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Morphological cues to verb meaning

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ABSTRACT
Two experiments investigated the role of inflections in verb learning. In Study I, 3- to 5-year-olds with typical language development were asked to extend novel verbs to new instances. They heard the verbs inflected with either *-ed* or *-ing* and were given a forced choice between events that maintained either the activity or the result of the original event. The younger children selected events according to the verb inflection: same-activity events for *-ing* and same-result events for *-ed*. Older preschoolers chose same-result events throughout. Study II was conducted to investigate the nature of this causal bias. A group of 4- to 5-year-olds with specific language impairment completed the same verb extension task. They were equivalent to the older Study I children in age and IQ but were at lower language levels than the younger group. Children in the SLI group used neither the inflectional strategy nor the same-result strategy. Findings from the two studies point to a developmental period during which children treat inflectional cues as reliable guides to verb meaning. The discussion focuses on the rise and fall of such inflectional bootstrapping and the linguistic character of the same-result bias that replaces it.

Children use a wide range of cues to guide their inferences about the meaning of new words. Some of these cues reside in properties of the reference object or event, but many come from the language input itself. Syntactic context (Gleitman, 1991; Naigles, 1990; Taylor & Gelman, 1988), features of known words (Clark, 1993), and grammatical morphology (Katz, Baker, & Macnamara, 1974) are all potent sources of information about meaning. The present investigation focuses on the role of grammatical morphemes. Research reported by Koenig and Naigles (1995) provides a useful starting point. Their subjects at 15 months failed to distinguish between nouns and verbs on the basis of grammatical morphology, although they did show some use of prosodic cues. By 2 years of age, however, children can recognize familiar closed class words (Gerken, Landau, & Remez, 1990) and are able to use grammatical morphology in decisions about form class membership and semantic categories. In Katz et al. (1974), for example, 2-year-olds were more likely to treat a novel word as a category label if it had been initially presented following an article (*the, a*): namely, as a common noun rather than a proper noun.

Behrend, Harris, and Cartwright (1995) saw the possibility of similar "morphological bootstrapping" underlying verb subcategorization. In English there is a certain congruence between the temporal meanings of the inflections *-ing* and

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-ed and the inherent aspectual meanings of activity and achievement verbs (Bybee, 1985; Pustejovsky, 1991). The progressive inflection *-ing* expresses the idea that something is ongoing, and is thus in harmony with verbs that refer to events that have no inherent endpoint and therefore extend in time (i.e., activity verbs such as *run*). The past inflection *-ed,* in contrast, expresses the idea of completion and thus is harmonious with verbs that refer to events that do have an inherent endpoint and are punctual (i.e., achievement verbs such as *break*). This semantic congruence apparently leads to patterns of heightened co-occurrence, at least in the language world of the young child learning English. Maternal input contains frequent pairings of activity verbs with *-ing* and achievement verbs with *-ed* (Sharai & Anderson, 1995). Children use the *-ing* and *-ed* inflections first with those verbs that have the most compatible meanings: activity and goal-oriented (telic) verbs, respectively (Clark, 1996). The language produced in the early preschool years yields similar correlations (Bloom & Harner, 1989; Bloom, Lifter, & Hafitz, 1980; Clark, 1996; Harner, 1981; Tomasello, 1992). This linguistic and developmental evidence indicates that young children might well be able to interpret the presence of *-ing* or *-ed* as a signal that a new verb has an activity or an achievement meaning.

To investigate whether such bootstrapping actually occurs, Behrend et al. (1995) asked young children to make inferences about the meaning of a novel verb. They showed 3- and 5-year-olds novel events involving "an adult [using] an unfamiliar instrument in an unusual way to produce a clear and specific result" (p. 93). Each event was accompanied by a novel verb inflected with either the progressive *-ing* or the perfective/past *-ed*. Following this initial event, the children saw four test events, three that differed from the original in either the instrument used, the action performed, or the result obtained and a fourth that was identical to the original. Test events were presented in turn. Following each event, the experimenter would ask the child whether the novel verb (with inflection) was an appropriate label for that event (e.g., "Was she pint*ing* that time, or was she doing something else?").

Behrend et al. predicted that when the novel verbs were inflected with progressive endings, children would accept only those events in which the *action* remained constant, and that when the novel verbs were inflected with past endings, children would accept only those events in which the *result* remained constant. Results from the study indicated that the 3-year-olds conformed to these predictions, but the 5-year-olds only showed the predicted pattern for verbs inflected with the past tense. The Behrend et al. data thus show that by age 3, children can use inflectional morphemes to guide their inferences about verb subcategorization, but they also suggest that such morphological bootstrapping may only be used during a particular phase of language acquisition.

Several features of Behrend et al. (1995) invite further study. First, their experimental task required memory of the original event over several competing trials and asked for a verbal, second-order judgment of similarity. This cognitive complexity may have been responsible for the generally low positive response rate in all conditions. Young children might perform differently on a simpler task. Second, there was no investigation of the role played by features of the event. Although it is true that Behrend et al.'s six initial events all had an

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inherent outcome (telicity), they differed in the degree to which the causal action extended in time (e.g., the punctual achievement event *grab* versus the durative accomplishment event *slide to*). For linguistic theorists, duration distinguishes between the two classes of telic verbs, achievements versus accomplishments, but not between activity verbs and all telic verbs (Pustejovsky, 1991). The young children in Behrend et al.'s study may have taken *-ing* as a cue to durativity rather than atelicity, but this possibility was not explored.

This report describes two experiments designed to replicate and extend the Behrend et al. (1995) findings. Study I tested the effects of changes in task parameters. We asked young children to extend the meaning of a novel verb either to an event that maintained the original action or an event that maintained the original result. We reduced the cognitive demands of the task by leaving the original event on screen and asking only for first-level similarity judgments. We also designed our events such that half were durative and half were punctual, allowing us to test the basis of children's decisions. We predicted that task changes would lead to higher response rates and more sharply defined developmental patterns. In addition, given the literature cited previously on correlations between verb types and inflections, we predicted that young children would indeed be found to base their verb extensions on the goal orientation, or telicity, of the event rather than duration.

STUDY I

Method

Subjects. Participants in this study were 21[1] preschool children between the ages of 3;6 and 5;2, from English-speaking families. The children were divided into two separate age groups ranging in age from 3;6 to 4;3 and 4;5 to 5;2, respectively. Mean ages and test scores from language and cognitive assessment are presented in Table 1. Statistical analyses indicated significant group differences for chronological age, $t = 7.39$; $df = 1, 19$; $p < 0.01$, but no significant differences for nonverbal IQ (Columbia Mental Maturity Scale [CMMS], Burgemeister, Hollander Blum, & Lorge, 1972), mean length of utterance (MLU), or raw scores from the Developmental Sentence Score (DSS, Lee, 1974), a global standardized measure of expressive language proficiency based on language sample data. Because our focus was to be on grammatical morphology, we also administered a standardized test of morphological performance, the Grammatic Closure subtest of the Test of Language Development (TOLD-GC, Burgemeister et al., 1972). This task asks children to complete items such as *"Jane likes to jump. Now she is ____"* while looking at picture stimuli. Mean raw scores for this task differed significantly between groups, as is evident in Table 1, $t = 2.12$, $df = 16$, $p = .05$.[2]

Materials. The core stimuli for this experiment were 12 videotaped transitive events, similar to those presented in Behrend (1990) and Behrend et al. (1995). Each core event consisted of a person performing an action that achieved a particular goal. The events were designed to be novel insofar as they involved

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Table 1. *Age, language scores, and IQ by group*

	Older NL ($n = 11$)	Younger NL ($n = 10$)
CA in months		
M	57	47
SD	2.91	3.10
MLU		
M	5.34	5.24
SD	0.63	0.78
DSS raw score		
M	8.37	7.91
SD	1.08	1.12
CMMS		
M	106.5	108.5
SD	5.15	6.00
TOLD-GC raw score		
M	10.5	8.1[a]
SD	2.5	1.9

Note: DSS, Developmental Sentence Score; CMMS, Columbia Mental Maturity Scales; TOLD-GC, Test of Language Development, Grammatic Closure subtest.
[a] $n = 7$.

unusual combinations of objects being manipulated in unpredictable ways. Each event would welcome either an activity verb or a telic verb, depending on the viewer's interpretive focus. When creating the novel events, two additional factors were considered: duration and type of end state. Four events were designed in each of three end-state categories: change of physical state (e.g., a cube being flattened), change of orientation (e.g., an object being knocked over), and change of location (e.g., an object going into a container). Within each of these categories, there were two events that extended in time (e.g., *roll, spin, grind*) and two that were punctual (e.g., *stab, flick, jab*). Finally, half of the punctual events were iterated (e.g., *repeatedly flick*), although it was not possible to balance this dimension across end states.

In addition to the 12 core events, 24 events were created that differed systematically from the originals. For each core event, two similar events were generated – one that used a different action to achieve the same result and one that used the same action to achieve a different result. In other respects, the members of each event triad were as similar as possible. A complete listing of the event triads is provided in the Appendix.

The 36 events were videotaped, edited, and compiled as follows. A core event was presented twice on the full screen, followed by one presentation in a smaller box at the top of the screen. This was followed by a simultaneous presentation of the event triad: the core event was again shown in the box at the top of the screen, with the altered events shown in boxes at the bottom right and left of the screen. After a 2-s pause, all three events were presented simultaneously

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Table 2. *Novel words*

Mof	Paz	Kuz
Tuz	Nev	Bef
Dax	Guf	Tov
Biv	Dis	Nish

Note: orthographic spelling.

again, in their same positions. The relative position of the result and the action members of the triad was randomly varied from triad to triad. This basic presentation sequence was repeated for all 12 events. The order of the core events was randomized once, and each child viewed the events in this same order.

Each event was described with a novel verb as it was first presented (e.g., "She's moffing."). The 12 nonce words were formulated according to the following specifications: consonant–vowel–consonant (CVC) syllable sequence; stop as initial consonant; fricative as final consonant; phonotactically acceptable in English. These specifications minimized the influence of phonotactics, syllable shape, or sound sequencing on the child's interpretation of the nonce form (see list in Table 2). Each novel verb was given in an inflected form, alternating across items between present progressive (e.g., "She's moffing.") and past tense (e.g., "She moffed."). Half of the children in each group received the first item inflected with *-ing* and the other half received it with *-ed*.

Procedures. To introduce the children to the task, the session began with three training items involving familiar events (e.g., a girl jumping, a girl breaking an egg). The child watched the event, paired with an inflected verb ("She jumped."), three times and then was asked to find a similar image among several other simultaneous choices. Instruction and repetition was provided as necessary until the child demonstrated a good understanding of the task. The experimental items were then presented. As just described, each core event was viewed three times in isolation. Just prior to each viewing, the experimenter would state the sentence containing the inflected novel verb. Following the initial three presentations, the child was told to "watch carefully" as the members of the event triad appeared simultaneously on the screen. Once these events had ended, their image remained on-screen and there was a brief pause. During this pause, the experimenter would point to the top box and say to the child: "Here she's biffing/she biffed. Point to another one!" The three events were then played again and the child selected an event scene. This scenario was repeated for all 12 trials, and the experimenter noted the child's response on a record form. Very few of the children spoke while watching the video events. The scattered comments that did occur tended to be labels of affected objects.

Results

The first set of analyses looked at whether young children can use morphological information to help interpret novel verbs. Because the experimental task

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Table 3. *Mean* (SD) *for number of times "same result" was selected for each inflection by age group*

Inflection	Younger	Older
-ing	1.6 (0.97)	4.0 (1.48)
-ed	4.2 (1.03)	4.1 (1.45)

Note: Max = 6.

elicited a forced choice response between two events (i.e., same-action or same-result), it was possible to capture response patterns by analyzing the number of times a child selected same-result events in each inflection condition. Table 3 presents group means for this variable. Overall, the younger group selected the same-result example more frequently for events labeled with the *-ed* inflection than for events labeled with the *-ing* inflection. The older group selected same-result events at equivalent frequencies regardless of whether verbs were inflected with the *-ing* inflection or the *-ed* inflection.

The reliability of the observed group differences was tested using a two-way, mixed-model analysis of variance (ANOVA), Group (2) × Inflection (2), with inflection treated as a within-subjects variables. The number of times a child chose the same-result event was the dependent variable. Since preliminary analyses of the presentation order of verb inflections indicated no effects, this factor was not included in this or any further analyses. The two-way ANOVA indicated reliable main effects for group, $F = 8.93$, $df = 1, 19$, $p < .01$, and for inflection, $F = 11.38$; $df = 1, 19$, $p < .01$. A reliable Group × Inflection interaction was also obtained, $F = 9.90$; $df = 1, 19$, $p < .01$. Overall, the older group selected more same-result events than did the younger group and same-result responses were more likely to occur when verbs were presented with *-ed* inflections than with *-ing* inflection. The comparison of greatest interest is in the interaction effect. As is clear in Table 3, children in the younger NL group were significantly more likely to select the event with the same result if the verb had initially been presented with an *-ed* inflection than if it had been presented with an *-ing* inflection. Children in the older NL group showed no such difference and tended to choose events with the same result regardless of the syntactic frame in which the verbs were presented.

The individual responses of each participant were examined to validate these group findings, looking for performance patterns across the 12 items. Three patterns were identified: (a) preference for same-action events regardless of inflection (9 or more, binomial $p = .07$); (b) preference for same-result events regardless of inflection (9 or more, binomial $p = .07$); (c) morphological bootstrapping, namely, same-action responses for *-ing* and same-result responses for *-ed* (9 or more "hits," $p = .07$). In the younger group, five children showed the bootstrapping pattern, whereas in the older group there was only one child showing this pattern. In contrast, five children in the older group showed a preference for same-result events, whereas no children in the younger group showed this pattern. One child in each group showed a same-action preference.

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Table 4. *Group means* (SD) *for number of "same-action" responses to events with three different types of temporal extent*

Group/event type	Punctual	Punctual-iterated	Durative
Younger	2.1 (0.88)	1.1 (0.88)	1.6 (0.97)
Older	1.0 (1.1)	1.1 (0.83)	0.64 (0.67)

Note: Max = 3.

The remaining eight children (four in each group) failed to meet the criteria for any pattern, though five were only off their group's modal pattern by one response. A statistical comparison of the individual performance patterns indicated that group differences in the distribution of response patterns were reliable, maximum likelihood chi square = 11.32, $df = 4$, $p < .05$. This finding is in accord with the previous grouped data analysis.

Finally, Pearson product-moment correlations were calculated between total number of same-result responses, IQ, and language raw scores (MLU, DSS, TOLD-GC). The resulting coefficients were modest in size, ranging from .05 to .35, and none was significant at the .05 level (not even the measure specific to morphological knowledge, the TOLD-GC).

The second set of analyses investigated the role played by the temporal properties of the events in determining the children's responses. Although all 12 of the core events were telic (i.e., resulting in changes of state with inherent end points), half of the actions were durative and half were punctual. In addition, half of the punctual events were iterated, a characteristic that might lead to them being viewed as extending in time. To test the effect of these temporal properties, three events were randomly selected from the durative set and responses to these events were compared to those for the three punctual and the three punctual-iterative events. Greater event duration seems to invite comments on ongoing action. Hence, if children were being influenced by the duration of the events, they should be more likely to interpret a novel verb as referring to an action when it describes durative and iterated events than when it describes punctual, noninterated events. Group means for same-action responses to the three event types are given in Table 4. As can be seen, differences between conditions were small for both groups, and there was little support for our prediction.

A two-way, mixed-model ANOVA was conducted to further investigate the effects of event duration, Group (2) × Event Type (3), with event type treated as a within-subjects variable. The number of "same action" responses was the dependent variable. The ANOVA yielded only a significant main effect for group, $F = 6.92$, $df = 1,19$, $p < .025$. Neither of the effects involving event type proved significant. As might be expected from earlier analyses, the older children selected more same-result events overall, but the group data provided no evidence that the duration of the events was influencing the response patterns at either age.

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Discussion

In major respects, the findings from this study replicate those reported by Behrend, et al. (1995). Younger preschoolers were more likely to judge that the meaning of a novel verb referred to an action if they initially heard the verb inflected with *-ing* and to judge that the meaning of a novel verb entailed the result of an action if they heard it inflected with *-ed*. Older preschoolers did not show this differentiated pattern and extended novel verbs according to the results of actions, regardless of the initial inflection. In contrast to Behrend et al., we did not manipulate the instrument in our design, we asked children only for match-to-sample judgments, and we reduced memory requirements by leaving the original event on-screen. These simplifications in the task brought the developmental patterns into sharper focus but had little effect on the response trends or the ages at which they occur.

Findings from this experiment add further detail to our understanding of early language acquisition. As reviewed here, there is a heightened co-occurrence of *-ed* with telic verbs and *-ing* with activity verbs in the language world of the young child. Although toddlers seem unable to use inflectional morphemes as cues to verb meaning (Koenig & Naigles, 1995), 3½-year-olds do take advantage of the probabilities and use inflections to guide their initial semantic representations. What leads to this new success with morphological bootstrapping? At least part of the answer may lie in grammatical developments. As described by Tomasello (1992), toddlers often learn an inflected form of a verb before they acquire the verb root, implying that at this stage, inflections are included as part of the lexical entry for a verb and do not yet function as part of an independent syntactic system. Further language experience and vocabulary growth (Bates & Goodman, 1999) leads to the separation of the root from the inflection and the emergence of inflectional paradigms in the grammar. Once established as an independent system, inflections can take on their own meanings and provide pointers to the likely semantic features of a new lexical root.

The age or stage at which inflectional paradigms achieve such independence remains uncertain. Researchers who use evidence from expressive language samples have reported contrastive use of English inflections in 24- to 28-month-olds (Bloom, et al., 1980), but a recent experiment by Bedore and Leonard (2000) suggested that the competence underlying this usage may limited. These researchers tested the ability of young 3-year-olds to "fast map" novel verbs. The children performed well when the inflection on the test item was identical to the one used in the initial presentation but had difficulty when the inflection was changed. Bedore and Leonard argued that although an inflectional paradigm may exist at this age, it is applied conservatively, to familiar verb roots; lexical entries for new verbs continue to include the inflection. The present findings suggest either that children have passed out of this phase as they approach age 4 or that the meaning of the inflection is noted even when the lexical entry is unanalyzed. To resolve such questions, we will need further research focused on the period during which inflectional paradigms are being established.

We turn now to the performance of the older preschool group. The responses of these children are interesting in two respects: they seem to have abandoned

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the strategy of morphological bootstrapping and they seem to have focused on the results of causal events. What aspects of development might lie behind these two findings? Consider first the fact that the 4-year-olds no longer used inflectional endings as a guide to their initial interpretation of novel verbs. They may still use morphological cues for other analyses such as determining form class membership, but the probabilistic links between *-ing* and activity verbs and between *-ed* and telic verbs are no longer potent. The key to this change may lie in the fact that the bootstrapping strategy not only relies on the probability of harmony between lexical and grammatical aspects but also on the presumed reliability of inflectional forms as markers of grammatical aspect. As children move into their 5th year, two sorts of development, one grammatical and one pragmatic, serve to undermine this reliability.

Researchers once argued that early tense forms in English were actually expressions of aspect (e.g., Antinucci & Miller, 1976), noting that the *-ed* was used only on telic verbs. That claim now seems to have been overstated, given that past tense forms are actually used on activity verbs very soon after the forms are acquired, albeit at low frequencies (see Fantuzzi, 1996, for review). It remains true, however, that the preponderance of early verb inflections do agree with lexical aspect (Bloom et al., 1980; Bloom & Harner, 1989; Clark, 1996; Harner, 1981), suggesting strong links between inflection and aspectual meanings. This may be an area in which early expressive language includes implicit competencies that only later become productive and explicit (Bowerman, 1985). If so, the catalyst for reorganization could be the emergence of the auxiliary system in the middle preschool years, bringing the possibility of the "past progressive," a form that explicitly differentiates grammatical aspect and tense. The acquisition of this form could promote the entry of new semantic features into the inflectional paradigm and a reorganization of the system. A failure to find an analogous formal distinction on the perfective side of the paradigm could then lead to an awareness of the plurifunctionality of the English *-ed,* a single form that serves both the past tense and perfective aspects.

There are also pertinent pragmatic developments during this period as children enter the world of true discourse. Their conversation reveals a new understanding of the other person's perspective and an ability to see the world from more than one vantage point; narrative monologues become longer and more removed from personal experience (Nelson, 1996). These new text-making capabilities require, and exercise, an elaboration of temporal language. As temporal perspectives and forms become more diverse, there is a reduction in the correlations between inflection and verb type, both in the input and in the child's own speech experience. The ultimate effect of both the differentiation of inflectional paradigms and these discourse developments is to provide the child with new evidence that English grammatical tense is not a reliable cue to verb meaning. This realization could underlie the demise of the inflectional bootstrapping strategy.

The second aspect of the older group's response pattern is equally interesting: they selected same-result events in both inflectional conditions. This pattern is not the necessary consequence of abandoning morphological bootstrapping. Responses could have been random or could have emphasized the action compo-

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nent of the events. Instead, the older children seemed to believe that the resulting end state was central to the verb's meaning. In our domino item, for example, older children extended the verb as if it meant *do something to make the dominoes fall down,* ignoring differences in action patterns (i.e., bowl versus twirl). They were unlikely to extend the verb as if it meant *bowl,* thus ignoring differences in result (i.e., dominoes falling vs. box spinning). Such a preference for end state over action in verb meaning has been observed in other investigations as well (Behrend, 1990; Forbes & Farrar, 1993). Although our novel verbs were presented in intransitive sentences to minimize the syntactic cues to causality (Bowerman, 1974; Naigles, 1990), the mere fact that the children were considering a verb that was presented while viewing someone engaged in a manipulative activity may have ensured the bias toward causal interpretation. Slobin (1985) argues that, from the earliest stages, such contexts are prototypical organizing points for grammatical development. The notions evoked by manipulative activities include object concepts, manual agency, changes of state, and "overarching notions of efficacy and causality" (p. 1174). This line of argument suggests a U-shaped course of development for the "fast mapping" of verbs. Toddlers may be using causal, result-oriented interpretations for new verbs soon after they enter the multiword stage. Then would follow the period during which inflectional cues gain dominance. Later, when the bootstrapping strategy is abandoned, children would revert to the default, causal interpretation.

An alternative explanation begins, not with the prototypical scene, but with Bowerman's (1974, 1977, 1985) account of changes in causal expressions during the end of the 4th year. An in-depth analysis of conversational samples from her own children revealed a period of language development during which there were related patterns of growth in lexical and syntactic form, namely, *wh-* questions, and paraphrastic causal sentences, as well as overgeneralization errors in causal syntax (e.g., *"I'm just gonna fall this on her"*). Although the forces that motivate these changes remain unclear, Bowerman does seem to have identified a period during which children are newly interested, and engaged, in the analysis of causal events. The responses of our older group could be one further manifestation of such interest. Studies that observe 2-year-olds in verb fast-mapping tasks would be useful in choosing between these accounts.

Finally, although we prefer explanations that focus on verb context or the analysis of causality, we must mention two other possibilities. First, the preference for same-result events could reflect a more differentiated lexicon. Even without overt labeling, children may have used verbal schemes, internally, to interpret the video scenes. Children who already had a lexical entry for a given activity might have been more likely to decide that a new verb presented in the context of that activity entailed the end state, and the older group would have presumably included more such children. For this explanation to work, however, children would not only need to know more activity terms, they would need to use them to interpret the video images. While we use labels such as "punch" and "bowl" in the Appendix to capture the manner of the video actions, children would probably use words such as "hit" and "throw" for these same events. If so, the younger and older preschoolers would not differ markedly in their encod-

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ing of the events, despite differing lexical resources, which mitigates the adequacy of this explanation.

Second, some or all of the preference for same-result events may reflect a task bias. Both this study and Behrend et al.'s (1995) research used only events with salient causal actions and end states. It could be that the older preschoolers were drawn to causal interpretations by the consistent presence across all test items of these resulting end states. Future studies that provide children with a mixture of event types could help to isolate this effect.

In sum, findings from Study I indicate that there is a developmental period during the early preschool years when children use inflectional morphemes as cues to verb meaning. We argue that this strategy is made possible by the emergence of independent inflectional paradigms. Older preschoolers, in contrast, do not seem to use inflectional cues. We argue that the differentiation of tense and aspect, as well as increased experience with discourse, leads them to discover the unreliability of inflection as a cue to verb meaning, and hence to abandon this bootstrapping strategy. Instead, older preschoolers give consistently causal interpretations of new verbs, either because causality is a default organizing force in language learning at virtually all ages or because it is a particularly salient organizing force for 4-year-olds.

This discussion leaves us with at least one additional question. The bias toward causal results can be viewed as either linguistic or nonlinguistic in nature. Although it is true that we failed to find that children's responses were affected by event duration, other cognitive factors could be responsible for our findings. The lack of correlation between same-result responses and our various language measures supports such a view. One way to investigate this possibility would be to observe children with specific language impairment (SLI), who show a developmental dissociation between cognition and language. If the same-result responses reflect nonverbal cognitive development rather than language knowledge or experience, children with appropriate mental ages should show this response even if their language is quite limited. We designed Study II to exploit this "natural experiment." A group of older preschoolers with SLI was asked to complete the morphological bootstrapping task. Their response patterns were then compared to those of children in the prior study to shed light on the nature of same result biases and the early availability of inflectional bootstrapping strategies.

STUDY II

Method

Subjects. Participants in Study II were 9 children between the ages of 4 and 5 with SLI. They were selected on the basis of cognitive and language assessments, both formal and informal. All were required to earn normal range performance IQs on the CMMS (Burgemeister et al., 1972) and to score below −1 *SD* on at least two of the following subtests of the TOLD (Newcomer & Hammill,

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1988); Grammatic Understanding, Sentence Imitation, and Grammatic Closure. Conversational language samples were also collected, transcribed, and analyzed for MLU and analysis by DSS (Lee, 1974), a standardized measure of global expressive language proficiency. All children were required to earn DSS scores below the 10th percentile, and to have used both the *-ing* and the *-ed* inflections in at least 33% of at least four obligatory contexts. The average percentage use in obligatory contexts for *-ing* was 86% and for *-ed,* 48%. Finally, all children in the SLI group had been judged to be socially appropriate by their teachers and were free of sensory or motor disability.

Mean age for the SLI group was 4;10; and mean performance IQ was 100.2. Neither of these values differed significantly from the older group in Study I. In contrast, the mean MLU for the SLI group was 3.4 (.59), the mean DSS raw score was 4.85 (.89), and the mean TOLD-GC subtest raw score was .67 (1.3). All of these values fall significantly below those of either group in the previous study, MLU: $F = 26.2$, $df = 2, 27$, $p < .01$; DSS: $F = 31.8$, $df = 2, 27$, $p < .01$; GC: $F = 62.4$, $df = 2, 24$, $p < .01$, Scheffé post hoc tests at .05.

Procedures. Children in the SLI group completed the experimental task as described in Study I.

Results

The primary analyses concerned the SLI group's relative performance in the two conditions of the experimental task. Would their event selection patterns indicate ties to verb inflection, or would they, like their age peers, prefer to select same-result events regardless of inflection? As before, we counted the number of same-result responses given *-ing* and giving *-ed*. Mean values (and standard deviations) were virtually identical in the two conditions: 2.9 (.93) and 3.0 (1.3), respectively, out of a possible 6, and did not differ from the pattern expected on the basis of chance alone.

Analyses of individual performance were conducted to see whether these group findings actually hid more differentiated, but contrasting, patterns. This was particularly important because the youngest two SLI children overlapped in age with the younger group in the previous study. However, when we applied the criteria developed in Study I, no child gave evidence of morphological bootstrapping or showed a preference for either same-result and same-action events.

The second analyses concerned the SLI group's relative performance with events of differing duration. If linguistic factors did not predict their performance, perhaps a nonlinguistic factor would do so. Mean number of same-action responses were calculated for events that were durative, punctual-iterated, and punctual. If the dimension of duration were guiding responses, we would expect more same-action responses to events with greater extent since they welcome comment on ongoingness. The three means (*SD*) were punctual, 1.4 (.73); punctual-iterated, 1.9 (.78); and durative 1.4 (.73). Given the evident similarity in these values, no further statistical tests were conducted.

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Discussion

Study I had suggested that morphological bootstrapping of verb meanings emerges out of the establishment of inflectional paradigms and declines when further language development reveals the unreliability of inflection as a source of information about the meaning of a new verb. In its place, children come to rely on a cognitive or semantic strategy that emphasizes the results of complex causal events. In Study II we selected a group of children with SLI who were the cognitive and age peers of the older preschoolers in Study I but had somewhat less language than the younger preschoolers in that study. This dissociation of verbal and nonverbal abilities gave us an opportunity to examine the character of the same-result strategy. The findings of Study II are empirically straightforward. The children with SLI gave no evidence of using either the inflections, the results of the events, or the duration of the events to guide their extensions of new verbs. Their performance on the training trials indicated that they understood the task, but their response to the experimental trials was at chance level. We consider now the implications of these facts for our understanding of inflectional bootstrapping.

First, and contrary to our expectations, the SLI group did not select same-result events, as might be expected from their age and normal range performance IQ. Although children with SLI have difficulty with certain cognitive tasks (Johnston, 1994), our experimental task placed little demand on memory and involved no obvious internal symbolization or higher level reasoning. Children who could find conceptual similarities between pictures on the CMMS should have been able to find causal similarities in our events – if nonverbal cognition were the critical factor and if the task were treated as a nonverbal task. Apparently, however, these conditions were not met. Our failure to find same-result biases in an appropriately aged SLI group implies instead that the same-result orientation is a linguistic phenomenon, namely, a strategy that may draw on cognitive resources but manipulates language "objects" and is used in the context of language learning. Such language-only strategies have been observed in other studies of lexical learning, especially studies of young children learning nouns (e.g., Jones, Smith, & Landau, 1991; but see also Cartwright & Behrends, 1995).

The observed lack of correlation in Study I between language variables and the same result strategy may reflect restricted variance or some other limitation of our language measures. Although the correlations were not statistically significant, it is worth noting that all of the group differences were in the right direction and that group means for the GC task were, in fact, significantly different. Moreover, when the correlations are recalculated to include the SLI group (increasing the range of language performance), the correlation between DSS raw scores and same-result responses is significant, $r = .41$, $p < 05$. These facts, like the findings from Study II, point to the fundamentally verbal nature of the factors responsible for the same-result strategy.

Second, the children with SLI gave no sign of using morphological bootstrapping strategies. This is noteworthy because all of them were using both the *-ing* and the *-ed* inflection in their spontaneous speech, albeit imperfectly. Recall that

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in Bedore and Leonard (2000), children at approximately the same language level as our SLI children had difficulty recognizing a verb root if its inflection was altered, implying that they did not initially treat the root and the inflection as independent forms. Both of these findings suggest that the inflectional paradigm must be well established, beyond the level found in young 3-year-olds, before it can support the learning of verb meanings. Note that this conclusion, not only informs our view of the inflectional bootstrapping strategy, it also points to a hidden cost of the morphology deficits seen in English-speaking children with SLI (Leonard, 1998). Besides causing miscommunication, poor control of grammatical morphology may impede lexical learning.

We close with a reminder that inflectional morphemes are only one of many sorts of cues to meaning. Our experimental task was designed to remove the social, semantic, and discourse cues that support language learning in real life. The findings of this study can therefore illuminate only one facet of what must ultimately be a multidimensional model of lexical development (Golinkoff, Hirsh-Pasek, & Hollich, 1999). We also acknowledge that it is risky business to argue from the performance of an atypically developing group. The validity of such arguments depends on the adequacy of our knowledge about the condition, psycholinguistic models, and understanding of the required response. In the present case, the analysis of the conceptual demands of the experimental task may be faulty; moreover, the cognitive limitations of the children with SLI may have impinged on their performance after all.

Taken at face value, however, the two studies point to a period during the middle preschool years when children learning English use inflectional morphemes as cues to the meaning of a novel verb. This strategy reflects both maturity and immaturity in the underlying paradigms. The inflectional systems must be well enough established to provide independent cues yet sufficiently incomplete to seem reliable. As unreliability becomes evident, children turn to semantically based strategies that may be enabled by conceptual growth but are, importantly, verbal in character. Further studies with typically developing preschoolers will be needed to confirm these conclusions.

APPENDIX

Event	Change type	Temporal shape	Iteration
Press a block into play dough to cut it in half	Physical state	Durative	No
New action: saw play dough in half	Physical state	Durative	No
New result: press play dough to make it flat	Physical state	Durative	No
Punch a balloon with a sharp object to pop it	Physical state	Punctual	No
New action: slam balloon onto a sharp object to pop it	Physical state	Punctual	No

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APPENDIX (*continued*)

Event	Change type	Temporal shape	Iteration
New result: punch balloon and it slowly deflates	Physical state	Punctual	No
Roll a rolling pin over a ball of dough to flatten	Physical state	Durative	No
New action: turn rolling pin on end and mash dough to flatten	Physical state	Durative	Yes
New result: roll rolling pin over dough and gingerbread man emerges	Physical state	Durative	Yes
Drop tablets (Alkaseltzer) into glass of water, water begins to fizz	Physical state	Punctual	Yes
Action change: flick tablets with forefinger into glass of water, water begins to fizz	Physical state	Punctual	Yes
Result change: drop tablets in glass of water, water changes color	Physical state	Punctual	Yes
Jab container over with spatula	Orientation	Punctual	No
New action: flip container over with spatula	Orientation	Punctual	No
New results: jab container, container spins, but does not fall over	Orientation	Punctual	No
Catapult ball into a wall, knocking the wall down	Orientation	Punctual	No
New action: jab ball mounted on stick into wall, wall falls	Orientation	Punctual	No
New result: wall swings on a string	Orientation unaffected	Punctual	No
Spin a pasta scooper to knock over some plastic cups	Orientation	Durative	No
New action: sweep cups over with the scooper	Orientation	Durative	No
New result: spin pasta scooper, causes something in cups to pop up when it touches it	Orientation	Durative	No
Roll (like bowling) an object into a row of dominoes, knocking them over	Orientation	Durative	No
New action: twirl object near dominoes, causing them to knock over	Orientation	Durative	No
New result: roll object against box mounted on top of sticks, box rotates	Orientation	Durative	No
Pour rice through funnel into cup	Location	Durative	No
New action: scoop up rice with funnel and put in cup	Location	Durative	No
New result: rice falls all over the table	Location	Durative	No

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APPENDIX (*continued*)

Event	Change type	Temporal shape	Iteration
Scoop up a ball of clay with a spoon and place it in a box	Location	Durative	No
New action: box on side, push clay into box with spoon	Location	Durative	No
New result: scoop up clay, it falls off disk and lands on table	Location	Durative	No
Flick sponge pieces to one side of a tray with a paint brush	Location	Punctual	Yes
New action: tap side of tray to move sponge pieces	Location	Punctual	Yes
New result: flick paint brush, causing paint to spray all over backdrop	Location	Punctual	Yes
Stab marshmallows onto a stick	Location	Punctual	Yes
New action: hold stick and pound marshmallows onto it	Location	Punctual	Yes
New result: stab marshmallows, they fly up in the air (like a tiddly wink)	Location	Punctual	Yes

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NOTES

1. Three additional children, two in the 3-year group and one in the 4-year group, were initial participants but were dropped from the study due to their apparently indiscriminate, position-based, response patterns. All, or all but one, of their responses were to the events only on the left (or right) of the screen.
2. Four children were younger than was suitable for administration of the TOLD. They are not included in this analysis.

REFERENCES

Antinucci, F., & Miller, R. (1976). How children talk about what happened. *Journal of Child Language, 3,* 167–189.

Bates, E., & Goodman, J. (1999). On the emergence of grammar from the lexicon. In B. MacWhinney (Ed.), *The emergence of language* (pp. 29–80). Mahwah, NJ: Erlbaum.

https://doi.org/10.1017/S0142716401004064 Published online by Cambridge University Press

Bedore, L., & Leonard, L. (2000). The effects of inflectional variation on fast mapping of verbs in Spanish and English. *Journal of Speech, Language and Hearing Research, 43,* 21–33.

Behrend, D. A. (1990). The development of verb concepts: Children's use of verbs to label familiar and novel events. *Child Development, 61,* 681–696.

Behrend, D. A., Harris, L. L., & Cartwright, K. B. (1995). Morphological cues to verb meaning: verb inflections and the initial mapping of verb meaning. *Journal of Child Language, 22,* 89–106.

Bloom, L., & Harner, L. (1989). On the developmental contour of child language: A reply to Smith & Weist. *Journal of Child Language, 16,* 207–216.

Bloom, L., Lifter, K., & Hafitz, J. (1980). Semantics of verbs and the development of verb inflection in child language. *Language, 56,* 386–412.

Bowerman, M. (1974). Learning the structure of causative verbs: A study in the relationship of cognitive, semantic, and syntactic development. *Papers and Reports on Child Language Development (Stanford University), 8,* 142–178.

(1977). *Possible lexical items: Evidence for the acquisition of rules for combining semantic material into words*. Paper presented at the Sixth Annual University of Wisconsin–Milwaukee Linguistic Symposium.

(1985). Beyond communicative adequacy: From piecemeal knowledge to an integrated system in the child's acquisition of language. In K. E. Nelson (Ed.), *Children's language* (Vol. 5, pp. 369–398). Hillsdale, NJ: Erlbaum.

Burgemeister, B. B., Hollander Blum, L., & Lorge, I. (1972). *Columbia Mental Maturity Scale,* New York: Harcourt Brace Javanovich.

Bybee, J. (1985). *Morphology: A study of the relation between meaning and form*. Amsterdam: John Bejamins.

Cartwright, K., & Behrend, D. (1995, April). *Developmental changes in the nature of preschool children's verb learning biases*. Paper presented to the Society for Research in Child Development, Indianapolis.

Clark, E. V. (1993). *The lexicon in acquisition*. Cambridge: Cambridge University Press.

(1996). Early verbs, event types and inflections. In C. E. Johnson & J. H. V. Gilbert (Eds.), *Children's language* (Vol. 9, pp. 61–73). Mahwah, NJ: Erlbaum.

Fantuzzi, C. (1996). *The emergence of temporal reference in child language: The acquisition of tense, aspect and argument structure*. Unpublished doctoral dissertation. University of California, Los Angeles.

Forbes, J. N., & Farrar, M. J. (1993). Children's initial assumptions about the meaning of novel motion verbs: Biased and conservative? *Cognitive Development, 8,* 273–290.

Gerken, L., Landau, B., & Remez, R. (1990). Function morphemes in young children's speech perception and production. *Developmental Psychology, 26,* 204–216.

Gleitman, L. (1991). The structural sources of verb meanings. *Language Acquisition, 1,* 3–56.

Golinkoff, R., Hirsh-Pasek, K., & Hollich, G. (1999). Emerging cues for early word learning. In B. MacWhinney (Ed.), *The emergence of language* (pp. 305–330). Mahwah, NJ: Erlbaum.

Harner, L. (1981). Children talk about the time and aspect of actions. *Child Development, 52,* 498–506.

Johnston, J. (1994). Cognitive abilities of children with language impairment. In R. Watkins & M. Rice (Eds.), *Specific language impairments in children*. Baltimore, MD: Paul H. Brookes.

Jones, S., Smith, L. B., & Landau, B. (1991). Object properties and knowledge in early lexical learning. *Child Development, 62,* 499–516.

Katz, N., Baker, E., & Macnamara, J. (1974). What's in a name? A study of how children learn common and proper nouns. *Child Development, 45,* 469–473.

Koenig, P., & Naigles, L. (1995). *One word speakers interpret a novel word as a predicate*. Paper presented at the Meeting of the Society for Research in Child Development, Kansas City.

Lee, L. (1974). *Developmental sentence analysis*. Evanston, IL: Northwestern University Press.

Leonard, L. (1998). *Children with specific language impairment.* Cambridge, MA: MIT Press.

Naigles, L. G. (1990). Children use syntax to learn verb meanings. *Journal of Child Language, 17,* 357–374.

Nelson, K. (1996). *Language in cognitive development*. Cambridge: Cambridge University Press.

Newcomer, P., & Hammill, D. (1988). *Test of Language Development 2–Primary*. Austin, TX: Pro-Ed.

https://doi.org/10.1017/S0142716401004064 Published online by Cambridge University Press

Pustejovsky, J. (1991). The syntax of event structure. *Cognition, 41,* 47–81.
Sharai, Y., & Anderson, R. (1995). The acquisition of tense aspect morphology: A prototype account. *Language, 71,* 743–762.
Slobin, D. (1985). Cross-linguistic evidence for the language-making capacity. In D. Slobin (Ed.), *The cross-linguistic study of language acquisition: Volume 2. Theoretical issues* (pp. 1157–1256). Hillsdale, NJ: Erlbaum.
Taylor, M., & Gelman, R. (1988). Adjectives and nouns: Children's strategies for learning new words. *Child Development, 59,* 411–419.
Tomasello, M. (1992). *First verbs*. New York: Cambridge University Press.

https://doi.org/10.1017/S0142716401004064 Published online by Cambridge University Press