & Nicoladis, 2005; Talmy, 1985, 2000). Cross-linguistic differences like these are directly relevant to acquisition, for if learners are to establish appropriate links between the verbs in their language and their meaning, they must first discover which components of meaning are incorporated into verbs in the language they are acquiring (Gentner, 1978; Hohenstein, 2001; Naigles & Terrazas, 1998; Oh, 2004; Papafragou, Massey, & Gleitman, 2002). Second, infants’ expectations for verbs may, in fact, depend upon the prior acquisition of (at least some) nouns. Because verbs express relations between objects and events, it is reasonable to assume that identifying a verb’s meaning will depend on the prior identification of the phrases that represent the objects (Gillette, Gleitman, Gleitman, & Lederer, 1999; Gleitman et al., 2005; Snedeker & Gleitman, 2004; Waxman & Lidz, in press). Simply put, verbs require arguments and noun phrases represent those arguments. Hence, without the nouns, it would be impossible to identify the arguments of a verb and therefore its meaning.

A review of the empirical evidence also suggests that infants’ specific expectations for verbs may follow a more protracted developmental course than their expectations for nouns. For example, at roughly 12 months, infants begin to produce a substantial number of words, but these are predominantly nouns, or to be more precise, words that refer to the kinds of concepts that are generally marked by nouns. It is not until roughly 24 to 30 months that infants begin to produce a sizeable number of verbs as well, and to use them systematically to refer to actions (e.g., eat, run), mental states (e.g., want, see) and relations (e.g., touch, move) (Bates et al., 1994; Caselli et al., 1995; Fenson et al., 1994; Gentner, 1981; Nelson, 1973).
Experimental evidence leads to the same conclusion as these observational studies of lexical development. Several different laboratories using several different experimental tasks reveal successful noun learning in infants as young as 9 to 14 months of age (Balaban & Waxman, 1997; Fulkerson, 1997; Fulkerson & Haaf, 2003; Hollich et al., 2000; Schafer, 2005; Waxman, 1999; Waxman & Braun, 2005; Woodward & Hoyne, 1999; Xu, 2002). In sharp contrast, in experimental verb-learning tasks, learners show surprising difficulties, many of which persist as late as three to five years of age, despite the fact that by 24 months they have begun to use verbs spontaneously and appropriately (Abbot-Smith, Lieven, & Tomasello, 2004; Behrend, 1995; Childers & Tomasello, 2001; Echols & Marti, 2004; Forbes & Farrar, 1993; Forbes & Poulin-Dubois, 1997; Golinkoff et al., 2000; Golinkoff, Jacquet, Hirsh-Pasek, & Nandakumar, 1996; Hirsh-Pasek, Golinkoff, Maguire, & Imai, 2005; Imai, Haryu, & Okada, 2003; Imai, Haryu, & Okada, 2005; Kersten & Smith, 2002; Maguire et al., 2002; Rice, 1980; Theakston, Lieven, Pine, & Rowland, 2001; Tomasello, 1992).

Moreover, even in those tasks in which infants successfully map novel verbs to events, important questions remain concerning the breadth and precision of these mappings. For example, one productive line of research has sought to identify when infants succeed in linking a novel verb to an event (and not to the objects participating in the event) (Ariyama, Oshima-Takane, Katerelos, & Poulin-Dubois, 2005; Casasola & Cohen, 2000; Werker, Cohen, Lloyd, Casasola, & Stager, 1998). Evidence from infants acquiring English, French and Japanese converge to suggest that by 18 – 24 months, infants successfully establish word-event associations. However, in most of these studies, the novel words were presented in isolation (e.g., “Blicking!”), stripped of any sentential context and of any linguistic evidence regarding their grammatical form. This design feature is important for three related reasons: First, in
English, words presented in isolation tend not to be nouns or verbs, but to be exclamations ("No!", "Stop!"). Second, infants interpret words in isolation differently than words presented in sentential context (Fennell, in press; Namy & Waxman, 2000). Third, although infants’ ability to pair novel isolated words with events is impressive, the relevance of this pairing to the process of verb-learning must be interpreted with caution. It is unclear whether infants’ performance reflects a specific expectation linking verbs to actions, or a more general expectation linking any novel word to an action.

In another program of research, researchers have taken a subtly different perspective. Focusing expressly on verbs, these researchers have presented novel verbs within syntactic frames that render their grammatical assignment unambiguous and have asked whether infants are able to use this syntactic information to help them discover which candidate event is being labelled by a novel verb (Bunger & Lidz, in press; Fisher, 1996; Gropen, Pinker, Hollander, & Goldberg, 1991; Maguire et al., 2002; Naigles, 1990, 1996; Naigles & Kako, 1993; Wagner, 2002; Wagner & Carey, 2003). Several studies have converged on the finding that by 24 months of age, infants are sensitive to different syntactic contexts on which verbs appear (e.g., transitive vs. intransitive frames) and use these contexts to guide their interpretation of verb meaning (e.g., a causal vs. non-causal event). In these studies, infants typically are presented with two different events and asked which event is being labelled by the novel verb. Notice that because the only candidate meanings offered are events, this design leaves open the question of whether infants might also map verbs more broadly to include meanings outside the domain of events (e.g., to object categories or even object properties).

Summarizing to this point, the breadth and precision of infants’ word-event mappings remains unclear. On the word side, although there is evidence that infants can successfully link a
novel word to an event, it is unclear whether this word-action link is specific to verbs. In the absence of experimental evidence comparing infants’ interpretations of verbs to their interpretations of words from any other grammatical category (e.g., noun, adjective), it is unclear whether they might also map novel words from other grammatical categories to events. On the event side, matters are also rather unspecified. In most of the previous work on verb learning, the only candidate meanings presented were events. In the absence of candidate meanings from other semantic classes, it is unclear whether infants might also map verbs to a broader range of meanings.

In the current experiments, our goal was to clarify the breadth and precision of 24-month-old infants’ mappings of novel words presented as verbs and nouns. We presented infants with dynamic scenes (e.g., a man waving a balloon), and asked a) whether infants could construe these scenes flexibly, noticing the consistent action (e.g., waving) as well as the consistent object (e.g., the balloon) and b) whether their construals would vary systematically as a function of the grammatical form of a novel word used to describe the scene. This set of manipulations enables us to determine whether verbs map only onto event categories and whether it is only verbs that do so.

We made several design decisions in selecting stimuli. First, to clarify the semantic roles of the event participants, all scenes involved animate agents acting upon inanimate patients. Second, to ensure that the actions would be present consistently throughout the entire trial, as were the objects, all actions were continuous (e.g., pet, wave) rather than fleeting (e.g., drop, slap). Third, to reduce the number of potential referents of each novel word, the same agent (e.g., the man) appeared in every scene within a given trial (see below). Finally, to examine the influence of language, infants in each experiment were randomly assigned to a Verb, Noun, or
No Word (control) condition. If infants have specific expectations for both verbs and nouns, then they should map words from these grammatical categories differently, mapping verbs specifically to event categories and nouns specifically to object categories.

Experiment 1: Mapping Words to Event Categories

In this experiment, 24-month-old infants were familiarized to a series of dynamic event scenes in which an animate agent (e.g., a man) performed a continuous action (e.g., waving) on an inanimate object (e.g., a balloon). At test, infants were presented with a two scenes simultaneously: a familiar test scene (e.g., the man waving the balloon) and a novel test scene involving a novel action (e.g., the man tapping the balloon). Infants were assigned randomly to a Verb, Noun, or No Word condition. We asked (1) whether 24-month-olds noticed the consistent actions depicted during familiarization and detected the novel action presented at test, (2) whether they mapped novel words onto consistent elements of these dynamic action scenes, and (3) whether their mappings were influenced by the grammatical form of the novel word to which they were exposed.

Method

Participants

Seventy-two 24-month-olds (32 males) with a mean age of 23.84 months (range: 22.14 to 26.05) were included in the final sample. All were recruited from Evanston, IL and its surrounding communities and were acquiring English as their native language. Infants were from primarily Caucasian middle- and upper-middle-class families. Parents completed the MacArthur Short Form Vocabulary Checklist: Level II - Form A (Fenson et al., 2000) and the infants’ mean production vocabulary was 57 words (ranging from 22 to 99); there were no differences in vocabulary among the conditions. An additional 13 infants were excluded due to: fussiness (n = 7), parental interference (n = 3), and experimenter error or technical difficulty (n = 3).
**Materials**

*Visual stimuli.* We began by creating digitized video recordings of live actors performing a series of continuous actions on objects. These were edited to create the series of action sequences described in Table 1. These action sequences were approximately 1 min in duration and were presented to infants against a black background, on either side of a 61 in. (155 cm) screen.

*Auditory stimuli.* A female native speaker of American English adopted an infant-directed speech register to produce the speech stimuli described in Table 1. We recorded her utterances in a sound-attenuated booth. These utterances were edited to control timing, duration, peaks, etc. and were then synchronized with the visual stimuli. The auditory stimuli, which varied as a function of condition (see below) were presented on a speaker that was centered on the visual display. See Appendix B for full set of stimuli and Table 1 for a representative sample.

**Apparatus and Procedure**

Infants and caretakers were welcomed into a laboratory playroom. While the infant played freely with toys, the caretaker signed a consent form and completed the MCDI. Next, the experimenter escorted the infant and caretaker into an adjoining test room (14 ft x 10 ft (4.3 m x 3.0 m)) where the infant was seated in an infant-seat, 6 ft (1.8 m) directly in front of the screen. The caretaker, seated either behind or beside the infant, was instructed not to talk or to influence the infant’s attention in any way. The experimenter then moved behind the screen to control the experimental procedure (described below). Throughout the procedure, infants’ looking behavior was recorded (for subsequent coding) with a video camera that was centered above the screen. Sessions lasted approximately 15 min.

The procedure itself included three distinct phases: a familiarization, contrast, and test phase (see Table 1). Each infant completed this three-phase procedure six different times. Each trial
involved a different sequence of scenes (e.g., a man waving a balloon, a girl petting a dog). See Appendix A for a complete description of the scenes in each trial. To capture infants’ attention at the beginning of each trial, a still photo of a smiling infant appeared at the center of the video screen for 4 s, accompanied by an audio track of an infant giggling. Trials were presented in one of two random orders, balanced across conditions. The left-right position of the familiar and novel test scenes was counterbalanced across trials.

Infants were randomly assigned to either the Verb, Noun, or No Word condition. Infants in all conditions saw exactly the same video scenes. What varied across conditions was the audio stimulus, as in Table 1.

Familiarization phase. (26 s) During the familiarization phase, infants in all conditions saw four scenes, presented one at a time on alternating sides of the screen. Each scene depicted the same actor (e.g., a man) performing the same action (e.g., waving) on one of four different objects of the same kind (e.g., four different balloons). The accompanying audio varied as function of condition. For example, in the Verb condition, they heard, “Look! The man is larping a balloon”; in the Noun condition, infants heard, “Look! The man is waving a larp”; in the No Word condition, they heard “Wow! Look what’s happening here.”

Contrast Phase. (14 s) Next, infants saw two scenes, presented one at a time in the center of the screen. Both scenes involved the now-familiar actor (e.g., the man). In the first contrast scene, this actor performed a novel action on a novel object (e.g., the man played a saxophone). On the accompanying audio, the female speaker projected a distinctly disappointed tone, but her comments varied as function of condition. In the Verb condition, she referred to the novel action saying, e.g., “Uh oh. He’s not larping that”. In the Noun condition, she referred to the novel object saying, e.g., “Uh oh. That’s not a larp”. In the No Word condition, she offered a generic comment (“Uh-oh.
Look at that”). In the second contrast scene, infants saw a familiar scene, selected randomly from the original familiarization phase (e.g., the man waving a balloon). On the accompanying audio, the female speaker adopted a cheerful tone, exclaiming, for example, “Yay, he is larping that” (Verb condition), “Yay, that is a larp” (Noun condition), or “Yay, look at this!” (No Word condition).

**Test Phase.** (12 s) Finally, infants in all conditions were presented with two test scenes, presented simultaneously on either side of the screen. Both involved the same actor (e.g., the man) and the same object (e.g., the balloon) as had been presented during familiarization; what varied was the action in which these were involved. In the familiar test scene, the man performed the now-familiar action (e.g., man waving a balloon); in the novel test scene, he performed a novel action (e.g., man tapping a balloon).

The test phase was divided into two distinct periods, one to assess infants’ baseline performance (4 sec) and another to assess infants’ response to a comprehension probe (8 sec) (also see Waxman & Booth, 2001). In the baseline period, the two test scenes were presented in concert with the same audio in all conditions (“Now look. They’re different”). Next, the screen went blank (.33 s). In the response period, the two test scenes reappeared, but the accompanying audio varied as a function of condition. In the Verb condition, the test questions contained the same novel verb that had been introduced during familiarization (e.g., “Which one is he larping?” or “Where is he larping something?”). In the Noun condition, the test question contained the same novel noun that had been introduced during familiarization (e.g., “Which one is a larp?” or “Where is a larp?”).1 In the No Word condition, the test question contained no novel word (e.g., “What do you see now?”).

**Coding**

The videotaped sessions were coded off-line with sound removed to ensure that coders, who were blind to the experimental hypotheses and the right-left position of the novel and
familiar test scenes, were also blind to condition assignment. Coders identified for each frame (30 frames per s), whether the infant’s eyes were oriented to the left scene, the right scene, or neither scene. This frame-by-frame coding permitted us to create two types of measure.

First, we created a high-resolution record of the time-course of infants’ looking behavior throughout the test phase. We calculated for each infant on each frame, the proportion of looks directed toward the familiar test scene (total number of looks devoted to the familiar test scene, divided by the total number of looks to the familiar and to the novel test scene) across trials. We then computed an average, across infants for each frame in each condition, to produce a high-resolution record of the time-course of infants’ looking behavior in each condition.

Second, for the purposes of statistical analysis, we selected two 3 second ‘windows’, one from the baseline period, and another from the response period. The baseline window included the last 3 seconds of the baseline period; the 3 second response window began with the onset of the novel word. Within each window, we calculated for each infant and each trial, the mean proportion of attention devoted to the familiar test scene (total accumulated attention devoted to the familiar test scene divided by the total accumulated attention devoted to both the familiar and novel test scenes).

A primary coder rated all of the infants. A second coder independently rated 9 infants, 3 per condition. For the baseline and response windows, consistency between coders (computed for each trial and then averaged across trials) was excellent (91.4% agreement; Cohen’s kappa = .85).

*Predictions*

If infants are sensitive to the action portrayed in the familiarization scenes, then they should detect the novel action portrayed in the novel test scene, and should therefore reveal a
strong preference for the novel test scene during the baseline window in all conditions. If infants
distinguish between novel words presented as verbs versus count nouns, and if this distinction is
recruited in word learning, then infants’ responses to the test question should vary systematically
as a function of condition. Finally, we suspected that infants’ interpretations of novel words
would become stronger over the course of the experimental session (see Waxman & Markow,
1998 for evidence to this effect with 21-month-olds), and that as a result, distinctions among the
conditions would emerge more clearly on the last three trials (Block 2) than the first three trials
(Block 1).

Verb Condition

If infants expect that verbs refer to categories of events (and not to categories of objects),
then during familiarization they should map the novel verb (e.g., *larping*) to the event category
(e.g., waving) and not to the objects undergoing the action (e.g., balloons). If this is the case, then
in response to the test question (e.g., “Which one is he *larping*?”), they should search for the
familiar *event*. As a result, they should move their attention away from the novel test scene (which
depicts a novel action) and toward the familiar test scene (which depicts the familiar action).

Noun Condition

If infants expect that count nouns refer to categories of objects (and not to categories of
events), then during familiarization they should map the novel noun (e.g., *larp*) to the object
category (e.g., balloons) and not to the action in which they were engaged (e.g., waving). If this is
the case, then in response to the test question (e.g., “Which one is a *larp*?”), they should search for
a familiar *object*. Because the familiar object appears in both the novel and familiar test scenes,
infants could reasonably direct their attention to either.
Notice that this condition may provide information regarding the breadth of infants’ interpretations of novel nouns. If infants are able to map a novel noun to an object category, independent of the actions in which objects are engaged, then they should have no strong preference for either the novel or the familiar test scene. However, it is also possible that infants will be more conservative in their interpretations, preferring to extend a novel noun rather closely to preserve the action-object pairing to which they were introduced during familiarization. If this is the case, then in response to the test question, they should search for the familiar test scene and thus move away from their baseline novelty preference.

No Word (Control) Condition

Infants in this condition should exhibit no change from the baseline to the response window.

Results

Figure 1 displays the continuous time-course of infants’ looking behavior in each condition throughout the test phase. A glance at this timeline offers several impressions. First, during the baseline period, infants in all conditions appear to be captivated by the novel test scene (which involves a novel action). This is consistent with the prediction that infants in all conditions would be sensitive to the actions portrayed in the dynamic familiarization scenes, and would therefore notice the novel action depicted in the novel test scene. Second, during the response period, performance among the three conditions began to diverge, with infants in the No Word control condition maintaining their focus on the novel test scene and those in the Verb and Noun conditions directing increasingly more attention toward the familiar test scene. This is consistent with the prediction that infants’ construals would be influenced by the introduction of novel words.
These impressions are revealing, but they do not get to the heart of the issue, which is to discover (a) whether and how the introduction of novel words affected infants’ construals of the scenes and (b) whether the distinctions among the experimental conditions became more apparent in Block 2 than in Block 1. To address these questions, we conducted an analysis of variance with condition (3: Verb, Noun, No Word) as a between-participants factor and window (2: baseline, response) and block (2: Block 1, Block 2) as within-participants factors. We used the proportion of looking time that infants devoted to the familiar test scene as the dependent measure (see Figures 2a and 2b). This analysis revealed a main effect for Window, \( F(1, 69) = 8.73, p < .005 \); infants looked reliably longer at the familiar scene in the response window \( (M = .42) \) than in the baseline window \( (M = .37) \). There was also main effect for Condition, \( F(2, 69) = 4.61, p < .05 \); infants hearing novel words looked reliably longer at the familiar test scene \( (M = .42 \) and .41 in the Verb and Noun conditions, respectively) than did those in the No Word condition \( (M = .36) \). These main effects were qualified by a reliable Window x Condition interaction, \( F(2, 69) = 3.92, p < .05 \). As predicted, infants in the No Word condition performed comparably in the response and baseline windows \( (M = .36 \) and .37, respectively), \( t(23) = .12, ns \). Also as predicted, infants in the Verb condition looked reliably longer at the familiar scene in the response window than in baseline window \( (M = .48 \) and .36, respectively), \( t(23) = 3.03, p < .01 \). Infants in the Noun condition also displayed this latter pattern \( (M = .44 \) and .37 respectively), \( t(23) = 2.09, p < .05 \).

To further clarify these effects, we conducted a series of planned analyses to consider the relation between performance in the baseline and response windows, for infants in each condition and on each block of trials. As predicted, infants in the No Word control condition demonstrated no change in attention from the baseline to the response window in either Block 1
or Block 2. Also, as predicted, infants in the Verb condition did exhibit a reliable change in attention, devoting more attention to the familiar test scene in the response than in baseline window. In Block 1, the difference between baseline and response was evident ($M = .44$ and .36, respectively), $t(23) = 1.94, p < .05$. But by Block 2, this difference was even more pronounced ($M = .52$ and .37, respectively), $t(23) = 2.79, p < .01$. This suggests that infants did in fact map novel verbs specifically to categories of events, but that this became clearer in the second block of trials. Infants in the Noun condition displayed an intriguing difference in performance in the two blocks. In Block 1, these infants devoted significantly more attention to the familiar test scene in the response than in the baseline window ($M = .46$ and .34, respectively), $t(23) = 3.31, p < .005$. But by Block 2, this difference had disappeared ($M = .42$ and .40, respectively), $t(23) = .49, ns$. This is consistent with the prediction that infants do not consider event categories as possible meanings for nouns.

**Discussion**

The results of this experiment offer three insights regarding word-learning in 24-month-old infants. First, infants’ performance in the baseline period reveals that they are quite sensitive to the consistent actions that were portrayed in the dynamic familiarization scenes and readily detected a change in action category at test. Second, infants’ performance in the response period varied systematically as a function of condition. Third, infants’ distinct patterns of interpretation emerged more clearly over the course of the experimental session as they gained experience with this rather complex mapping task. Taken together, these results suggest that 24-month-old infants distinguish between novel words presented as verbs versus count nouns, and recruit this distinction in mapping words to meaning. These results also raise some intriguing questions.
Consider first the evidence concerning verb meaning. The current results document that by 24 months of age, infants map novel verbs specifically to categories of event, and not to categories of object. However, the breadth of their representation of verb meaning remains unclear. One possibility is that in infants’ representation of verb meaning, the action is fused with the particular object(s) involved in that action. However, it is also possible that in infants’ representations, the action is uncoupled from the participants involved in the actions. This more abstract representation would permit infants to extend novel verbs to instances of the same action, independent of the participants involved. Put differently, the question is whether infants map novel verbs like *larping* narrowly to scenes involving *waving a balloon*, or more abstractly to scenes involving *waving*. In the design of current experiment, we cannot disentangle these possibilities because the test scene in which the familiar action was portrayed always involved the familiar object as well. Therefore, in Experiment 2, we go on to ask whether 24-month-old infants are able to extend a novel verb beyond the action-object pairing on which it was introduced.

The current results also offer insights into infants’ interpretation of novel nouns. Previous work has documented that infants as young as 14 months of age interpret novel count nouns as referring specifically to categories of objects, and not to their surface properties (e.g., color, texture) (Booth & Waxman, 2003; Waxman, 1999; Waxman & Booth, 2001). The results of the current experiment take us one step further: Although these 24-month-old infants were attentive to the categories of action depicted during familiarization, they did not consider these to be candidates for noun meaning. Even in the face of a salient action, infants mapped novel nouns to the object categories.
The current results also shed some light on infants’ treatment of novel nouns in a rather ambiguous situation. Recall that in the current experiment, both the novel and familiar test scenes depicted a member of the familiar object category (e.g., balloon). Therefore, as we have pointed out, if infants did indeed map the novel noun to the object category during familiarization, then either test scene would constitute a correct extension of that noun. Interestingly, infants appear to have resolved this ambiguity differently over the course of the experimental session. In Block 1, they extended the novel nouns narrowly, directing their attention reliably away from their baseline preference for the novel test scene toward the familiar test scene (which preserved the original action-object pairing). In Block 2, they performed differently, maintaining their baseline preference for the novel test scene (which presented a novel action-object pairing).

How can we best interpret this pattern? We suggest that by 24 months, infants’ representations of noun meanings are rather abstract. As they became accustomed to this (ambiguous) task, they reveal these abstract expectations, extending nouns to object categories, independent of the actions in which those objects are engaged. However, before accepting this interpretation, it will be important to rule out an alternative: that infants were unable to resolve the meaning of novel nouns in this ambiguous task, and that as a result, they simply returned to their baseline preference for the novel test scene in Block 2. Experiment 2 was designed to address this issue.

Experiment 2: Mapping Words to Object Categories

Experiment 2 was designed to further clarify the breadth and precision of 24-month-old infants’ interpretations of novel words presented as verbs and nouns. The design was identical to that of Experiment 1, except for one crucial modification in the test scenes. Infants in the current
experiment saw the very same familiarization scenes as in Experiment 1 (e.g., a man waving a balloon), the very same contrast scene (e.g., a man playing a saxophone) and the very same familiar test scene (e.g., a man waving a balloon). However, the novel test scenes were modified: In Experiment 2, the novel test scene involved a novel object (e.g., the man waving a rake) whereas in Experiment 1, it had involved a novel action (e.g., the man tapping the balloon). Infants were assigned randomly to a Verb, Noun, or No Word condition. We asked (1) whether infants noticed the consistent objects presented during familiarization and detected the object change in the novel test scene, (2) whether they mapped novel words onto consistent elements in these dynamic action scenes, and (3) whether their mappings were influenced by the grammatical form of the novel word to which they were exposed.

This design permits us to pursue three issues. First, we can ask whether 24-month-old infants are sensitive to the participant objects that are involved in these dynamic action scenes. If they are, they should detect the novel object and as a result, should reveal a preference for the novel test scene during the baseline window. Second, because only one test scene involves the familiar object, this design provides a direct test of the breadth and flexibility of infants’ interpretation of novel nouns. If they map novel nouns to object categories, independent of the actions in which the objects are engaged, then in response to the test question, infants in the Noun condition should move away from their baseline novelty preference (e.g., man waving a rake) to direct increasing attention toward the familiar test scene (e.g., the man waving the balloon). Finally, the current design permits us to gain some precision concerning infants’ representation of verb meaning. Notice that in this design, the familiar action now appears in both the novel and familiar test scenes. If infants represent novel verbs narrowly, then infants in the Verb condition should preserve the same action-object pairing that they observed in familiarization, and should therefore direct
increased attention to the familiar test scene in response to the test question. Yet if in their representation of verb meaning infants are able to uncouple the action from its participant objects, then they should extend novel verbs more broadly to include instances of an action despite a change in participant objects. If this is the case, then infants in the Verb condition should maintain their focus on the novel test scene in response to the test question.

Method

Participants

Seventy-two 24-month-olds (37 males) with a mean age of 24.08 months (range: 21.64 to 26.25) were included in the final sample. All participants were recruited from Evanston, IL and its surrounding communities and were acquiring English as their native language. Infants were from primarily Caucasian middle- and upper-middle-class families. Parents completed the MacArthur Checklist: Level II - Form A (Fenson et al., 2000) and infants’ mean production vocabulary was 52 words (ranging from 4 to 98) and did not differ among the three conditions. An additional 19 infants were excluded due to: fussiness (n = 13), parental interference (n = 3), or experimenter error/technical difficulty (n = 3).

Materials

The audio and visual materials were identical to those in Experiment 1, with one exception. In Experiment 1, the novel test scene had depicted a novel action (e.g., the man tapping the balloon); in contrast, in Experiment 2, the novel test scene depicted a novel object (e.g., the man waving a rake). As in Experiment 1, participants in all conditions viewed the same video sequences; the accompanying audio input varied as a function of their condition assignment. See Table 2 for a sample representation of the sequence and Appendix A & B for a complete set of stimuli.
Apparatus and Procedure

This was identical to Experiment 1.

Coding

This was identical to Experiment 1. Agreement between coders for the selected windows, calculated for 3 infants in each condition, was excellent (93.5% agreement; Cohen’s kappa = .88).

Predictions

The predictions follow the same logic as those for Experiment 1. If infants are sensitive to the objects portrayed in the familiarization scenes, then they should detect the novel object portrayed in the novel test scene, and should therefore reveal a strong preference for the novel test scene during the baseline window in all conditions. Moreover, if infants distinguish between novel words presented as verbs versus nouns, and if this distinction is recruited in establishing meaning, then infants’ responses to the test question should vary systematically as a function of condition. Finally, infants’ interpretations of novel words should become stronger over the course of the experimental session, and as a result, distinctions among the conditions should emerge more clearly on the last three trials (Block 2) than the first three trials (Block 1).

Verb Condition

If 24-month-old infants expect that verbs refer to categories of events (and not to categories of objects), then during familiarization, they should map the novel verb (e.g., larping) to the action (e.g., waving) and not to the object undergoing the action (e.g., the balloon). Recall that in this experiment, the familiar action (e.g., waving) is depicted in both the novel and familiar test scenes. This permits us to consider the breadth of infants’ representations of verb meaning. If infants fuse the action with its participants, then they should map each novel verb narrowly to the action-object
pairing presented during familiarization. As a result, in response to the test question (“Which one is he larping?”) infants should move their attention reliably away from the novel test scene (which depicts a novel object) and toward the familiar test scene (which depicts the original object-action pairing). If, on the other hand, infants are able to uncouple the action from its participants, then they should map the novel verb to the familiar action, independent of the objects involved. If this is the case, then in response to the test question, infants could reasonably direct their attention to either the novel or the familiar test scene because the familiar action appears in both.

Noun Condition

If infants expect that nouns refer to categories of object (and not to categories of events), then during familiarization, they should map the novel noun (e.g., larp) to the object (e.g., the balloon) and not the action in which it is engaged (e.g., waving). Therefore, in response to the test question (e.g., “Which one is a larp?”), they should search for the familiar object. As a result, infants should shift their attention from the novel test scene (which depicts a novel object) toward the familiar test scene (which depicts the familiar object).

No Word (Control) Condition

Infants in this condition should exhibit no change from the baseline to the response window.

Results

Figure 3 displays the continuous time-course of looking behavior in each condition throughout the test phase. A glance at thus timeline suggests that during the baseline period, infants in all three conditions prefer the novel test scene (which involves a novel object). This is consistent with the prediction that infants in all conditions would detect the novel object presented at test. However, in response to the test question, performance among the conditions
began to diverge, with infants in the No Word and Verb conditions maintaining their focus on the novel test scene and those in the Noun condition directing increased attention to the familiar test scene.

As in Experiment 1, we used the proportion of attention devoted to the familiar test scene as a dependent measure, and submitted this to an ANOVA, with condition (3: Verb, Noun, No Word) as a between-participants factor and window (2: baseline, response) and block (2: Block 1, Block 2) as within-participants factors (see Figures 4a and 4b). This analysis revealed a main effect for Window, $F(1, 69) = 15.40, p < .001$; infants devoted reliably more attention to the familiar test scene in the response than in the baseline window ($M = .37$ and $.39$, respectively). There was also a marginal effect for Condition, $F(2, 69) = 3.12, p = .05$. Overall, infants in the Noun condition devoted more attention to the familiar test scene ($M = .45$) than did their counterparts in either the Verb ($M = .40$) or No Word ($M = .40$) conditions.

As in Experiment 1, we pursued these effects in a series of planned contrasts, comparing the relation between performance in the baseline and response windows, for infants in each condition and on each block of trials. In Block 1, infants in the No Word condition devoted reliably more attention to the familiar test scene in the response ($M = .45$) than in the baseline window ($M = .36$), $t(23) = 2.34, p < .05$. This difference, which was unanticipated, did not persist; by Block 2, infants performed as predicted, revealing no difference in attention in the response and the baseline windows ($M = .42$ and .38, respectively), $t(23) = 1.09, ns$. Performance in the Verb condition mirrored that of the No Word condition. In Block 1, infants devoted more attention to the familiar test scene in the response ($M = .46$) than the baseline window ($M = .37$), $t(23) = 2.63, p < .01$. However, by Block 2, infants performed comparably in the response and the baseline window ($M = .39$ and .37, respectively), $t(23) = 0.49, ns$. This is consistent with the
prediction that infants’ representation of verb meaning is uncoupled from the objects involved in the event and that as a result, infants accept events involving new objects as candidates for verb meaning. Finally, consider performance in the Noun condition. Like their counterparts in the No Word and Verb conditions, in Block 1 these infants devoted significantly more attention to the familiar test scene in the response \( (M = .50) \) than in baseline window \( (M = .40) \), \( t(23) = 2.41, p < .05 \). However unlike their counterparts in the other conditions, this effect held up in Block 2 \( (M = .50 \) and \( .40, \) respectively), \( t(23) = 1.92, p < .05 \). This suggests that infants in the Noun condition did indeed map novel nouns specifically to categories of object.

Discussion

The results of this second experiment fortify the results of Experiment 1. First, performance in the baseline period reveals that infants are sensitive to the consistent objects that were portrayed in the dynamic familiarization scenes and readily detect a change in the object category at test. Second, performance in the response period varied systematically as a function of condition, suggesting that the infants distinguish novel words presented as nouns vs. verbs, treat this distinction as relevant to meaning. Third, infants reveal these distinct mapping from grammatical form to meaning more clearly over the course of the experimental session.

Perhaps more importantly, the current results offer insights into the breadth of infants’ representations of both novel verbs and count nouns. Consider first the evidence concerning verbs. Recall that in the current experiment, the familiar and novel test scenes differ only in the event participants, but not in the events themselves. By Block 2, once infants gained familiarity with this rather complex mapping task, they revealed an ability to extend a novel verb beyond the action-object pairing on which it was introduced. The current results also clarify the breadth of infants’ representations of novel nouns. Recall that the familiar object was present in the
familiar, but not the novel test scene. Infants’ performance in the test phase revealed their ability
to map novel nouns specifically object categories.

General Discussion

Taken together, the results of these two experiments reveal three main findings. First,
infants’ preferences for the novel test scene during the baseline window in each experiment reveals
that they were able to detect the novel element in dynamic scenes, whether it was a novel action
(Experiment 1) or a novel object (Experiment 2). This suggests that in the current experiments,
infants were able to identify the objects in these scenes as well as the relations among them.
Second, with respect to word learning, the results indicate that infants can construe novel words,
applied to these scenes, as referring either to event categories (Experiment 1) or to object categories
(Experiment 2). Finally, and most importantly, the results indicate that infants’ construals are
shaped by the grammatical form of the novel word. They mapped novel nouns to categories of
objects (and not to the actions in which they were engaged) and novel verbs to categories of events
(and not to the participant objects involved). Clearly, then 24-month-old infants distinguish novel
nouns from verbs in continuous speech, and treat this distinction as relevant to establishing the
meaning of novel words.

These experiments also offer insight into the breadth of 24-month-old infants’ expectations
for noun- and for verb-learning. First, the observation that infants interpreted novel nouns (but not
novel verbs) as referring to categories of objects (and not to categories of events) is consistent with
previous evidence suggesting that by 14 months of age, infants map nouns specifically to category-
based commonalities. But, the current results take us one step further because they provide the first
evidence that at 24-months, infants’ focus on category-based commonalities in noun-learning is
sufficiently strong to persist even in the presence of dynamic action scenes, and even when an
action-based commonality is also available.

Second, the current results inform the breadth of infants’ interpretations of verbs. Infants in
the current experiments mapped novel verbs to event categories, and not to the participants
involved in the event. This suggests that infants are able to map novel verbs (e.g., *marping*) onto
event categories (e.g., waving events) that are not fused with the particular participants in the event
(e.g., waving balloons). This outcome stands in contrast to the claim that for young word learners,
the meaning of a verb is initially fused to a particular syntactic frame and to the particular
participant objects involved in an event (Tomasello, 1992). On the verb-island hypothesis, it is only
after hearing the same verb *either* in different syntactic frames or in the same frame with different
participants that the learner can begin to extract a meaning for the verb that is independent of those
participants. Our data provide a rather different view: After having heard a novel verb in
conjunction with only one set of participants, 24-month-old infants extended that verb to a different
scene involving the same action, but different participants. This suggests that in interpreting novel
verbs, infants are indeed able to focus on the relations between event participants, rather than the
participants themselves.

These results open the door for a range of investigations regarding the development and
scope of infants’ word learning abilities. In particular, it will be important in future work to
examine the evolution of infants’ verb-learning ability, asking when infants begin to identify
verbs in the input and when they begin to map verbs specifically to event categories. A key issue
will be whether infants’ specific expectations for verbs emerges early, as is the case for nouns, or
whether it follows a more protracted course (Gillette et al., 1999; Gleitman et al., 2005; Waxman
& Lidz, in press).
Another avenue for future work is to ascertain more precisely the breadth of infants’ early verb meanings. As we have seen, at 24 months, infants’ understanding of verbs is sufficiently abstract to include instances of actions with novel participants. This result stands in contrast to learners’ early understanding of adjectives. The evidence suggests that by 21 months of age, infants acquiring English distinguish novel words presented as adjectives from those presented as nouns (Waxman & Markow, 1998). Nonetheless, at this juncture, they still do not show a fully mature understanding of adjectives (Klibanoff & Waxman, 2000; Mintz & Gleitman, 2002). Instead, they show an initial tendency to extend adjectives narrowly within, but not across, a given basic level category. For example, having learned the adjective “red” applied to a red ball, infants successfully extend the term “red” to other red (but not yellow) balls,, but they fail to extend it to other red things that are not balls (e.g., to red sneakers). It will therefore be important to discover whether infants follow this ‘narrow-to-broad’ developmental pattern in verb-learning as well. In particular, it will be important to discover whether infants younger than 24 months extend novel verbs narrowly, as is the case with adjectives.

The results reported here raise some additional questions regarding the evolution of infants’ establishment of word meaning. On the word side, we can see that infants capitalize on morphosyntactic cues to grammatical category assignment. We can now ask which particular morphosyntactic cues are most effective in cueing the relevant grammatical distinctions (cf. Maratsos, 1998; Mintz, 2003; Mintz, Newport, & Bever, 2002) and when infants’ become sensitive to each cue. In addition, we can ask about the range of syntactic environments that will enable verb-learning. In the current experiments, infants learned transitive verbs (e.g., *larp*) denoting ongoing activities (e.g., waving) that involved two participants (e.g., a man and a balloon). In ongoing research we examine their capacity for learning intransitive verbs (Lidz,
Bunger, Leddon, & Waxman, 2006). Focusing on conceptual matters, it will be important to
discover the whether infants can map verbs to other kinds of events (e.g., punctuate rather than
continuous events) with different numbers of participants and with different temporal or causal
characteristics (cf. Bunger & Lidz, in press; Wagner & Carey, 2003).

In closing, the current experiments provide experimental evidence concerning the breadth
and precision of 24-month-old infants’ mappings of novel words presented as verbs and nouns.
Infants not only distinguish novel nouns from verbs, but also treat this distinction as relevant to
establishing meaning. Moreover, their representations are sufficiently abstract to permit them to
extend novel words appropriately beyond the precise scenes on which they have been introduced.
These findings, which contrast with previous studies in which children up to age five fail to
demonstrate successful verb learning, set the stage for additional developmental and cross-
linguistic work on the origin and evolution of infants’ word-learning capacities.
References


Verbs and Nouns


Author Note

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Footnotes

1 In the design of this experiment, novel words were embedded within two different sentence frames. In the Verb condition, these were “Which one is he/she Xing?” and “Where is he/she Xing something?” In the Noun condition, these were “Which one is a X?” and “Where is a X?” Within each condition, infants heard half of the novel words presented in one frame, and the other half in the other frame. The frames were counterbalanced over trials and presented in alternation. Preliminary analyses revealed that performance in each condition did not differ as a function of these constructions. Therefore, for the sake of simplicity, in the current analyses, we collapse across them in reporting results.

2 In Experiments 1 and 2, statistical comparisons between baseline and response windows in the Verb and Noun conditions are one-tailed, due to the directional component of our predictions.
**TABLE 1**  
Representative set of the stimuli presented in Experiment 1

<table>
<thead>
<tr>
<th>Familiarization</th>
<th>Contrast</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Exp. 1:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Action</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Test</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><img src="image1.png" alt="Man waving balloon" /> (4 consecutive exemplars)</td>
<td><img src="image2.png" alt="Man playing toy saxophone" /></td>
<td><img src="image3.png" alt="Man waving balloon" /></td>
</tr>
<tr>
<td><img src="image4.png" alt="Man waving balloon" /></td>
<td><img src="image5.png" alt="Man waving balloon" /></td>
<td><img src="image6.png" alt="Man tapping balloon" /></td>
</tr>
</tbody>
</table>

**Verb:** “Look, the man is *larping* a balloon!”

**Noun:** “Look, the man is waving a *larp*!”

**No Word:** “Look at this!”

**Verb:** Uh-oh! He’s not *larping* that.

**Verb:** Yay! He is *larping* that.

**Verb:** Now look, they’re different! (Baseline)  
“Which one is he *larping*?” (Response)

**Noun:** Uh-oh! That’s not a *larp*!

**Noun:** Yay! That is a *larp*!

**Noun:** Now look, they’re different! (Baseline)  
“Which one is a *larp*?” (Response)

**No Word:** Uh-oh! Look at that.

**No Word:** Yay! Look at this.

**No Word:** Now look, they’re different! (Baseline)  
“What do you see now?” (Response)
## TABLE 2
Representative set of the stimuli presented in Experiment 2

<table>
<thead>
<tr>
<th>Familiarization</th>
<th>Contrast</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Exp. 2:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Object Test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Man waving balloon (4 consecutive exemplars)</td>
<td>Man playing toy saxophone</td>
<td>Man waving balloon</td>
</tr>
<tr>
<td><strong>Verb:</strong> “Look, the man is <strong>larping</strong> a balloon!” <strong>Noun:</strong> “Look, the man is waving a <strong>larp</strong>!” <strong>No Word:</strong> “Look at this!”</td>
<td><strong>Verb:</strong> Uh-oh! He’s not <strong>larping</strong> that. <strong>Noun:</strong> Uh-oh! That’s not a <strong>larp</strong>! <strong>No Word:</strong> Uh-oh! Look at that.</td>
<td><strong>Verb:</strong> “Now look, they’re different! (Baseline) Which one is he <strong>larping</strong>?” (Response) <strong>Noun:</strong> “Now look, they’re different! (Baseline) Which one is a <strong>larp</strong>?” (Response) <strong>No Word:</strong> “Now look, they’re different! (Baseline) What do you see now?” (Response)</td>
</tr>
<tr>
<td>Familiar Scene</td>
<td>Novel Scene</td>
<td></td>
</tr>
</tbody>
</table>
Figure Captions

Figure 1. Time-course of infants’ looking behavior in each condition for Experiment 1, aggregated over all six trials.

Figure 2a. Mean proportion of looking time towards the familiar test scene as a function of condition in Experiment 1, aggregated over the first three trials (Block 1).

Figure 2b. Mean proportion of looking time towards the familiar test scene as a function of condition in Experiment 1, aggregated over the last three trials (Block 2).

Figure 3. Time-course of infants’ looking behavior in each condition for Experiment 2, aggregated over all six trials.

Figure 4a. Mean proportion of looking time towards the familiar test scene as a function of condition in Experiment 2, aggregated over the first three trials (Block 1).

Figure 4b. Mean proportion of looking time towards the familiar test scene as a function of condition in Experiment 2, aggregated over the last three trials (Block 2).
Which one is a larp?

Which one is he larping?

What do you see now?
Which one is a larp?
Which one is he larping?
What do you see now?
Verbs and Nouns

**Proportion looking towards familiar scene**

- **Verb**: Baseline and Response
- **Noun**: Baseline and Response
- **No Word**: Baseline and Response

- * p < .05

---

**Proportion looking towards familiar scene**

- **Verb**: Baseline and Response
- **Noun**: Baseline and Response
- **No Word**: Baseline and Response

- * p < .05
**APPENDIX A: Complete Sets of Stimuli for Experiments 1 and 2**

<table>
<thead>
<tr>
<th>Familiarization (four consecutive scenes)</th>
<th>Contrast</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Man waving balloon</td>
<td>Playing toy saxophone</td>
<td>Waving balloon</td>
</tr>
<tr>
<td>Woman washing cup</td>
<td>Playing guitar</td>
<td>Washing cup</td>
</tr>
<tr>
<td>Man pushing chair</td>
<td>Bouncing ball</td>
<td>Pushing chair</td>
</tr>
<tr>
<td>Woman twirling umbrella</td>
<td>Lifting hat on head</td>
<td>Twirling umbrella</td>
</tr>
<tr>
<td>Boy pulling bunny</td>
<td>Sweeping floor with broom</td>
<td>Pulling bunny</td>
</tr>
<tr>
<td>Girl petting dog</td>
<td>Drinking from cup</td>
<td>Petting dog</td>
</tr>
</tbody>
</table>

- Familiar scene
- Novel scene
  - Tapping balloon
  - Waving rake
  - Drinking from cup
  - Washing plate
  - Lifting chair
  - Pushing box
  - Spinning umbrella
  - Twirling pillow
  - Tossing bunny
  - Pulling bucket
  - Kissing dog
  - Petting Frisbee

Exp. 1: Action Test
Exp. 2: Object Test
**APPENDIX B:** Complete Sets of Introductory phrases used in Experiments 1 and 2

<table>
<thead>
<tr>
<th>Trial</th>
<th>Familiarization</th>
<th>Contrast</th>
<th>Baseline</th>
<th>Test</th>
<th>Response¹</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Waving Balloon</strong></td>
<td>1) Look, the man is <em>larping</em> a balloon.</td>
<td>2) The man is <em>larping</em> another balloon.</td>
<td>Uh oh!</td>
<td>Yay!</td>
<td>Now look.</td>
</tr>
<tr>
<td>Noun</td>
<td>3) Do you see the man <em>larping</em> a balloon?</td>
<td>4) Look, the man is <em>larping</em> a balloon!</td>
<td>He’s not <em>larping</em> that!</td>
<td>He is <em>larping</em> that!</td>
<td>They’re different.</td>
</tr>
<tr>
<td>No Word</td>
<td>1) Wow, look what’s happening here.</td>
<td>2) Look at this.</td>
<td>Uh oh!</td>
<td>Yay!</td>
<td>Now look.</td>
</tr>
<tr>
<td></td>
<td>3) Do you see that?</td>
<td>4) Hey, look there!</td>
<td>Look at that!</td>
<td>Look at this!</td>
<td>They’re different.</td>
</tr>
<tr>
<td><strong>Washing Cup</strong></td>
<td>1) Look, the girl is <em>semming</em> a cup.</td>
<td>2) The girl is <em>semming</em> another cup.</td>
<td>Uh oh!</td>
<td>Yay!</td>
<td>Now look.</td>
</tr>
<tr>
<td>Verb</td>
<td>3) Do you see the girl <em>semming</em> a cup?</td>
<td>4) Look, the girl is <em>semming</em> a cup!</td>
<td>She’s not <em>semming</em> that!</td>
<td>She is <em>semming</em> that!</td>
<td>They’re different.</td>
</tr>
<tr>
<td>Noun</td>
<td>1) Look, the girl is washing a <em>sem</em>.</td>
<td>2) The girl is washing another <em>sem</em>.</td>
<td>Uh oh!</td>
<td>Yay!</td>
<td>Now look.</td>
</tr>
<tr>
<td></td>
<td>3) Do you see the girl washing a <em>sem</em>?</td>
<td>4) Look, the girl is washing a <em>sem</em>!</td>
<td>That’s not a <em>sem</em>!</td>
<td>That is a <em>sem</em>!</td>
<td>They’re different.</td>
</tr>
<tr>
<td>No Word</td>
<td>1) Wow, look what’s happening here.</td>
<td>2) Look at this.</td>
<td>Uh oh!</td>
<td>Yay!</td>
<td>Now look.</td>
</tr>
<tr>
<td></td>
<td>3) Do you see that?</td>
<td>4) Hey, look there!</td>
<td>Look at that!</td>
<td>Look at this!</td>
<td>They’re different.</td>
</tr>
<tr>
<td><strong>Pushing Chair</strong></td>
<td>1) Look, the man is <em>dacking</em> a chair.</td>
<td>2) The man is <em>dacking</em> another chair.</td>
<td>Uh oh!</td>
<td>Yay!</td>
<td>Now look.</td>
</tr>
<tr>
<td>Verb</td>
<td>3) Do you see the man <em>dacking</em> a chair?</td>
<td>4) Look, the man is <em>dacking</em> a chair!</td>
<td>He’s not <em>dacking</em> that!</td>
<td>He is <em>dacking</em> that!</td>
<td>They’re different.</td>
</tr>
<tr>
<td>Noun</td>
<td>1) Look, the man is pushing a <em>dack</em>.</td>
<td>2) The man is pushing another <em>dack</em>.</td>
<td>Uh oh!</td>
<td>Yay!</td>
<td>Now look.</td>
</tr>
<tr>
<td></td>
<td>3) Do you see the man pushing a <em>dack</em>?</td>
<td>4) Look, the man is pushing a <em>dack</em>!</td>
<td>That’s not a <em>dack</em>!</td>
<td>That is a <em>dack</em>!</td>
<td>They’re different.</td>
</tr>
<tr>
<td>No Word</td>
<td>1) Wow, look what’s happening here.</td>
<td>2) Look at this.</td>
<td>Uh oh!</td>
<td>Yay!</td>
<td>Now look.</td>
</tr>
<tr>
<td></td>
<td>3) Do you see that?</td>
<td>4) Hey, look there!</td>
<td>Look at that!</td>
<td>Look at this!</td>
<td>They’re different.</td>
</tr>
</tbody>
</table>

¹ Each infant heard the following construction “Which one is he/she Xing?” (Verb condition) or “Which one is a X?” (Noun condition) on three of their six trials. On the remaining three trials, the infants heard “Where is he/she Xing something?” (Verb condition) or “Where is a X?” (Noun condition).
<table>
<thead>
<tr>
<th>Trial</th>
<th>Familiarization</th>
<th>Contrast</th>
<th>Baseline</th>
<th>Test</th>
<th>Response¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Twirling</td>
<td>1) Look, the girl is <em>wugging</em> an umbrella.</td>
<td>Uh oh!</td>
<td>Yay!</td>
<td>Now look.</td>
<td>Which one is he <em>wugoing</em>? or Where is he <em>wugoing</em> something?</td>
</tr>
<tr>
<td>Umbrella</td>
<td>2) The girl is <em>wugging</em> another umbrella.</td>
<td>He’s not <em>wugoing</em> that!</td>
<td>He is <em>wugoing</em> that!</td>
<td>They’re different.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3) Do you see the girl <em>wugging</em> an umbrella?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4) Look, the girl is <em>wugoing</em> an umbrella!</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noun</td>
<td>1) Look, the girl is twirling a <em>wugit</em>.</td>
<td>Uh oh!</td>
<td>Yay!</td>
<td>Now look.</td>
<td>Which one is a <em>wugit</em>? or Where is a <em>wugit</em>?</td>
</tr>
<tr>
<td></td>
<td>2) The girl is twirling another <em>wugit</em>.</td>
<td>That’s not a <em>wugit</em>!</td>
<td>That is a <em>wugit</em>!</td>
<td>They’re different.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3) Do you see the girl twirling a <em>wugit</em>?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4) Look, the girl is twirling a <em>wugit</em>!</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Word</td>
<td>1) Wow, look what’s happening here.</td>
<td>Uh oh!</td>
<td>Yay!</td>
<td>Now look.</td>
<td>What do you see now?</td>
</tr>
<tr>
<td></td>
<td>2) Look at this.</td>
<td>Look at that!</td>
<td>Look at this!</td>
<td>They’re different.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3) Do you see that?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4) Hey, look there!</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pulling</td>
<td>1) Look, the man is <em>toping</em> a bunny.</td>
<td>Uh oh!</td>
<td>Yay!</td>
<td>Now look.</td>
<td>Which one is she <em>toping</em>? or Where is she <em>toping</em> something?</td>
</tr>
<tr>
<td>Bunny</td>
<td>2) The man is <em>toping</em> another bunny.</td>
<td>She’s not <em>toping</em> that!</td>
<td>She is <em>toping</em> that!</td>
<td>They’re different.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3) Do you see the man <em>toping</em> a bunny?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4) Look, the man is <em>toping</em> a bunny!</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noun</td>
<td>1) Look, the man is pulling a <em>topin</em>.</td>
<td>Uh oh!</td>
<td>Yay!</td>
<td>Now look.</td>
<td>Which one is a <em>topin</em>? or Where is a <em>topin</em>?</td>
</tr>
<tr>
<td></td>
<td>2) The man is pulling another <em>topin</em>.</td>
<td>That’s not a <em>topin</em>!</td>
<td>That is a <em>topin</em>!</td>
<td>They’re different.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3) Do you see the man pulling a <em>topin</em>?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4) Look, the man is pulling a <em>topin</em>!</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Word</td>
<td>1) Wow, look what’s happening here.</td>
<td>Uh oh!</td>
<td>Yay!</td>
<td>Now look.</td>
<td>What do you see now?</td>
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<tr>
<td></td>
<td>2) Look at this.</td>
<td>Look at that!</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Petting</td>
<td>1) Look, the girl is <em>pilking</em> a dog.</td>
<td>Uh oh!</td>
<td>Yay!</td>
<td>Now look.</td>
<td>Which one is he <em>pikling</em>? or Where is he <em>pikling</em> something?</td>
</tr>
<tr>
<td>Dog</td>
<td>2) The girl is <em>pikling</em> another dog.</td>
<td>He’s not <em>pikling</em> that!</td>
<td>He is <em>pikling</em> that!</td>
<td>They’re different.</td>
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<tr>
<td></td>
<td>3) Do you see the girl <em>pikling</em> a dog?</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>4) Look, the girl is <em>pikling</em> a dog!</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noun</td>
<td>1) Look, the girl is petting a <em>pikler</em>.</td>
<td>Uh oh!</td>
<td>Yay!</td>
<td>Now look.</td>
<td>Which one is a <em>pikler</em>? or Where is a <em>pikler</em>?</td>
</tr>
<tr>
<td></td>
<td>2) The girl is petting another <em>pikler</em>.</td>
<td>That’s not a <em>pikler</em>!</td>
<td>That is a <em>pikler</em>!</td>
<td>They’re different.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3) Do you see the girl petting a <em>pikler</em>?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4) Look, the girl is petting a <em>pikler</em>!</td>
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<td>No Word</td>
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