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# Naming and Exclaiming: Infants' Sensitivity to Naming Contexts

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In three experiments, we examined 17-month-olds' acquisition of novel symbols (words and gestures) as names for object categories. Experiment 1 compares infants' extension of novel symbols when they are presented within a familiar naming phrase (e.g., "Look at this [symbol]!") versus presented alone (e.g., "Look! … [symbol]!") Infants mapped novel gestures successfully in both naming contexts. However, infants mapped novel words only within the context of familiar naming phrases. Thus, although infants can learn both words and gestures, they have divergent expectations about the circumstances under which the 2 symbolic forms name objects. Experiments 2 and 3 test the hypothesis that infants' expectations about the circumstances under which words that name objects are acquired by monitoring how adults indicate their intention to name. By employing a training paradigm, these two experiments demonstrated that infants can infer how an experimenter signals his or her intention to name an object on the basis of a very brief training experience.

Infants possess a powerful, early ability to learn names for objects. By as early as 12 months of age, they successfully map novel words to objects and object categories (Fenson et al., 1994; Waxman & Markow, 1995; Woodward, Markman, &

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Fitzsimmons, 1994). Infants use a variety of cues to determine the meaning of a novel utterance including social referential cues (e.g., pointing and eye gaze), prosody, and sentence structure (Baldwin, 1993a, 1993b; Baldwin & Markman, 1989; Baldwin et al., 1996; Fernald, 1989; Jusczyk & Kemler Nelson, 1996; Tomasello & Akhtar, 1995; Tomasello & Barton, 1994). This sensitivity to various cues available in the speech environment appears to facilitate the early acquisition of object names. Infants also engage actively in spontaneous naming routines in which they (repeatedly) request and provide names for objects (Brown, 1956). Thus, during the first several months of word learning, object naming becomes a very familiar and highly ritualized activity for infants.

A recent series of studies by Namy and Waxman (1998) sheds some new light on the factors influencing word acquisition during this active period. These studies compared the acquisition of novel words versus novel symbolic gestures as object names at 18 and 26 months of age. Results indicated that 18-month-old infants were equally capable of learning novel symbolic gestures and novel words as names for object categories. In contrast, 26-month-olds readily learned words as names for objects, but did not succeed at mapping the gestures to objects unless they were given explicit training. Based on these findings, Namy and Waxman (1998) suggested that object naming originates in a general symbolic capacity that encompasses both words and gestures, as evidenced by 18-month-olds' performance. However, by 26 months, infants are more sensitive to the conventions of communication and begin to focus more exclusively on the predominant form of object naming, which, for hearing infants, is spoken words and not gestures.

Woodward and Hoyne (1999) reported a similar developmental trend in infants' ability to map nonverbal sounds (e.g., squeaks and whistles) to objects. At 13 months, infants readily mapped both words and nonverbal sounds to objects. However, at 20 months, infants failed to map nonverbal sounds. Studies by Acredolo and Goodwyn (1985, 1988) and Iverson, Capirci, and Caselli (1994) lend additional support to the idea that infants initially use both words and symbolic gestures to name and request objects, but that the spontaneous use of symbolic gestures tapers off over time, as infants' verbal lexicons grow.

Although these findings are compelling, they have an important limitation. Because the symbolic forms introduced to infants have all been presented within highly ritualized and familiar naming contexts, it is unclear whether these outcomes reflect a more general expectation that signals occurring within familiar naming routines should be interpreted as object names. For example, Namy and Waxman's (1998) 18-month-old infants may have interpreted both novel words and novel gestures as names for object categories because the symbols were embedded in familiar naming phrases (e.g., "We call this one ___" or "Look at this ___"). This would imply that the processes underlying early symbol use and word acquisition are driven by *sentential* aspects of the naming context; that is, infants have learned that particular sentence frames carry particular types of meaning.

Thus, it may be that infants' knowledge about how adults tend to use language in naming contexts drives infants' acquisition of words as well as gestural symbols.

The three experiments reported here explore this issue systematically. In Experiment 1, we ask whether children rely on the sentence context to infer that the experimenter is using the symbol as an object name. We compare infants' success at mapping a novel symbol (either a word or a gesture) to an object category when the symbol is either embedded within familiar naming phrases (the phrase condition) or presented alone, stripped of any sentential frame (the alone condition). In Experiments 2 and 3, we explore further how infants' expectations about the contexts in which adults name objects might be acquired, by manipulating children's experience with words alone (Experiment 2) or with words in entirely novel nonsense phrases (Experiment 3).

To examine these issues, we focus specifically on 17-month-old infants because infants at this age are still in the one-word stage of lexical development but have a demonstrated ability to map both words and gestures to object categories. We capitalize on the paradigm developed by Namy and Waxman (1998). An experimenter introduces a novel symbol as a name for an object category (e.g., fruit) by labeling various instances of the category (e.g., an apple and a pear) with a novel symbol within a naturalistic play session. At test, the experimenter asks the child to select an object bearing the same symbol from between an additional category member (e.g., a banana) and unrelated distractors (e.g., a clown). We presented superordinate-level object categories because novel words and gestures have elicited consistent effects of object labeling at this hierarchical level (Markman & Hutchinson, 1984; Namy, in press; Namy & Waxman, 1998; Waxman, 1990; Waxman & Hall, 1993; Waxman & Markow, 1995). An additional benefit of presenting superordinate categories is that 17-month-olds typically know the basic-level names for the category instances (e.g., apple, banana), but tend not to have a lexical item for the more inclusive superordinate category (e.g., fruit). This lends plausibility to the task of learning a novel symbol for the superordinate category.



## EXPERIMENT 1

In this experiment, we ask whether infants' success at mapping novel symbols, both words and gestures, to object categories, is accounted for by the symbols or by the naming contexts in which the symbols are embedded. We compare infants' ability to map either words or gestures to object categories when they are presented within familiar naming phrases (phrase condition: "Look at this [symbol]!") versus when they are presented alone, with no carrier phrase (alone condition: "Look! … [symbol]!").

Based on previous studies, infants in the phrase condition should successfully map both words and gestures to object categories, extending the symbols to novel members of the target category more frequently than to the unrelated distractors. Performance in the alone condition permits us to examine the contribution of the naming phrase itself. If infants succeed in mapping novel symbols in the alone condition, this would suggest that the occurrence of a novel symbol within an ostensive social–referential context is a sufficient cue to the infants that the novel symbol is intended as an object name. However, if infants fail to map novel symbols in the alone condition, this would suggest that naming phrases play an instrumental role in infants' ability to interpret novel symbols as names for object categories.



## Method

### *Participants*

Sixty-four infants (*M* age = 17.5 months, range = 16.7–18.8 months) from the Chicago area participated in this study. Participants were from predominantly White, middle-class families, recruited via direct mailings and advertisements in parenting magazines. We included only infants who were not yet combining words (according to parental report). We also imposed a stringent inclusion criterion for this and the subsequent studies, accepting for analysis infants who made a clear choice on at least seven of the eight trials presented (discussed later). Six additional infants were excluded, 4 due to failure to make a choice on at least seven of the eight trials and 2 for failing to complete the task.

### *Stimuli*

Stimuli were 18 plastic toy replicas of objects, ranging from 3 cm to 10.5 cm in height. All objects were selected to be familiar to infants of this age. These stimuli were arranged to form two sets of nine objects each. Each set consisted of five members of a superordinate-level target category (fruit, animal) and four unrelated distractor items. One of the five category members served as a target object; the other four were each paired with a distractor during test trials. A sample stimulus set is depicted in Table 1.

### *Procedure*

The infants were tested individually in a laboratory playroom. They were seated directly across a table from the experimenter, with caregivers seated next to the infant. Caregivers were asked to avoid interacting with the infant and were spe-

TABLE 1
Sample Stimulus Set Used in Experiments 1 and 2

| *Target Category* | *Category* | *Distractor* |
|---|---|---|
| Fruit | | |
| Training objects | Pear | — |
| | Apple (red) | — |
| Target object | Pear | — |
| Test objects | | |
| Mapping extension | Apple (red) | Bed |
| | Apple (yellow) | Duck |
| | Orange | Plate |
| | Banana | Clown |



cifically instructed not to name any of the objects. All sessions were videotaped for subsequent coding.

Infants were randomly assigned to one of two conditions: the phrase condition or the alone condition. Within each condition, half of the infants were assigned to each symbol type: They either learned novel words or novel symbolic gestures as names for objects. There was an initial warm-up phase followed by the experiment proper. The experiment proper was composed of an introduction phase and a test phase for each of two superordinate-level object categories (fruit and animals).

*Warm-up period.* The purpose of the warm-up period was to familiarize the infants briefly with the type of input they would receive during the experiment proper. The infant was permitted to play freely with an unfamiliar toy animal, which was not included in the experiment proper. The experimenter drew the infant's attention to the object twice. The manner in which she referred to the object varied depending on condition assignment. For infants in the phrase condition, the experimenter pointed to the unfamiliar object and presented a novel symbol (either a word or a gesture) within familiar naming phrases, saying, "We call this one [symbol]! See this [symbol]?" She then held out her hand, and asked the child, "Can you show me that [symbol]?" Infants learning words heard the object labeled with a novel word. Infants learning gestures saw the experimenter label it with an arbitrary gesture.

In the alone condition, the experimenter labeled the object with a novel symbol but isolated the symbol from any syntactic context, saying, "Look what I have! … [symbol]! See this? … [symbol]!" She then held out her hand asking, "What can you show me? … [symbol]!" Note that the semantic content of the phrases used in the alone and phrase conditions is roughly equivalent and in some cases the wording was nearly identical (e.g., "See this [symbol]?" versus "See this? … [symbol]!"). However, in these cases, we used intonation and pause differences in the two conditions to distinguish the phrase from the alone sentence context.

TABLE 2
Experiments 1 and 2: List of Novel Words and Symbolic Gestures

| *Novel Words* | *Novel Gestures*[a,b] |
|---|---|
| Blicket | Dropping motion, closed fist opening, palm down |
| Riffel | Side-to-side motion, hand extended as if to shake hands |
| Zivik[b] | Up-and-down knocking motion with closed fist |

[a]These were patterned after gestures used in sign languages (S. Goldin-Meadow, personal commuication, June 1995). [b]Used only in Experiment 1.



The same words and gestures were used in the phrase and alone conditions. All symbols were intended to be completely novel, arbitrary, unrelated to the objects, and easily imitated by the infants. The novel words and gestures employed in this study are listed in Table 2.

*Introduction phase.* The purpose of this phase was to introduce infants to a novel name for the target category within a naturalistic, interactive play session. After removing the warm-up object, the experimenter presented two members of the target category, the target object and one choice object (e.g., a pear and an apple for the fruit category). She drew the infant's attention to each of the two objects five times while the infant played freely with the objects. The manner in which the experimenter labeled the two objects during play varied by condition. In the phrase conditions, the experimenter named the objects with either a word or gesture, using familiar naming phrases, for example, "We call this one [symbol]!" and "Look at this [symbol]!" In the alone condition, the experimenter named the objects with either a word or gesture, stripped of any sentence context, but also used referential phrases without names to ensure that the child was attending to the objects; for example, "What's this? [symbol]!" and "Look here! [symbol]!"

The purpose in introducing the symbols for two different members of the object category was twofold. First, this manipulation provided the infants with some information about the span of the category; namely, that the category depicted was a superordinate category (e.g., fruit) as opposed to a basic-level category (e.g., apple). Second, this manipulation enabled us to test infants' ability to map the novel symbol to an object that had been explicitly labeled by using one of the two labeled objects as a test object. We could then assess whether children's mapping behaviors differed reliably from their extension of the symbols to novel members of the category that had not been explicitly labeled during the introduction phase.

*Test phase.* Immediately following the introduction, the experimenter administered the test phase. For each target category (fruit and animal) there were four test trials, each of which involved a target object (one of the two objects used during the introduction phase; e.g., the pear), another member of the target category (e.g.,

an apple) and an unrelated distractor (e.g., a duck). To begin each trial, the infant was permitted to play freely with the three objects for 15 sec. The experimenter then removed the three objects from the infant's reach. She focused the infant's attention on the target object. She then presented the two test objects to the infant simultaneously and elicited a choice between the two test objects (e.g., apple vs. duck). The two test objects were each placed within the child's grasp, one to either side of his or her midline. The experimented extended her hand, palm up, at the infant's midline to elicit a choice. While she elicited the choice, the experimenter's gaze was directed at the infant's face. Once the infant made a choice, the experimenter simply said, "Thank you," regardless of the infant's response, and then moved on to the next trial.

The instructions during the test phase varied by condition. In the phrase conditions, the experimenter said, "Look at this [symbol]! Can you find another [symbol]?" In the alone conditions, the experimenter said, "Look! … [symbol]! What else can you find? … [symbol]!" We altered the sentence context in the alone condition during the test phase, as well as the introduction phase, because we suspected that the query used in the phrase condition ("Can you find another [symbol]?") might serve as a naming phrase for infants.

For each target category, there were two types of test trials: one mapping trial and three extension trials. On the mapping trial, the category choice was one of the two objects that had been previously labeled during the introduction phase (e.g., the apple). This enabled us to determine whether the infants had made the pairing between the symbol presented during the introduction phase and its referent.

The mapping trial was followed by three extension trials in which the category choices were novel instances of the target category. See Table 1 for a sample stimulus set. These trials permitted us to examine infants' willingness to extend a symbol beyond the instances on which it was taught. The three extension trials were presented in the same order for all children. The left–right placement of the two choice objects in each trial was randomly determined for each child. Order of presentation of the two categories (fruit and vehicle) was counterbalanced within each group.

### *Coding*

Infants' choices on each trial were recorded. Three different types of responses were possible. These included (a) selecting the category member, (b) selecting the distractor, or (c) making no clear choice. A coding classification of no choice was made if an infant selected both objects simultaneously or in quick succession or if the child failed to select either object during the test trial. An infant's response was classified as a choice if the infant touched or picked up one object, or handed one of the two objects to the experimenter. Four participants who failed to make a clear choice on at least seven of the eight trials were excluded from the analysis.

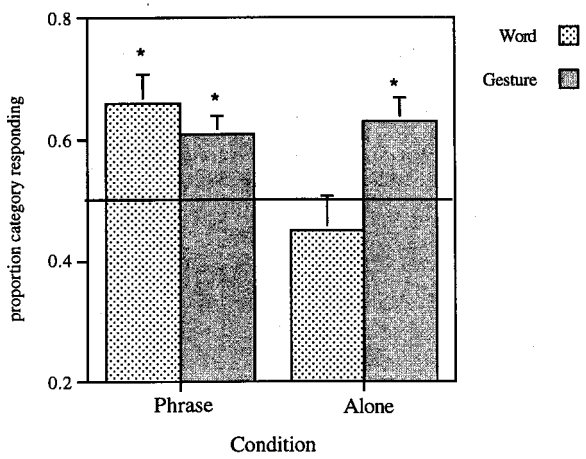


FIGURE 1 Experiment 1: Mean proportion category responding for each symbol type in each condition. Asterisks indicate that proportions are greater than would be expected based on random responding.

A primary coder analyzed the videotapes of all 64 infants. A second coder analyzed a randomly selected 25% of the infants in each condition. Intercoder agreement on individual trials was 91%. Reliability was established using the kappa statistic, $\kappa = .514$, $p < .001$.

## Results

The mean proportion of trials in which infants in each group selected category members during the forced-choice task is displayed in Figure 1. Because there were no reliable differences between the two target categories (animal and fruit), we present the data collapsed across the two target categories.

We subjected the data to a three-way analysis of variance (ANOVA) with condition (2) and symbol (2) as between-subjects factors and trial type (2: mapping vs. extension) as a within-subjects factor. A main effect of condition, $F(1, 60) = 5.18$, $p < .05$, indicated that infants in the phrase condition were more likely to select category members than were infants the alone condition. This main effect was mediated by a Condition × Symbol interaction, $F(1, 60) = 5.64$, $p < .05$. Infants learning novel words were more likely to select category members in the phrase ($M = 0.66$, $SD = 0.19$) than in the alone ($M = 0.45$, $SD = 0.23$) condition; Tukey's honestly significant difference, $p < .05$. However, for infants learning gestures, performance did not vary as a function of condition ($M = 0.61$, $SD = 0.12$ in the phrase condition and $M = 0.63$, $SD = 0.16$ in the alone condition).

The ANOVA also revealed a main effect of trial type, $F(1, 60) = 7.49$, $p < .01$. Unexpectedly, infants selected category members less frequently on mapping trials than on extension trials. This effect may have been driven by either an a priori preference for the particular distractors used in the two mapping trials or a novelty preference for the distractors after playing with the category match during the introduction phase. In either case, the effect should be interpreted with caution because there were only two mapping trials, as opposed to six extension trials.

We also compared performance in each group to chance responding (.50), collapsing across trial type. Infants learning words selected the category members at a rate that exceeded chance in the phrase condition, $t(15) = 3.52$, $p < .005$, but not in the alone condition. Infants' learning gestures were above chance responding in both the phrase, $t(15) = 3.66$, $p < .005$, and alone, $t(15) = 3.29$, $p < .005$, conditions. These results are consistent with the patterns of results indicated in the ANOVA.

Finally, to examine how representative these group data were of individuals' performance, we also examined the overall distribution of individual patterns of responding. Figure 2 presents a frequency distribution of the number of infants who selected category members at each level of the distribution of possible scores in each condition. We compared patterns of performance in the alone and phrase conditions for words and gestures separately. To test whether infants who deviated from chance showed clear patterns of mapping the symbol in each condition, we used Fisher's exact tests to compare the relative proportion of infants who were in the upper half (> .50) as opposed to the lower half (< .50), excluding those infants who fell at .50, in each condition.

For those learning words, a greater number of infants were in the upper half in the phrase condition (11 infants) than in the alone condition (5 infants), $p = .003$. This suggests that the higher mean rates of category responding in the phrase condition compared with the alone condition are the result of consistent differences in responding across individual infants within the two conditions. For infants learning gestures, the number of infants in the upper half did not differ between the two conditions (10 infants in the phrase condition and 11 in the alone condition), $p = .52$. This suggests that for 17-month-olds' learning gestures, the similar rate of category responding in the phrase and alone conditions is the result of similar, consistent patterns of response in the two conditions.

## Discussion

Infants who were introduced to novel gestures successfully interpreted them as names for object categories, whether they were presented within familiar naming phrases or alone. In contrast, infants learning novel words revealed a different pattern; they extended the words to object categories when they were embedded in familiar naming phrases but performed at chance when the words were presented alone.

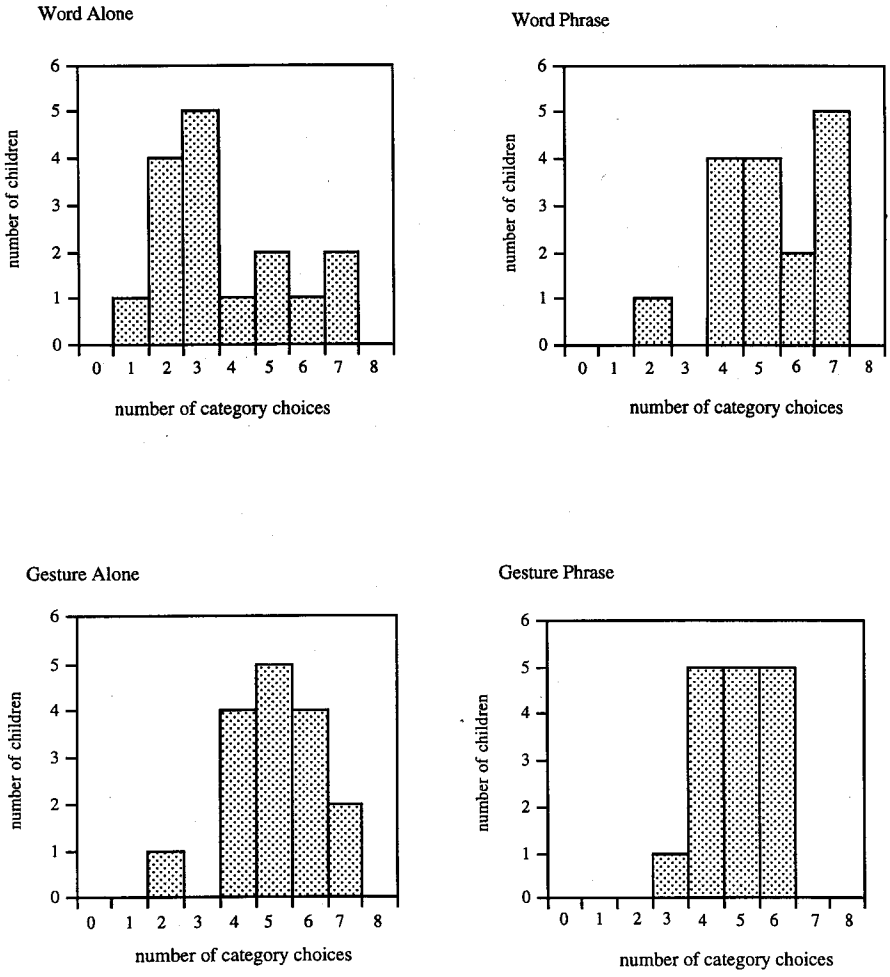


FIGURE 2 Experiment 1: Frequency histograms of individual children's performance for each symbol type in each condition (where chance performance is four out of eight trials).

This outcome replicates earlier work regarding 17- to 18-month-old infants' ability to learn gestures as object names (Namy & Waxman, 1998). These data also indicate that infants' success at mapping gestures to objects during this period is not dependent on the sentence context in which they are presented. Even when the gestures were presented alone, infants extended gestures to members of object categories. This is consistent with the position that infants' acquisition of symbols is a general process not specific to word learning. However these data provide an additional contribution. They reveal that infants' success at mapping words to object

categories varied as a function of sentential context. Infants more readily mapped novel words to object categories when the words were embedded in familiar naming phrases than when they were presented alone.

The difference between the pattern for children's interpretations of words versus gestures is counterintuitive, for it suggests that hearing infants' tendency to map words to object categories occurs under a more restricted set of contexts than does their tendency to map gestures. How can we account for this counterintuitive finding? Seventeen-month-olds appear to have learned to use sentence context to distinguish between words that are object names and those that are not. This differentiation of naming and nonnaming contexts is likely acquired on the basis of the systematic ways in which adults tend to refer to objects. When adults name objects, these names tend to be embedded within particular naming phrases. When adults use words in isolation, they typically intend not to name objects, but rather to utter commands (e.g., "Stop!") or exclamations (e.g., "Wow!"). We propose that children are adept at deducing which contexts correspond to adults' naming acts and which do not, on the basis of experience. Importantly, this experience-based account can also explain infants' success at learning gestures both in and outside of naming phrases. For hearing infants, gestures are not consistently embedded within particular phrases. As a result, infants have not developed an expectation that adults intend to highlight different aspects of meaning when they produce gestures in different contexts.

In the next experiment, we test the prediction that infants develop expectations about the meanings associated with particular sentence contexts by monitoring how adults employ those sentence contexts over time. We make the following prediction: If infants monitor adults' intentions to infer meaning, then we may be able to alter infants' expectations about the meaning of novel words presented alone by altering how the experimenter uses words alone during a training period. If the experimenter conveys that he or she intends to name objects using words alone by providing familiar names (e.g., "Car!") presented alone during a training period, infants may subsequently interpret novel words as object names, even when they are presented alone. That is, infants may observe that the experimenter is naming objects using words alone during training, and may infer from this experience that the experimenter employs this "word alone" context to indicate intention to name objects. As a result, the infants may subsequently interpret novel words presented alone as object names.

## EXPERIMENT 2

In this experiment, we manipulated infants' experience with words presented alone. We began the task with a training period during which the experimenter introduced several familiar objects (e.g., a car, a spoon). For half of the infants, those

in the naming condition, the experimenter labeled these objects with their familiar, basic-level names (e.g., "Car!") presented in isolation, rather than in naming phrases. For the remaining infants, those in the exclaiming condition, the experimenter referred to the objects using single-word exclamations (e.g., "Whee!") instead of object names.

We subsequently introduced infants in both conditions to novel words presented alone (e.g., "Blicket!") and tested their interpretations of the novel words. We predicted that this brief training would influence children's subsequent interpretation of novel words presented alone. Infants in the naming condition should now readily interpret novel words alone as object names. However, training in the exclaiming condition should do nothing to alter infants' existing expectation that adults do not use words alone to name objects. Thus, performance in the exclaiming condition should replicate the performance of infants learning novel words alone in Experiment 1; these infants should fail to map the novel words to object categories.



## Method

### *Participants*

Twenty 17-month-olds (*M* age = 17.4 months, range = 17.0–18.4 months) from the same population as in Experiment 1 participated. Two additional infants were excluded from the analysis due to failure to make a sufficient number of clear choices.

### *Stimuli*

Stimuli included the same two stimulus sets used in Experiment 1. There were three additional training objects, including a toy car, a toy spoon, and a toy cookie.

### *Procedure*

The infants were tested individually in a laboratory playroom. They were seated directly across a table from the experimenter, with caregivers seated next to the child. Caregivers were asked to avoid interacting with the child and were specifically instructed not to name any of the objects. All sessions were videotaped for subsequent coding.

Infants were randomly assigned to one of two conditions, the naming or the exclaiming condition. In both conditions, there was a training phase followed by the experiment proper. The only difference in procedure between the two conditions was in the training phase. The protocol in the experiment proper was identical to the procedure used in Experiment 1 in both conditions.

*Training phase.* During this brief, 1- to 2-min training period, the infants in both conditions played with three familiar toy objects: a car, a spoon, and a cookie. The experimenter presented each object in turn and referred to it five times within a naturalistic play session. In the naming condition, the experimenter labeled the object five times with its familiar basic-level label, stripped of any naming phrase (e.g., "Look here! … Car!" or "What's this? … Car!"). In the exclaiming condition, the experimenter referred to it using a familiar, single-word exclamation five times (e.g., "Look here! … Whee!" or "What's this? … Whee!"). She used the words *whee, yummy,* and *wow* to refer to the car, cookie, and spoon, respectively.

The training was immediately followed by the introduction and test phases, which were identical in the naming and exclaiming conditions.



*Introduction and test phases.* The protocol used during these phases was identical to the procedure used in the alone condition in Experiment 1. During the introduction phase, the infants heard the experimenter label two members of the target category five times each, using a novel word stripped of its carrier phrase (e.g., "Look here! … [word]!"). During the test phase for each category, the experimenter administered four test trials as in Experiment 1. For each trial, the experimenter labeled the target object and then elicited a choice between the category choice and the distractor, saying, "Look! … [word]! What else can you find? … [word]!"

### Coding

Coding was identical to the coding procedure used in Experiment 1. A primary coder analyzed the videotapes of all 20 infants. A second coder analyzed a randomly selected 50% of the infants in each condition. Intercoder agreement on individual trials was 97.5%. Reliability, calculated using the kappa statistic, was high, $\kappa = .953$, $p < .001$.

## Results

The mean proportion of trials on which infants in each condition selected category members during the forced-choice task is displayed in Figure 3. Because there were no reliable differences between the two target categories (animal and fruit), we present the data collapsed across the two target categories.

We subjected the data to a two-way ANOVA with condition (2) as a between-subjects factor and trial type (2: mapping vs. extension) as a within-subjects factor. A main effect of condition, $F(1, 18) = 6.128$, $p < .05$, indicated that infants in the naming condition ($M = 0.61$, $SD = 0.13$) were more likely to select category

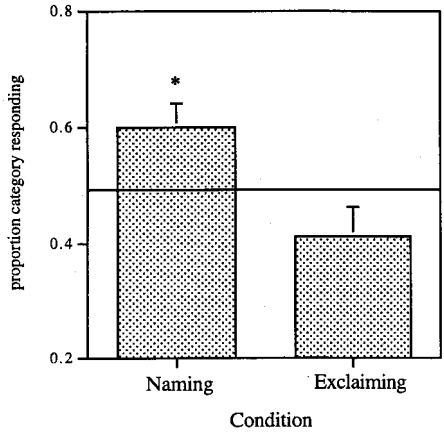


FIGURE 3 Experiment 2: Mean proportion category responding in each condition (the asterisk indicates that proportion is greater than would be expected based on random responding).

members than were infants in the exclaiming condition ($M$ = 0.41, $SD$ = 0.16). There was no effect of trial type.

We also compared performance in each group to chance responding (.50), collapsing across trial type and target category. Infants in the naming condition selected the category members at a rate that exceeded chance, $t(9) = 2.45$, $p < .05$, but those in the exclaiming condition did not. Thus, performance in the exclaiming condition mirrors performance of those learning words alone in Experiment 1.

Finally, as in Experiment 1, we examined the distribution of individual patterns of responding. Figure 4 presents a frequency distribution of the number of infants who selected category members at each level of the distribution in each condition. A Fisher's exact test comparing the relative proportion of infants who perform above .50 (as opposed to below .50) in each condition revealed a reliable difference between the naming (6 infants) and the exclaiming (1 infant) conditions, $p$ = .044. This suggests that the higher mean rates of category responding in the naming condition compared with the exclaiming condition are the result of consistently different response patterns across individuals within the two conditions.

## Discussion

These results demonstrate that 17-month-olds are able to interpret words presented alone as names for object categories and that infants can modulate their expectations about adults' naming on the basis of experience interacting with the experimenter. After hearing an adult use familiar object names in isolation to refer to

object categories, infants successfully interpreted novel words in isolation as object names. However, after hearing an adult use familiar exclamations in isolation, infants failed to map the novel words to object categories, replicating the effect of words presented alone in Experiment 1. This outcome suggests that infants monitor adults' intentions during the training period and adapt their expectations about the experimenter's intentions when they encounter novel words during the test phase. These data highlight the flexible and adaptive nature of infants' early symbol acquisition.



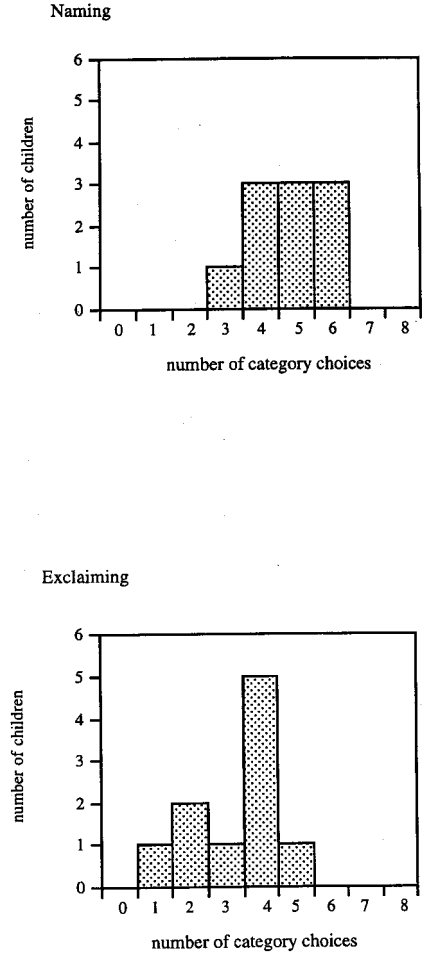


FIGURE 4 Experiment 2: Frequency histograms of individual children's performance in each condition (where chance performance is four out of eight trials).

## EXPERIMENT 3

Experiment 2 demonstrated that children can learn to expect an object name in a context that was not previously associated with naming. The goal of this experiment was to push this flexibility further, to examine whether children could also consider a completely novel phrase, composed of a string of nonsense words, as a naming phrase. In this experiment, we used the same training paradigm employed in Experiment 2 to test infants' success at inferring that an experimenter is employing a string of nonsense words ("Shaylem bosher [object name]!") to convey his or her intention to name an object category. If children in the naming condition comprehend, after a brief 1- to 2-min training period, that a novel word embedded in the novel phrase (e.g., "Shaylem bosher blicket!") is an object name, we will have strong evidence that infants rapidly adapt their expectations about how a particular adult intends to name objects on the basis of very brief exposure. To rule out the possibility that children simply interpret the entire novel utterance as an object name in the absence of training, we included a third control condition in addition to the naming and exclaiming conditions. In the control condition, children viewed the training objects without any labeling during the training phase and did not encounter the nonsense phrase at all until the test period. We predicted that children in the naming condition would select category members more often than chance, whereas those in the exclaiming and control conditions would respond randomly.

### Method

#### *Participants*

Forty-eight 17-month-olds (*M* age = 17.3 months, range = 16.6–18.8 months) from the Atlanta area participated in this study. Participants were from predominantly White or Black middle-class families, recruited via direct mailings. We included only infants who were not yet combining words (according to parental report). We administered 10 rather than 8 test trials. We included only those infants who made a clear choice on at least 9 of the 10 trials presented (discussed later). Thirteen additional infants were excluded, 12 due to failure to complete the task or make a sufficient number of clear choices and 1 for exhibiting a side preference on all 10 trials. Among the 12 infants failing to complete the procedure, 6 were in the naming condition, 2 were in the exclaiming condition, and 4 were in the control condition.

#### *Stimuli*

Stimuli were similar to those in the previous experiments. For each set (fruit and animals), we added an additional test trial for a total of one mapping trial and four extension trials per category.

### *Procedure*

The experimental procedure was similar to that in Experiment 2.

Infants were randomly assigned to one of three conditions, the naming, exclaiming, or control condition. In all three conditions, there was a training phase followed by the experiment proper. The only difference in procedure among the three conditions occurred in the training phase. The protocol in the experiment proper was identical across conditions.

*Training phase.* During this brief, 1- to 2-min training period, the infants in all conditions played with three familiar toy objects individually, including a key, a bottle, and an airplane. The experimenter presented each object in turn and referred to it five times within a naturalistic play session. In the naming condition, the experimenter labeled the object five times with its familiar basic-level label, embedded in a nonsense phrase (e.g., "Look! Shaylem bosher key!" or "See here? Shaylem bosher key!"). The prosody and intonation employed were declarative sounding, with an emphasis on the final word. In the exclaiming condition, the experimenter referred to the object with the nonsense phrase, but instead of using a familiar label, used a familiar, single-word exclamation five times (e.g., "Look! Shaylem bosher wow!" or "See here? Shaylem bosher wow!"). She employed the same prosody in this condition as in the naming condition. She used the exclamations, "Wow," "Yummy," and "Whee" to refer to the key, bottle, and airplane, respectively. In the control condition, the experimenter drew the infants' attention to the objects, but without using either a label or the novel sentence frame (e.g., "Look! See what I have?"). During this play session, all other interaction with the infants was conducted in normal English constructions (e.g., "You like that one?" or "Let's look at what else I have!").

The training was immediately followed by the introduction and test phases, which were identical across conditions.

*Introduction phase.* The introduction phase was the same across all conditions and was similar to Experiment 2. The experimenter labeled each of the two target objects five times with a novel word (e.g., "Blicket") while the infant played freely with the objects. Each time the experimenter used the novel label, she embedded it in the nonsense phrase that was introduced during the training phase (e.g., "Look! Shaylem bosher blicket!" or "See what I have? Shaylem bosher blicket!").

*Test phase.* The test phase was also similar to Experiment 2. To begin each trial, the infant was permitted to play freely with the three objects for 15 sec. The experimenter then removed the three objects from the infant's reach. She focused the

infant's attention on the target object saying, for example, "Look! Shaylem bosher blicket!" She then presented the two test objects to the infant simultaneously and elicited a choice between the two test objects (e.g., apple vs. duck), asking, "What else can you find? Blicket!" As in Experiment 2, we employed this wording to eliminate the possibility that the query might cue the infants to interpret the novel word as an object name.

As in the previous experiments, the left–right placement of the two choice objects in each trial was randomly determined for each child. Order of presentation of the two categories (fruit and animal) was counterbalanced within each condition.



### *Coding*

Coding was identical to that in the first two experiments. A primary coder analyzed the videotapes of all 48 infants. A second coder analyzed a randomly selected 25% of the infants in each condition. Intercoder agreement on individual trials was 97.5%. Reliability, using the kappa statistic, was high, $\kappa = .803$, $p < .001$.

## Results

The mean proportion of trials on which infants in each condition selected category members during the forced-choice task is displayed in Figure 5. Because there were no reliable differences between the two target categories (animal and fruit), we present the data collapsed across the two target categories.

We subjected the data to a two-way ANOVA with condition (3) as a between-subjects factor and trial type (2: mapping vs. extension) as a within-subjects factor. There was a marginal main effect of condition, $F(2, 45) = 2.72$, $p = .077$. Post hoc analyses indicated that infants in the naming condition ($M = 0.63$, $SD = 0.17$) were marginally more likely to select category members than those in the control conditions ($M = 0.49$, $SD = 0.17$), $p < .10$. Those in the exclaiming ($M = 0.54$, $SD = 0.22$) condition did not differ reliably from those in either the naming or control condition. There was also an effect of trial type, $F(1, 44) = 7.86$, $p < .01$, indicating that, as in Experiment 1, children selected category members more often on the extension trials than the mapping trials. This effect was consistent across conditions, suggesting that the effect was driven by a preference for the novel distractors on the mapping trials after having played with the category match for several minutes during the introduction phase.

Comparisons to chance (collapsing across trial type) yielded different patterns of performance across conditions. Infants in the naming condition selected category members at a rate that exceeded chance, $t(15) = 3.02$, $p < .01$. However, those in the exclaiming and control conditions did not differ from chance, both $t$s$(15) < 1.0$, *ns.*

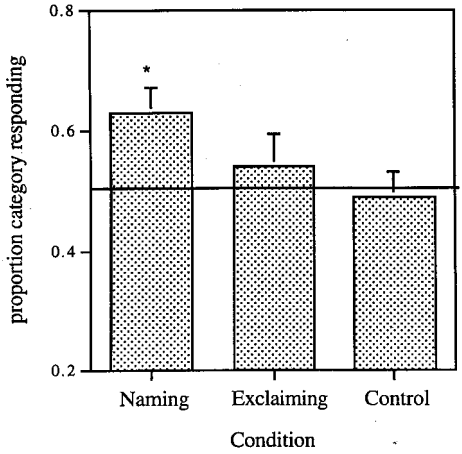


FIGURE 5 Experiment 3: Mean proportion category responding in each condition (the asterisk indicates that proportion is greater than would be expected based on random responding).

Finally, we examined the distribution of individual patterns of responding. Figure 6 presents a frequency distribution of the number of infants who selected category members at each range of the distribution in each condition. A Fisher's exact test comparing the relative proportion of infants who were in the upper as opposed to the lower half in each condition revealed a marginally reliable difference between the naming and exclaiming conditions ($p = .067$) and a reliable difference between the naming and control conditions ($p = .033$), but no difference between the exclaiming and control conditions ($p = .300$). This suggests that the higher mean rates of category responding in the naming condition compared with the exclaiming condition are the result of consistently different response patterns across individuals within the two conditions.

## Discussion

These results, although not as robust as those reported in Experiment 2, demonstrated that 17-month-olds are able to interpret novel words embedded in a novel sentence as object names after a very brief training period. Infants in the naming condition appear to have inferred the experimenter's intention to name when using this novel sentence. In contrast, those in the exclaiming and control conditions responded randomly. This experiment provides further and rather striking support for the argument that infants readily adapt their expectations about how an adult intends to name objects on the basis of experience.

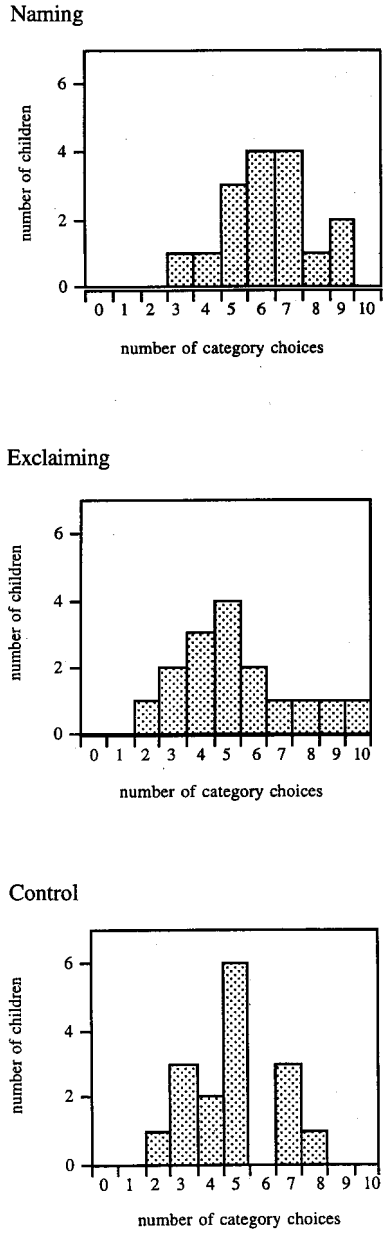


FIGURE 6 Experiment 3: Frequency histograms of individual children's performance in each condition (where chance performance is 5 out of 10 trials).

## GENERAL DISCUSSION

The results of these three experiments provide a replication and two new insights into the mechanisms by which infants acquire names for object categories. First, the results of Experiment 1 replicate the finding that at 17 months, infants readily map both novel words and novel gestures to object categories (Namy & Waxman, 1998). Second, these results reveal a divergence between novel words and novel gestures: Infants readily interpret novel words as names for object categories when they are embedded in familiar naming phrases, but fail to do so when the novel words are presented alone. This outcome is striking because even when the novel words were presented alone, they were presented within the rich social–referential context in which objects are typically labeled. In contrast, infants readily interpreted novel gestures as names for object categories whether they were embedded in naming phrases or presented alone. Thus, by 17 months, infants have acquired a more refined set of expectations about the circumstances under which adults intend to name objects than they have for gestures. Third, the results of Experiments 2 and 3 emphasize the flexibility of infants' expectations about naming contexts. Infants readily mapped novel words presented either alone (Experiment 2) or in novel nonsense phrases (Experiment 3) to object categories after only a brief training period in which the experimenter used object names in this manner.

How can we account for the finding that infants have acquired different expectations about the circumstances under which words and gestures name objects? The results of Experiments 2 and 3 suggest that infants' abilities to map words and gestures have diverged on the basis of experience. Hearing infants have learned that adults tend to use words presented alone as commands or exclamations, whereas words presented in naming phrases tend to convey names for objects and object categories. That is, the associations between object names and particular phrases are strengthened by these repeated pairings. However, infants have had no such experience with gestures. Because adults do not employ sentence context to convey different types of meaning in the gestural modality, infants have not experienced these tight associations between gestures and naming phrases. As a result, infants have developed no expectations about how sentence contexts relate to gestural naming.

The results of Experiments 2 and 3 also highlight that infants develop expectations based on long-term regularities in the input (e.g., regularities linking naming phrases to object names), but are also sensitive to transient influences (e.g., the training periods in Experiments 2 and 3). This interpretation of the data is consistent with the dynamic systems view of development (e.g., Smith & Samuelson, 1997; Thelen & Smith, 1994). The training period in the naming condition established an expectation that novel words presented alone (Experiment 2) or in nonsense phrases (Experiment 3) were object names. The corresponding training in

the exclaiming condition did little to weight the system in favor of interpreting novel words as object names.

Although infants in Experiments 2 and 3 altered their expectations about naming contexts on the basis of a brief training period, we suspect that the influence of this training period is fleeting. Because, in most cases, object names will be embedded within familiar naming phrases, the long-term consistencies will most likely outweigh the transient influences imposed in our training period. Thus, although infants may adapt their expectations to reflect adults' intentions to name using words presented alone or in nonsense phrases within the experimental context, we suspect that such shifts will last only as long as the input in the immediate environment supports them. In future work, it will be interesting to explore both the longevity of this expectation and the extent to which this effect will generalize to speakers other than the original experimenter.

In conclusion, this set of studies provides a snapshot of an important transitional stage in infants' symbolic development. At 17 months, infants accept multiple symbolic forms as object names but their experience has led them to differentiate the circumstances under which words and gestures tend to name objects. These findings fit within a developmental account of infants' naming abilities. Our results are consistent with the perspective that an initially general symbolic ability may develop into a more specific set of expectations on the basis of experience. We suspect that at some earlier point, infants may map words presented alone to object categories as readily as they map gestures alone. These data also suggest that, over time, infants will become increasingly sensitive to adults' intentions when employing particular sentence frames to convey particular types of meaning.

An early sensitivity to the relation between sentence frames and meaning will inform infants' interpretations of novel words they encounter. An initial distinction between naming and nonnaming contexts may give rise to more subtle syntactic distinctions that mark words as belonging to particular grammatical form classes, such as noun, verb, or adjective (Gentner, 1978; Gleitman & Gleitman, 1994; Goldberg, 1995; Grimshaw, 1987; Lederer, Gleitman, & Gleitman, 1995; Tomasello & Brooks, 1999; Waxman, 1999; Waxman & Markow, 1998). As this linguistic sensitivity develops, gestures will continue to play an important role in the hearing infant's communicative repertoire, but unlike words, they are not typically used to name object categories; neither do they develop into an independent syntactic system (Goldin-Meadow, 1993; McNeill, 1992; Singleton, McNeill, & Goldin-Meadow, 1995). Rather, gestures take on more of a supplementary role in the infant's developing communication system. These studies highlight the flexibility with which infants learn object names and the strong role of experience, particularly experience that supports infants' inferences about adults' referential intentions, in the acquisition of object names.

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