Research Article

''Really? She Blicked the Baby?''

Two-Year-Olds Learn Combinatorial Facts About Verbs by Listening

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ABSTRACT—*Children use syntax to guide verb learning. We asked whether the syntactic structure in which a novel verb occurs is meaningful to children even without a concurrent scene from which to infer the verb's semantic content. In two experiments, 2-year-olds observed dialogues in which interlocutors used a new verb in transitive ("Jane blicked the baby!") or intransitive ("Jane blicked!") sentences. The children later heard the verb in isolation ("Find blicking!") while watching a one-participant event and a two-participant event presented side by side. Children who had heard transitive dialogues looked reliably longer at the two-participant event than did those who had heard intransitive dialogues. This effect persisted even when children were tested on a different day, but disappeared when no novel verb accompanied the test events (Experiment 2). Thus, 2-year-olds gather useful combinatorial information about a novel verb simply from hearing it in sentences, and later retrieve that information to guide interpretation of the verb.*

Children use syntax as well as observations of events to learn verb meanings. This phenomenon is known as *syntactic bootstrapping* (Gleitman, 1990). Syntactic bootstrapping works because the syntactic structures licensed by each verb are systematically related to its meaning. For example, transitive verbs take two noun-phrase arguments (e.g., "He tickled him") and describe conceptual-semantic predicates involving two core participants (tickler, ticklee). In contrast, intransitive verbs take one noun-phrase argument ("He laughed") and describe conceptual-semantic predicates involving a single core participant (laugher).

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In accord with these systematic relationships, children assign different interpretations to novel verbs appearing in different sentence structures (e.g., Fisher, 2002; Naigles, 1990). In one experiment, for example, 21-month-olds heard a made-up transitive ("He's gorping him!") or intransitive ("He's gorping!") verb while viewing two simultaneously presented events (Yuan, Fisher, Gertner, & Snedeker, 2007). One event involved two participants (one boy causing another to bend), and the other involved one participant (a boy making arm motions). Children hearing a transitive verb looked reliably longer at the two-participant event than did those hearing an intransitive verb.

In the preceding example, the syntactic difference between the transitive and intransitive sentences could convey only aspects of verb meaning relevant to the number of participants involved—that is, relevant to the verb's semantic structure, but not to its semantic content (Grimshaw, 1993). Thus, the transitive structure ("He's gorping him!") informed children that the verb's meaning involved two participant roles; the verb's semantic content (e.g., "cause to bend") had to be gathered from observing the events (Fisher, 1996; Gleitman, 1990). But was observation of the events also necessary for children to identify the verb's semantic structure? In the experiments reported here, we investigated whether the syntactic structure in which a novel verb occurs independently conveys information about the verb's semantic structure to children, even when there is no concurrent referential scene providing clues to the verb's semantic content. Can children learn a new verb's combinatorial privileges—its transitivity and thus its number of participant roles—simply from listening to sentences in which the verb appears?

One possibility is that simultaneous access to syntactic and referential contexts is necessary for syntax to guide verb learning. Grimshaw (1994) proposed that children use syntax to guide verb interpretation by first generating a candidate interpretation of an observed scene, then generating an appropriate sentence to express that interpretation, and finally comparing this predicted sentence's structure with the input sentence; correspondence between the predicted and input sentences

leads to learning about the verb's meaning. According to this proposal, the informativeness of syntax depends on scene-derived semantic content. Without a concurrent referential scene, no candidate interpretations are generated, and nothing is learned about the verb. This proposal is derived from lexical-projectionist accounts of the relationship between verb meaning and syntax. According to these accounts, verbs' semantic representations determine their syntactic privileges (e.g., Levin & Rappaport Hovav, 2005); syntactic structure itself does not carry meaning independently of the verb.

An alternative possibility is that syntactic structures are independently meaningful, even without a concurrent scene providing information about a verb's semantic content. A child who hears the sentence "Jane blicked the baby!" in the absence of a helpful referential context could still learn that *blick* is transitive and therefore involves two participant roles. When the verb is later invoked in a referential setting, the child could retrieve this combinatorial information to guide the assignment of semantic content to the verb. This proposal depends on a key claim of the syntactic-bootstrapping theory (Gleitman, 1990) that is shared by constructional approaches to syntax and semantics (Goldberg, 1995): Syntactic structures themselves contribute meaning to sentences. According to this proposal, information about a new verb's syntactic context is informative independently of its semantic content.

Prior experimental studies of syntactic bootstrapping cannot be used to distinguish these alternatives, because all involved providing children with simultaneous access to syntactic and referential contexts (Fisher, 2002; Naigles, 1990; Yuan et al., 2007). In the experiments reported here, we separated these information sources, giving children syntactic and referential contexts for a novel verb that were separated in time and unrelated in content.

In two experiments, 2-year-olds were trained and tested on a novel verb. Figure 1 summarizes the procedure. First, in the dialogue phase, half the children encountered the verb in transitive sentences, and half encountered it in intransitive sentences. Later, in event phases, the children viewed two

Dialogue Phase

Transitive dialogues:

A: Hey...Jim is gonna blick the cat!
B: Really? He's gonna blick the cat?
A: And Mary was blicking the man.
B: Wow, she was blicking the man.

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A: Guess what? Jane blicked the baby!
B: Hmm, she blicked the baby?
A: And Bill was blicking the duck.
B: Yeah, he was blicking the duck.

Intransitive dialogues:

A: Hey...Jim is gonna blick!
B: Really? He's gonna blick?
A: And Mary was blicking.
B: Wow, she was blicking.

———

A: Guess what? Jane blicked!
B: Hmm, she blicked?
A: And Bill was blicking.
B: Yeah, he was blicking.

Event Phase 1

"Find blicking! Where's blicking? See? Where's blicking?"

Event Phase 2

"Find blicking! Where's blicking? Find blicking! Find blicking!"

Fig. 1. Dialogue and event phases for the novel verb in Experiment 1. Half the children heard transitive dialogues, and half heard intransitive dialogues. The transitive and intransitive dialogues were identical except for the presence versus absence of the direct-object noun phrase in each sentence. In the event phases, all children watched the same two novel events and heard the verb in syntactically uninformative sentences.

simultaneously presented novel events: a two-participant event (one girl swinging another girl's leg) and a one-participant event (a girl making circles with her arm). During these event phases, the verb was presented in a syntactically uninformative context ("Find blicking!"). If children can learn combinatorial facts about a verb without knowing its semantic content, and can retrieve these facts when they hear the verb again, then children who heard transitive dialogues would be expected to interpret the verb as describing a two-participant relation and therefore to look longer at the two-participant event than children who heard intransitive dialogues.

Success in our task required that the children learn distributional facts about brand-new words, and there is considerable evidence that they can do this. Infants detect distributional patterns in word-segmentation and artificial-grammar-learning tasks (Gómez & Gerken, 1999; Marcus, Vijayan, Bandi Rao, & Vishton, 1999; Saffran, Aslin, & Newport, 1996), and they use distributional patterns to assign new words to major grammatical categories, such as noun and verb (Mintz, 2006). The present experiments extended the study of distributional learning about new words by moving to a new domain, syntactic subcategories within the verb category (transitive vs. intransitive), and by investigating whether this distributional learning affects the subsequent assignment of semantic content to a verb.

Success in our task also required that the children retrieve from their lexicon information about the verb's combinatorial privileges when they reencountered it. Again, there is evidence that young children can do this. Knowledge of the sentence-structure properties of particular verbs influences preschoolers' sentence comprehension (Gordon & Chafetz, 1990; Snedeker & Trueswell, 2004) and production (Tomasello, 2000). As indicated by the two proposals we summarized earlier, however, learning a verb's sentence-structure properties could depend on knowledge of its semantic content (e.g., a verb meaning "tickle" requires two participants, and thus two noun-phrase arguments) or could be based in part on distributional learning. These two potential information sources are confounded in studies of familiar verbs. In the present research, we investigated whether children can learn combinatorial facts about a new verb from hearing sentences alone, and if they can later use these facts in interpreting sentences.

Most centrally, success in our task required that the children find sentence structures independently meaningful, without the aid of concurrent scenes.

EXPERIMENT 1

Method

Participants

Sixteen 2-year-olds (mean age = 28.6 months, range = 26.6–30.2 months; 8 girls, 8 boys) participated. All were native English speakers. An additional child was eliminated because of fussiness. The children's productive vocabularies, measured by the MacArthur-Bates Communicative Development Inventory (Level II, short form; Fenson et al., 2000), ranged from 29 to 100 ($Mdn = 78.5$).

Apparatus

Children sat on a parent's lap, facing two 20-in. television screens. The screens were separated by 12 in. and positioned 30 in. away from the children. Audio stimuli played from a central speaker. A hidden camera recorded children's eye movements. Parents wore opaque glasses.

Materials and Procedure

The stimuli were videos of two women conversing and of people performing actions. The latter were accompanied by sound tracks recorded by a female native English speaker. All videos were combined into synchronized pairs for presentation on the two TV screens.

The procedure began with two practice trials involving familiar verbs, one intransitive (*clap*) and one transitive (*tickle*). Each trial involved three phases. In the *dialogue phase* of the first trial, two women uttered the verb *clap* in eight intransitive sentences (e.g., "Mary clapped!"). This dialogue consisted of two four-sentence video clips separated by a 3-s interval. Each video clip appeared on the two TV screens simultaneously. After a 7-s interval, *Event Phase 1* began: Two 8-s video events played simultaneously, one on each screen, and children heard "Find clapping!" The target event showed a man clapping; the distractor event showed another man sleeping. Following a 3-s interval, this event pair was presented again in *Event Phase 2*.

After a 4-s interval, the second trial proceeded in the same manner. In the dialogue phase, children heard *tickle* in eight transitive sentences (e.g., "Hannah tickled Grandpa!"). In the event phases, the target event showed one woman tickling another; the distractor event showed one woman feeding another. The practice trials informed the children that one video in each event phase matched the sound track.

Following a 4-s interval, the children received a test trial in which a novel verb (*blick*) was introduced in the same manner (Fig. 1). In the dialogue phase, the novel verb was presented in eight transitive or eight intransitive sentences. In the event phases, the children watched the two novel events and heard the verb in isolation (e.g., "Find blicking!").

The dialogue video clips averaged 27.0 s in duration (range = 24.1–29.7 s). The left/right position of the two test events was counterbalanced with dialogue condition.

Coding

From silent video, we coded where the children looked (left, right, or away from the test events) during the event phases, frame by frame. Reliability was assessed for 3 children; coders agreed on 98% of video frames.

Looking times to the two-participant event, to the one-participant event, and away from the events were averaged across the test-trial event phases.[1] Inspection of means suggested that children who heard intransitive dialogues tended to look away slightly longer ($M = 0.54$ s, $SE = 0.24$ s) than did children who heard transitive dialogues ($M = 0.31$ s, $SE = 0.19$ s). This difference was not reliable in Experiment 1 ($t < 1$), but the corresponding difference was reliable in Experiment 2. Given possible differences in look-away times, we conducted analyses on raw looking times to the two-participant event and to the one-participant event, rather than on a single measure of looking time to one event as a proportion of total looking time to the two events.

Preliminary analyses of test-trial performance revealed no interactions of dialogue condition with sex, or with whether children's vocabulary or practice-trial performance was above or below the median. The data were therefore collapsed across sex, vocabulary, and practice-trial performance.

Results and Discussion

As Table 1 shows, looking times during the test trial were affected by dialogue experience. Children who heard transitive dialogues looked reliably longer at the two-participant event than did those who heard intransitive dialogues, $t(14) = 3.05$, $p_{rep} = .97$, $d = 1.52$. They also looked less at the one-participant event than did those who heard intransitive dialogues, though this difference was not reliable, $t(14) = 1.94$, $p_{rep} = .90$, $d = 0.97$. Thus, 2-year-olds learned combinatorial facts about a novel verb in a nonreferential context, simply by listening. This knowledge subsequently influenced their attention to a two-participant event.

EXPERIMENT 2

In Experiment 1, 2-year-olds learned a new verb's combinatorial privileges from dialogues and later recruited that information in interpreting the verb. Thus, combinatorial information relevant to a verb's semantic structure can be acquired without access to the verb's semantic content. In Experiment 2, we sought to replicate this key result and addressed three additional questions.

First, could the children in Experiment 1 have detected a superficial pattern during the practice trials and used that pattern to guide their responses in the test trial? During the first practice trial, each sentence in the dialogue phase mentioned one participant, and each event in the event phases showed one participant. During the second practice trial, each dialogue sentence mentioned two participants, and each event showed two participants. This pattern might have led children who heard

TABLE 1

Mean Looking and Look-Away Times (in Seconds), Averaged Across the Two Event Phases, in the Test Trial in Experiment 1

Dialogue type	Looking time		Look-away time
	Two-participant event	One-participant event	
Transitive	4.82 (0.43)	2.87 (0.51)	0.31 (0.19)
Intransitive	3.33 (0.24)	4.12 (0.40)	0.54 (0.24)

Note. Standard errors are given in parentheses.

transitive sentences in the test-trial dialogue phase to prefer the two-participant event. To eliminate this possibility, we omitted the dialogue phases for the practice trials; thus, in Experiment 2, the children had no opportunity to learn that the dialogues were related to the subsequent event phases.

Second, could the dialogue effect obtained in the test trial of Experiment 1 reflect sensitivity to the number of referents mentioned in the dialogue phase, rather than learning about the novel verb? Each sentence in the transitive dialogue mentioned two participants, whereas each sentence in the intransitive dialogue mentioned one. These sentences might have biased children in the transitive, but not the intransitive, condition to attend longer to the two-participant event in subsequent event phases. To eliminate this possibility, we added a control condition in which no novel verb was presented during the test-trial event phases. If the dialogue effect in Experiment 1 reflected learning about the novel verb, then it would disappear when no novel verb was presented during the test-trial event phases.

Third, we probed the robustness of children's learning by introducing a delay between the dialogue and event phases of the test trial. Two delay conditions were implemented. In both, the dialogue phase of the test trial was presented before the experiment proper began; then, the children received only the event phases of the practice and test trials. The event phases were presented immediately (same-day condition) or 1 to 2 days later (different-day condition).

Method

Eighty 2-year-olds (mean age = 28.4 months, range = 26.8–30.4 months; 44 girls, 36 boys) participated, 32 in the same-day and 48 in the different-day condition. Twelve additional children were eliminated because of side bias ($n = 3$), distraction ($n = 1$), practice-trial performance (as measured by the average looking time to the target event in the practice trials) more than 2.5 standard deviations below the mean ($n = 1$), average looking time to the two-participant event in the test trial more than 2.5 standard deviations from the mean of the relevant condition ($n = 3$), or failure to return for the second session in the different-day condition ($n = 4$). Vocabulary scores ranged from 11 to 100 ($Mdn = 72.5$). Within each delay condition, children were

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[1] Data for an event phase were treated as missing if the child looked away for more than half of that event phase (two observations in Experiment 1 and three in Experiment 2).

assigned to one of the four combinations of dialogue (transitive, intransitive) and test (experimental, control) conditions.

The materials and procedure for the same-day condition were like those of Experiment 1, but with several changes. First, the dialogue phase of the test trial was presented before the experiment on an 8-in. portable DVD player. The experimenter then removed the DVD player and initiated the event phases of the practice and test trials, which again were presented on the two-screen display. The test-trial dialogue and event phases were therefore separated by a delay of 100 to 120 s. Second, the dialogue phase of the test trial included a third video clip with 4 additional sentences (12 total), to give the children ample opportunity to learn the verb's combinatorial privileges. Third, there were no dialogue phases for the practice trials. Fourth, in the test trial, children received three event phases rather than two, so they had ample opportunity to retrieve what they had learned about the new verb. Fifth, during the test-trial event phases, half the children in each dialogue condition heard the novel verb (experimental condition: "Find blicking!"), and half heard neutral utterances without the verb (control condition: "What's happening?").

The different-day condition was identical except that the dialogue phase of the test trial was presented on a projection screen in another room and included a fourth video clip with 4 additional sentences (16 total). The event phases were presented either 1 day later (experimental condition: $n = 16$; control condition: $n = 11$) or 2 days later (experimental condition: $n = 8$, control condition: $n = 13$). Preliminary analyses of looking times in the different-day condition revealed no interactions of dialogue and test condition with whether testing occurred 1 or 2 days later ($Fs < 1$).

Coding reliability was assessed for 15 children and yielded 98% agreement. Preliminary analyses showed that look-away times varied with dialogue and test condition: A 2 (dialogue condition: transitive, intransitive) × 2 (test condition: experi-

mental, control) × 2 (delay condition: same-day, different-day) analysis of variance revealed a marginal effect of dialogue condition, $F(1, 72) = 3.68$, $p_{rep} = .91$; an effect of test condition, $F(1, 72) = 4.64$, $p_{rep} = .93$; and an interaction of dialogue and test condition, $F(1, 72) = 4.33$, $p_{rep} = .93$. The means in Table 2 suggest that children in the intransitive-dialogue, experimental condition tended to look away longer than children in other conditions, at both delays. As noted earlier, the difference in look-away times led us to analyze raw looking times to the two- and one-participant events.

Preliminary analyses of test-trial performance revealed no interactions of dialogue and test condition with sex, or with whether children's vocabulary or practice-trial performance was above or below the median. The data were therefore collapsed across these factors.

Results and Discussion

Children who heard transitive dialogues looked longer at the two-participant event and less at the one-participant event than did those who heard intransitive dialogues, but only in the experimental condition (see Table 2). The same pattern held at each delay.

Table 3 shows the results of 2 (dialogue condition: transitive, intransitive) × 2 (test condition: experimental, control) × 2 (delay condition: same-day, different-day) analyses of variance for the two looking-time measures. Analyses of looking times to the two-participant event revealed a significant effect of dialogue condition and a significant interaction of dialogue and test condition. As in Experiment 1, analyses of looking times to the one-participant event revealed similar, but less statistically robust, effects.

In the experimental condition, children who heard transitive dialogues looked reliably longer at the two-participant event than did those who heard intransitive dialogues, $t(38) = 4.36$, $p_{rep} = .99$, $d = 1.38$. In the control condition, looking time to the two-

TABLE 2

Mean Looking and Look-Away Times (in Seconds), Averaged Across the Three Event Phases, in the Test Trial in Experiment 2

Dialogue type	Same-day condition		Different-day condition		Overall	
	Experimental	Control	Experimental	Control	Experimental	Control
	Looking time to the two-participant event					
Transitive	5.41 (0.38)	4.30 (0.41)	5.02 (0.27)	4.82 (0.30)	5.17 (0.22)	4.61 (0.24)
Intransitive	4.11 (0.09)	4.60 (0.45)	3.90 (0.26)	4.57 (0.32)	3.99 (0.16)	4.58 (0.26)
	Looking time to the one-participant event					
Transitive	2.28 (0.33)	3.32 (0.44)	2.52 (0.24)	2.80 (0.30)	2.43 (0.19)	3.01 (0.25)
Intransitive	3.09 (0.19)	3.10 (0.45)	3.50 (0.30)	3.00 (0.31)	3.33 (0.20)	3.04 (0.25)
	Look-away time					
Transitive	0.30 (0.07)	0.37 (0.12)	0.46 (0.10)	0.38 (0.10)	0.40 (0.07)	0.38 (0.08)
Intransitive	0.80 (0.16)	0.30 (0.05)	0.60 (0.14)	0.43 (0.10)	0.68 (0.10)	0.38 (0.06)

Note. Standard errors are given in parentheses.

TABLE 3

Analysis of Variance Results for Looking Times in Experiment 2

Effect	Two-participant event	One-participant event
Dialogue condition	$F(1, 72) = 6.56^*$	$F(1, 72) = 3.55^\dagger$
Test condition	$F(1, 72) < 1$	$F(1, 72) < 1$
Delay condition	$F(1, 72) < 1$	$F(1, 72) < 1$
Dialogue Condition × Test Condition	$F(1, 72) = 7.14^{**}$	$F(1, 72) = 3.74^\dagger$
Dialogue Condition × Delay Condition	$F(1, 72) < 1$	$F(1, 72) < 1$
Test Condition × Delay Condition	$F(1, 72) = 1.40$	$F(1, 72) = 1.87$
Dialogue Condition × Test Condition × Delay Condition	$F(1, 72) < 1$	$F(1, 72) < 1$

$^\dagger p < .1$, $p_{\mathrm{rep}} = .91$. $^*p < .05$, $p_{\mathrm{rep}} = .96$. $^{**}p < .01$, $p_{\mathrm{rep}} = .97$.

participant event did not vary with dialogue condition ($t < 1$). These effects held within each delay condition. That is, the effect of dialogue condition on looking time to the two-participant event emerged in the same-day, experimental condition, $t(14) = 3.33$, $p_{\mathrm{rep}} = .98$, $d = 1.66$, and in the different-day, experimental condition, $t(22) = 2.95$, $p_{\mathrm{rep}} = .97$, $d = 1.21$, but this effect did not emerge in the control condition at either delay ($ts < 1$).

Similarly, in the experimental condition, children who heard transitive dialogues looked reliably less at the one-participant event than did those who heard intransitive dialogues, $t(38) = 3.28$, $p_{\mathrm{rep}} = .99$, $d = 1.04$. In the control condition, looking time to the one-participant event did not vary with dialogue condition ($t < 1$). Separate comparisons within each delay condition revealed that the effect of dialogue condition was reliable in the different-day, experimental condition, $t(22) = 2.53$, $p_{\mathrm{rep}} = .95$, $d = 1.03$, but marginal in the same-day, experimental condition, $t(14) = 2.08$, $p_{\mathrm{rep}} = .91$, $d = 1.04$; dialogue condition did not have a reliable effect in the control condition at either delay ($ts < 1$).

Why was the dialogue effect more robust in analyses of looking times to the two-participant event than in analyses of looking times to the one-participant event? The answer may be linked to our finding that in the experimental condition, children who heard intransitive dialogues looked away longer than did those who heard transitive dialogues. The means in Table 2 reveal a baseline preference for the two-participant event: Across conditions, children spent an average of 4.59 s (per 8-s event phase) looking at the two-participant event and 2.95 s looking at the one-participant event. They may simply have been unwilling to spend much more time looking at the one-partici-pant event. Children in the intransitive-dialogue, experimental condition could also have looked away more than others because the intransitive verb was less constraining given the referential contexts provided at test. A transitive verb must refer to a two-participant event, but an intransitive verb could refer to a one-participant event or to part of a two-participant event (Naigles & Kako, 1993; Yuan et al., 2007).

Experiment 2 replicated and extended the findings of Experiment 1. Two-year-olds learned combinatorial facts about a novel verb in a nonreferential context and later retrieved these facts to interpret the verb. This dialogue effect appeared despite the absence of dialogue phases in the practice trials, which eliminates the possibility that the effect in Experiment 1 resulted from superficial patterns detected during the practice trials. The dialogue effect was restricted to the experimental group, which shows that the children linked what they learned during the dialogues to the novel verb; the presentation of the novel verb during the event phases cued the children to retrieve what they had learned. Experiment 2 yielded positive effects whether the dialogue and event phases were separated by a delay of 2 min or by a delay of 1 to 2 days. Evidently, children's ability to learn combinatorial facts about a new verb from listening, and to retain those facts, is quite robust.

What was the source of the syntax-semantics links that permitted the children to draw semantic conclusions about the verb on the basis of its transitivity? In particular, could the children have learned during the experiment to link a transitive verb with a two-participant event? In the practice trials, children heard an intransitive ("Find clapping!") and a transitive ("Find tickling!") verb accompanied by appropriate events. Because the children knew these verbs and their transitivity, these trials could have provided training in the link between verb transitivity and number of event participants. This account of our results still requires that the children learned the new verb's combinatorial properties from the dialogues. However, according to this explanation, children's ability to use that knowledge to interpret the verb was supported by learning during the experiment. Prior evidence renders it unlikely that the children's success depended entirely on learning during the experiment: Two-year-olds appropriately interpret simple transitive and intransitive sentences containing novel verbs in tasks with no practice trials (Fisher, 2002; Gertner, 2007; Naigles, 1990). Such findings suggest that children at this age already possess some knowledge of the relevant syntax-semantics links. Nevertheless, it remains possible that in our restricted testing context, the practice trials might have indirectly supported comprehension of the novel verb, perhaps by priming useful syntactic-semantic representations (Dittmar, Abbot-Smith, Lieven, & Tomasello, 2008). Future experiments will explore this possibility.

GENERAL DISCUSSION

In two experiments, 2-year-olds learned about a new verb's combinatorial privileges from brief dialogues, without a referential context that hinted at the verb's semantic content. If they later encountered the verb in a referential context, they retrieved this combinatorial information and used it to guide their attention to candidate events. Children who had heard the verb used transitively looked longer at a two-participant event than did those who had heard the verb used intransitively. This effect persisted when testing occurred on a different day. These experiments provide compelling new evidence for a key assumption of syntactic bootstrapping—that sentence structures carry meaning independently of the verbs in those structures. These findings also raise interesting questions for future research about the nature of the combinatorial information children acquired about the new verb from their listening experience.

First, how did the children encode the dialogue sentences? During the dialogues, the children could have created lexical entries with the linguistic status of new transitive or intransitive verbs. Alternatively, they could have created shallower representations, noting that the new verb occurred with two nouns, or with one. Under some circumstances, 25-month-olds distinguish transitive sentences ("The duck is gorping the bunny!") from two-noun intransitive sentences ("The duck and the bunny are gorping!"; Naigles, 1990). In our dialogues, however, the challenge of encountering sentences without referential support might have caused the children to resort to shallower representations. Crucially, even shallow sentence representations should lead to success in this task. Elsewhere we have proposed that children are biased to interpret each noun in a sentence as a semantic argument of a predicate term (Fisher, 1996). According to this proposal, as soon as children can identify some nouns, they assign different interpretations to transitive and intransitive verbs by mapping a two-noun verb onto a two-participant conceptual predicate and a one-noun verb onto a one-participant conceptual predicate. This proposal suggests that even children younger than 2 years old might succeed in a version of this task. Future experiments will pursue this possibility, and explore 2-year-olds' sentence representations by presenting dialogues that disentangle transitivity from the number of nouns.

Still another possibility is that the children remembered one or more dialogue sentences verbatim, rather than encoding a more abstract representation. This would be akin to an instance-based account of our findings. Note that even such an instance-based account would involve interesting generalization on the child's part: Retrieved instances of sentences such as "Jane blicked the baby" or "Jim is gonna blick the cat" did not prevent the children from extending the new verb to a two-participant event involving two grown women. This suggests that useful abstraction of some form took place, whether upon retrieval (in an instance-based system) or upon encoding (in an abstractionist system).

Second, did the children engage in semantic processing while encoding the dialogue sentences? Even without a useful referential context, the children might have used the distributional information available in the dialogue sentences (e.g., two-noun or transitive verb) to infer an appropriate semantic structure (two participant roles). Alternatively, the children could have gathered the distributional information without inferring a semantic structure until they encountered the verb in a referential context. We anticipate that the dialogue-and-test method introduced here will allow us to address this issue, by manipulating the content of the dialogue sentences and the referential options provided at test. For example, in a recent extension of this task, 2-year-olds' interpretations of a verb reflected the characteristics of the nouns that filled the verb's argument slots during the dialogues (e.g., the nouns' animacy; Scott & Fisher, in press). This finding suggests that the children assigned a partial interpretation to the sentences containing the novel verbs while they listened to the dialogues, in the absence of a referential scene.

The ability to gather combinatorial facts about unknown verbs by listening, and to retain these facts over time, could help solve a problem for syntactic bootstrapping and for syntax acquisition: Sentences can contain extra (adjunct) phrases, and in many languages, verbs' arguments can be omitted if they are recoverable in the discourse context. Thus, individual sentences are not reliable indicators of a verb's argument structure. In principle, learners could overcome this difficulty by gathering syntactic information across many sentences to estimate each verb's argument structure (Fisher & Gleitman, 2002). The present findings suggest that children have the necessary tools to do this. Two-year-olds interpret a sentence using not only the syntactic information available in the current sentence, but also the verb's syntactic history.

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