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Why Nouns Trump Verbs in Word Learning: New Evidence from Children and Adults in the Human Simulation Paradigm

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Despite tremendous cross-linguistic and cross-cultural variation in linguistic input, early vocabularies are dominated by nouns. One explanation for this pattern appeals to the conceptual capacity of the learner—nouns predominate because the concepts to which they refer are somehow simpler or more accessible to young learners than the concepts to which verbs refer. Evidence for this viewpoint has come primarily from infants and toddlers. Another explanation appeals to the linguistic requirements underlying word learning—nouns predominate because their acquisition is well-supported by observation, while verbs often depend on additional linguistic information which early word learners are not yet able to utilize. Evidence for this viewpoint has thus far come primarily from adults in the Human Simulation Paradigm (HSP). To bridge this gap, we modified the HSP task to accommodate children. Although children's *approach* to this task differed markedly from that of adults, their *patterns of performance* were strikingly similar. Given observation alone, 7-year-olds—like adults—identified nouns more successfully than verbs. When observation was supplemented with linguistic information, 7-year-olds successfully recruited this information to identify verbs. This outcome represents the first empirical demonstration that young children's noun advantage may be attributable, at least in part, to the distinct linguistic requirements underlying the acquisition of nouns and verbs.

Young children's vocabularies contain a disproportionately large number of nouns and a disproportionately small number of verbs, relative to the frequency with which both types of words typically occur in discourse (MacNamara,

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1972; Gentner, 1982; Woodward & Markman, 1998; Gentner & Boroditsky, 2001; Waxman & Lidz, 2006). While it is true that early vocabularies do contain words that refer to things other than whole objects—including body parts (*nose*), substances (*juice*), properties (*hot*), sounds (*meow*), actions (*eat*), and places (*outside*)—names for objects account for a larger proportion of total vocabulary in young children than in older children or adults (Fenson et al., 1994; Bloom, 2000). In fact, although children's first words appear at around 12 months of age, it typically takes another two or three years before the proportion of nouns in a child's productive vocabulary resembles that of an adult (Huttenlocher, Smiley, & Charney, 1983; Fenson et al., 1994; Gentner & Boroditsky, 2001).

This 'noun advantage' cannot be attributed solely to properties of infant-directed speech that cause nouns to occur more frequently; nouns are learned more easily than verbs even when input frequency is controlled for (e.g., Leonard, Schwartz, Morris, & Chapman, 1981; Rice & Woodsmall, 1988; Merriman, Marazita, & Jarvis, 1993; Imai, Haryu, & Okada, 2005). It is also not the case that the noun advantage occurs only in 'noun-friendly' languages that possess linguistic properties (e.g., word order, word frequency, stress patterns) that might make nouns more salient than other forms (Gentner, 1982). A noun advantage in early vocabularies has been reported in 'verb-friendly' languages as well, including Korean (Au, Dapretto, & Song, 1994), Japanese (Ogura, 2001, as cited in Imai et al., 2006), Italian (Caselli et al., 1995), and Navajo (Gentner & Boroditsky, 2001). Although there is some debate concerning the cross-linguistic evidence for the noun advantage (e.g., Choi & Gopnik, 1995; Tardif, Gelman, & Xu, 1999), the controversy appears to reflect methodological issues: Research based on parental reports of their infants' vocabularies consistently reports a noun advantage, while research based on infants' spontaneous language production in interactive play sessions sometimes does not (Lavin, Hall, & Waxman, 2006). Overall, it appears that concrete nouns do enjoy a privileged status for early word learners across languages and cultures, an advantage that may be attenuated or enhanced by certain language- or culture-specific factors (Gentner & Boroditsky, 2001; Kako, 2005; Waxman & Lidz, 2006; Lavin et al., 2006).

Because word learning entails establishing a mapping between a conceptual unit and a linguistic unit, it is not surprising that attempts to explain the early noun advantage have appealed to both conceptual and linguistic factors. Of course, these two factors are unlikely to be in opposition. Infants cull information from a variety of sources (e.g., perceptual, conceptual, linguistic) to identify words and establish their meaning (Woodward & Markman, 1998; Waxman & Lidz, 2006). Both conceptual and linguistic factors are at play in early lexical development and may contribute to the noun advantage. Nonetheless, in an effort to pinpoint the influence of each factor at various points in development, researchers have designed tasks to examine their contributions independently.

Focusing on the conceptual side, some researchers have argued that nouns predominate because the concepts to which they refer are more accessible to young learners than the concepts to which verbs refer (e.g., Gentner, 1978; Gopnik & Meltzoff, 1986; Byrnes & Gelman, 1991; Smiley & Huttenlocher, 1995). On this view, infants produce nouns early and verbs later because noun concepts are available sooner than verb concepts. However, there is growing evidence that even prelinguistic infants possess conceptual systems that include rudimentary representations of objects and relations that naturally map onto linguistic subjects and predicates (Baillargeon & Wang, 2002; Fisher & Gleitman, 2002). This suggests that there is considerable conceptual continuity across development and that infants, like adults, may be capable of representing the kinds of concepts underlying both nouns and verbs.

Gleitman and her colleagues (Landau & Gleitman, 1985; Gleitman, 1990; Gillette, Gleitman, Gleitman, & Lederer, 1999; Fisher & Gleitman, 2002) have focused on the linguistic requirements underlying word learning, suggesting that verbs are acquired relatively late not because the underlying concepts to which they refer are unavailable to young word learners, but because the linguistic information required to successfully learn verbs is not yet available to them. More specifically, the argument is that although the meaning of a concrete noun can often be inferred by observing the context in which it is uttered, the meaning of a verb depends more heavily on syntactic information and other linguistic cues, including semantic components such as the speaker's point of view.

This proposal has clear implications for early word learning. Because very young word learners have not yet established the ability to use linguistic information of this sort, they begin the task of lexical acquisition armed with observation as their primary source of information. As a result, they are most likely to succeed in acquiring words whose underlying concepts can be identified from observation—primarily concrete nouns. These early-acquired nouns may then serve as a foundation for subsequent development, supporting the acquisition of additional nouns, making apparent critical aspects of linguistic structure, and facilitating the acquisition of predicates, including verbs and adjectives. Concrete nouns are therefore the stepping stones upon which subsequent word learning proceeds (Gleitman, 1990; Waxman & Lidz, 2006).

The Human Simulation Paradigm

Evidence for this proposal has come from an innovative experimental paradigm known as the Human Simulation Paradigm (HSP), introduced by Gillette et al. (1999) and adopted by several others since (Snedeker, Gleitman, & Brent, 1999; Snedeker, 2000; Snedeker & Gleitman, 2004; Kako, 2005; Lavin et al., 2006). The goal of the HSP is to measure the contribution of linguistic information to word learning by holding conceptual factors constant. To accomplish this goal,

researchers have used adult participants as 'simulations' of early word learners. These participants are provided with access to the kind of information that is (by hypothesis) available to learners at the onset of word learning. That is, adults are permitted to observe the scenes in which a 'mystery' word occurs, without the benefit of any additional supporting linguistic information, and asked to identify the word. Because the participants are adults, any difference in their ability to identify nouns versus verbs in this task cannot be attributed to a difference in their ability to represent the underlying concepts.

In the paradigm's original implementation, adult participants watched a series of short video clips of a mother interacting with her toddler. The mother uttered the same target word across several different scenes, but the audio track had been removed and each target word had been replaced by an audible beep. Thus, participants heard no speech—only the beeps. Their task was to guess the target words, some of which were nouns and some verbs, purely on the basis of their visual observation of the scenes. In fact, when adults were deprived of access to linguistic information, they were more successful in identifying nouns than verbs (Gillette et al., 1999). This finding was interpreted as evidence that visual observation alone supports noun learning to a greater degree than verb learning. Moreover, adult participants' success at guessing verbs increased steadily as they were provided with increasing amounts of linguistic information, a finding that underscores the importance of linguistic information in the discovery of verb meaning.

Obviously, the task demands faced by adults in the HSP differ from those faced by early word learners building a lexicon from the start. Nevertheless, the point of a simulation in general is not necessarily to mimic precisely the mechanism by which some process occurs, but rather to provide *in principle* evidence that a certain outcome could occur given a certain input and a certain set of constraints. Therefore, the value of the paradigm is not that it duplicates the way in which children learn words—it clearly does not—but that it illustrates that when they are denied access to syntactic and other linguistic information, even adult participants produce evidence for a noun advantage, and this advantage parallels that observed in early lexical development.

Developmental Concerns

Findings from prior implementations of the HSP thus reveal the importance of linguistic information in the establishment of verb meaning, but they also raise a vital developmental question: To what extent can this *in principle* evidence, obtained from adults, inform our theories of early word learning? This question becomes especially compelling when one considers the metacognitive demands of the HSP. Essentially, the HSP task is a guessing game, and one that requires sustained and deliberative attention. Although adults in this paradigm are deprived of linguistic information, they are certainly armed with more than

observation alone. To resolve the uncertainty regarding the identity of the target word, it is plausible to assume that when adults are presented with a scene, they generate a set of candidate words from their existing lexicon, judge the acceptability of one candidate against another, update their ongoing judgments by discarding weaker candidates in favor of stronger alternatives, and inhibit responses based on aspects of the current scene that are inconsistent with previously collected evidence.

Although adults readily recruit these abilities in the HSP task, there are reasons to suspect that children may not. Despite the fact that they are in many ways fully fluent language users, even school-aged children lack many of the strategic and metacognitive skills that adults must bring to bear in this task. In fact, developmental research on a wide range of cognitive tasks including—but not limited to—memory, comprehension, and referential communication tasks converges to suggest that children's ability to deploy effective problem-solving strategies changes dramatically well into the elementary school years (Flavell, Friedrichs, & Hoyt, 1970; Markman, 1979; Patterson & Kister, 1981; Bonitatibus, 1988; Courage, 1989; Siegler & Jenkins, 1989; Kreutzer et al., 1992; Flavell, 1996; Klahr & MacWhinney, 1998).

Consider, for example, the strategies that children invoke in the game of 20-questions, a task that is similar in many ways to the HSP guessing task. There is strong evidence that the strategies that children invoke to resolve the uncertainty in the game of 20-questions change dramatically through the elementary school years (Denney & Connors, 1974; Denney, Jones, & Krigel, 1979). Courage (1989) found that children ages four through seven performed poorly in a game in which they were required to identify a target item from among a set of eight items by asking the experimenter as few yes-no questions as possible. Children of all age groups tended to adopt a 'local' strategy, guessing individual items (e.g., 'Is it this one?') rather than asking more general, strategic questions that would eliminate several items from consideration with a single question (e.g., 'Is it blue?'). Because young children invoke less efficient strategies like this on a broad range of tasks in which they are called upon to resolve uncertainty or ambiguity, and because there is uncertainty involved in identifying the 'mystery' word in the HSP task, it would be reasonable to conjecture that children might approach this task with strategies that are less effective than those adopted by adults.

This observation raises an important question: Might the pattern of results seen in the HSP depend upon strategies that are available to adults, but unavailable to children? As we have pointed out, when it comes to resolving ambiguity or uncertainty, children invoke less effective strategies than adults do and these strategic differences may also influence children's approach to finding solutions in the HSP task. If, despite such differences in approach, children's relative successes in guessing nouns and verbs in the HSP are comparable to those of

adults, this would reveal that the power of linguistic information in this task does not depend on the sophisticated metacognitive support with which adults are equipped. Evidence to this effect would (a) strengthen the *in principle* claim that the discovery of verb meaning relies more heavily on linguistic information than does noun meaning; (b) support the view that the noun advantage in the early lexicon is attributable, at least in part, to the fact that very young word learners do not yet have access to the linguistic information that is required to support the discovery of verb meaning; and (c) reveal that the necessary linguistic information can be gleaned not only by adult 'simulations,' but also by children who have yet to develop the metacognitive and strategic sophistication of adults.

To be clear, the question is not whether novice word learners can recruit linguistic information to discover the meaning of a novel word: there is ample evidence that they do. For example, by 14 months, infants use the linguistic form of a novel word as a cue to its meaning (Waxman, 1999; Waxman & Booth, 2001; Echols & Marti, 2004), and by 18 months, infants use the syntactic structure of a sentence to distinguish among candidate meanings for a novel verb (Naigles, 1990, 1996; Hirsh-Pasek & Golinkoff, 1996; Bunger & Lidz, 2004; Lidz, Bunger, Leddon, & Waxman, 2006; Fisher & Song, 2006). Thus, the question is not whether young word learners can recruit linguistic information, but rather whether they (like adults in the HSP task) rely *more heavily* on linguistic information to arrive at the meaning of novel verbs than novel nouns.

With this question in mind, we sought to develop a version of the HSP task that would accommodate children. We preserved the logic of the HSP design but introduced several modifications to render the task more engaging, especially for children. In Experiment 1, we established that the patterns of results for adults reported in previous work (Snedeker et al., 1999; Snedeker, 2000; Snedeker & Gleitman, 2004; Kako, 2005; Lavin et al., 2006) persist in the face of these procedural modifications. This set the stage for Experiment 2, in which we sought to discover how 7-year-old children approached the HSP, whether children (like adults) would be more successful in identifying nouns than verbs from observation alone, and whether the addition of linguistic information would facilitate children's (like adults') success in identifying verbs.

EXPERIMENT 1: THE VALUE OF LINGUISTIC INFORMATION FOR ADULTS

The goal of Experiment 1 was to develop a means of examining the contribution of linguistic information to word learning that would accommodate children as well as adults. We therefore retained the logic of the now-standard HSP task (Gillette et al., 1999; Snedeker et al., 1999; Snedeker, 2000; Snedeker & Gleitman, 2004; Kako, 2005; Lavin et al., 2006), but introduced a number of modifications.

The most important modification was the source of the videos. In previous work, participants were asked to guess target words from videotaped clips of naturalistic mother-toddler interactions. Apparently, however, even adult participants did not find these videos especially engaging (T. Lavin, personal communication, November 5, 2004; J. Snedeker, personal communication, November 19, 2004). We therefore selected clips from commercially-available episodes of the television series 'Sesame Street' (Parente, 2004). As Sesame Street episodes are created especially to captivate young viewers and their parents, they offer the important advantage of readily engaging young children and adults alike (Borgenicht, 1998; Fisch & Truglio, 2000). Second, although in most previous implementations of this paradigm the experimenter offered participants explicit information regarding the grammatical form of the target words, we chose not to do so because we suspected that providing this sort of information would be less useful to child participants than to adults. Withholding this information also allowed us to analyze the grammatical class of words that participants offered as guesses.

Third, in previous implementations of the HSP, participants offered a guess after viewing each of six exemplars of the target word, and then offered a 'final' guess after viewing the last exemplar. Our review of the literature on the development of problem-solving in the face of uncertainty (e.g., the 20-questions game) led us to suspect that children and adults might recruit different strategies in this task. Therefore, instead of analyzing participants' final guesses, we decided to analyze participants' guesses for each individual clip and to consider the ways in which their guesses evolved over the course of the cross-situational exposure.

Despite these modifications, we did maintain the primary design features of the paradigm. Most importantly, to simulate cross-situational learning, the clips for each target word were drawn from different scenes in which the target word was uttered by different characters in different contexts. Participants were randomly assigned to either the 'no linguistic information' (–LI) or 'full linguistic information' (+LI) condition. In both, the clips' audio tracks were altered so that each target word was replaced by a beep. In the –LI condition, participants heard no audio other than the beeps. In the +LI condition, participants heard all of the surrounding speech as well as the beeps.

We should note that our +LI condition differed from the 'full information' condition reported by Gillette et al. (1999) in two ways. First, Gillette et al. included only verbs in this condition; we included both nouns and verbs. This provided us with an opportunity to explore whether the noun advantage would persist even in the presence of full linguistic context, for either adults or children. Second, Gillette et al. presented participants with silent videos, accompanied by printed versions of the sentences that had been spoken by the mother in which the target word was replaced by a nonsense word (e.g., 'Can you GORP Markie on

the phone?'). Because our goal was to accommodate children who are not yet fluent readers, our participants heard the complete audio track, with the exception of the target words, which had been replaced by beeps.

We predicted that despite these modifications, adults' performance in this task would mirror that of previous reports. More specifically, we expected that adults in the –LI condition, who had the benefit of observational information alone, would identify nouns correctly more often than verbs, but that adults in the +LI condition, for whom the same observational information was accompanied by linguistic information, would identify verbs as successfully as they did nouns.

Method

Participants

Twenty-four undergraduate students at Northwestern University (13 women) participated and received credit toward an introductory psychology course. Participants were randomly assigned to either the 'no linguistic information' (–LI, $n = 12$) or 'full linguistic information' (+LI, $n = 12$) condition.

Materials

Selecting the target words. We began by reviewing approximately 12 hours of commercially-available Sesame Street DVDs. Our goal was to select a set of target words, half nouns and half verbs, that were familiar to both adults and early word learners, and that were uttered in a variety of scenes across a number of different contexts. We established two selection criteria: First, each word should be sufficiently familiar that it is produced by at least 80% of 30-month-olds, according to lexical development norms (Dale & Fenson, 1996). Second, each word should occur at least six times across a number of different scenes. In addition, we made a strong effort to identify clips in which the object or action described by the target word was visible. This required some flexibility, especially when it came to 'mental' verbs (e.g., *think*, *want*, *hope*), because these verbs refer to mental states or activities that are not visible. Nonetheless, it was important to include mental verbs because they are frequent in child-directed speech, because children do learn their meaning, and because they were represented in previous investigations using the HSP.

Although the mental states described by mental verbs are not themselves visible, there are sometimes observable aspects of a scene that correlate with these states. For example, when a mother says 'I love you' while hugging her toddler, the hugging action is an observable (yet imperfect) correlate of her mental state. However, when she says 'I hope it is sunny today' while eating breakfast with her toddler, there is no observable correlate of her mental state (hoping). To accommodate both types of scenes for the mental verbs, we selected clips in

which the individual experiencing the mental state was visible. For example, we included one clip in which Elmo says 'Elmo loves the number of the day,' because it was Elmo who was doing the 'loving' and he was visible.

Remarkably, we were hard-pressed to find six nouns and six verbs that met these criteria. This difficulty is illustrated by an episode in which a pregnant Mama Bear, together with Papa and Baby Bear, prepare for the arrival of a new baby. As the story unfolds, numerous references are made to the 'baby.' However, because the baby does not arrive until the end of the episode, in most cases in which the noun *baby* is uttered, there is no baby to be seen. Numerous references are made to invisible actions as well. For example, Mama Bear feels the baby kicking at one point and much discussion about 'kicking' ensues, but when the verb *kicking* is uttered, no kicking is visible. We believe that the difficulty we faced in finding target words that met our criteria reflects the challenges that early word learners face in discovering word meaning from observation.

Ultimately, the first six words of each grammatical class that were identified as meeting the criteria described above were selected as target words. The target nouns were *book*, *friend*, *head*, *nose*, *picture*, and *present*; the target verbs were *love*, *play*, *see*, *sit*, *talk*, and *want*. Importantly, different types of nouns and verbs were represented. For example, nouns included basic level object labels (*book*, *picture*), names for body parts (*head*, *nose*), and situation-restricted nouns, whose definitions depend on context (*friend*, *present*; Hall & Waxman, 1993). Verbs included action verbs (*play*, *sit*, *talk*) as well as mental verbs (*love*, *see*, *want*). This is important because these are indeed the types of nouns and verbs that are present in the input to young children. At the same time, however, there is evidence that even within a given grammatical class, some of these types of words are more easily learned through observation than others. For example, in the absence of linguistic context, nouns referring to basic level object categories are learned more readily than nouns referring to non-basic level categories (Kako, 2005), and verbs referring to more imageable actions are learned more readily than verbs referring to less imageable concepts (Snedeker & Gleitman, 2004). Including a variety of target word types allowed us to examine whether performance within each grammatical category varied as a function of word type.

Establishing comparability. We next sought to establish the comparability of our words to those in earlier reports. Following Gillette et al. (1999), we asked an independent group of 30 undergraduate students at Northwestern University (18 women) to rate the 'imageability' of 22 words, including the 12 target words plus five adjectives (*free*, *healthy*, *red*, *shiny*, and *tall*) and five prepositions (*during*, *for*, *inside*, *together*, and *with*). Words were presented alphabetically and participants were instructed to rate each word on a scale of 1 ('not at all imageable') to 7 ('extremely imageable'). Nouns were preceded with 'a' and verbs with 'to' to ensure that words would be identified unambiguously as nouns or verbs,

respectively. Following Gillette et al. (1999), participants were told, 'Please rate the imageability of the words on the following pages. Imageability is the degree to which the word arouses a mental image (i.e., a mental picture, sound, or other sensory experience). Any word that arouses a mental image very quickly and easily should be given a HIGH imageability rating. For example, words like *apple*, *hit*, or *sweet* might be given high imageability ratings. Any word that arouses a mental image with difficulty, or not at all, should be given a LOW imageability rating. For example, words like *fact*, *ambitious*, or *the* might be given low imageability ratings.' The results were wholly comparable to those of Gillette et al. (1999) in that for our stimuli, the mean imageability rating for nouns (M = 6.45, SD = .302) was higher than that for verbs (M = 4.35, SD = .883), $t(10) = 5.52$, $p < .001$, two-tailed (Table 1).

Producing the stimuli. For each target word, we produced a series of video clips that was 60 to 90 seconds in duration and contained six exemplars of the target word (with one exception—we could only find five suitable exemplars of *sit*). Each clip lasted 10 to 20 sec and was separated from the next clip by a 2-sec pause. In some cases, the target word was uttered more than once within the same clip. The length of each clip was determined as follows: We used the sentence that contained the target word as a starting point, and then we included as much video and dialog before and after this sentence as necessary in order to make its meaning clear in context. In some cases, the sentence containing the target word was the only speech heard in the clip; in others, additional dialog occurred before or after the target sentence. The target word always occurred embedded in full syntax (e.g., 'Hey Elmo, do you BEEP an apple?'). In general, we constructed each clip to be at least 10 seconds in length, but only as long as necessary to be meaningful.

All participants saw the same video clips, but the accompanying audio input varied as a function of condition. In the –LI condition, the entire audio track was removed, and 350-Hz beeps (150 milliseconds in duration) were inserted in place

TABLE 1
Target Word Imageability Ratings

Nouns	*M (SD)*	*Verbs*	*M (SD)*
nose	6.9 (.35)	sit	5.4 (1.5)
book	6.6 (.85)	talk	4.9 (1.5)
head	6.6 (.72)	play	4.8 (1.4)
friend	6.3 (1.1)	see	4.1 (1.3)
present	6.2 (1.1)	love	4.0 (1.3)
picture	6.1 (1.3)	want	2.9 (.97)

of the target words. In the +LI condition, the audio track was left intact except for the target words, which were replaced with beeps.

Procedure

Participants were tested individually, sitting before a computer screen in a quiet room in our lab. The experimenter explained that they would see a series of short video clips in which a particular word had been replaced by a beep. At this point, participants in the –LI condition were told that they would not hear any audio other than the beeps. In both conditions, the experimenter continued as follows: 'Your task is to guess the word. You will see six different exemplars of the word, across different scenes and spoken by different characters. It is the *same* word repeated six different times. You will be asked to guess the word after each scene. Therefore, you have a total of six chances to guess the word. Some scenes contain multiple beeps. In these cases, the beeps represent the same word. When you have completed all your guesses for a word, the task will start over again with a new word and you will have six chances to guess the new word. This procedure will be repeated for twelve different words.'

To begin each series, the experimenter said, 'Now we are starting with a new word.' After each clip within the series, the experimenter paused to elicit the participant's guess. Before proceeding to the next clip, the experimenter said, 'This is another example of the same word.' Before the last clip in a series was presented, participants were told, 'This is the last chance to guess this word.'

Participants viewed each clip once. If a participant failed to offer a guess for a particular clip, the experimenter simply proceeded to the next clip. If participants asked for more information about the target words, the experimenter simply said that they were 'common' words. Target words were presented in one of two random orders, and nouns and verbs appeared in alternating fashion. For half of the participants, the first target word was a noun, and for the others, a verb.

Scoring

Each participant provided up to 71 separate guesses across all clips (five exemplars for *sit* plus six exemplars for each of the 11 other target words). Any single word of any grammatical class was considered an acceptable response, as were contractions and multi-word proper nouns (e.g., *Big Bird*). We coded each response in two ways. First, we determined whether it was correct—that is, whether it matched the target. Plurals and other forms of the target word were considered to be matches (e.g., *talks*, *talked*, and *talking* would all be considered matches for the target word *talk*). Second, we identified the grammatical class of

each response as noun, verb, adjective, or other (e.g., articles, deictics).[1] Thus, for each target word (e.g., *talk*), a response could be (a) correct; (b) incorrect but from the correct grammatical class (e.g., *run*); or (c) incorrect and from an incorrect grammatical class (e.g., *shoe)*.

Results and Discussion

The results of Experiment 1 converge well with previous work to suggest that (a) adult learners often succeed in identifying the meaning of a noun on the basis of observation alone; (b) this is not the case for verbs; and (c) additional linguistic support is critical to success in identifying the meaning of a verb. Our results, which mirror those of Gillette et al. (1999), attest to the strength of this phenomenon, and reveal that it is sufficiently robust to hold up in the face of several procedural changes, including the change in input from mother-toddler interactions to Sesame Street episodes.

In our first analysis, we took a very lenient view of participants' success, calculating the proportion of target nouns and verbs that each participant guessed correctly at least once out of the six opportunities (Figure 1). As predicted, participants in the –LI condition were more successful at guessing nouns (M = .528, SD = .156) than verbs (M = .194, SD = .120), matched $t(11) = 5.74$, $p = .0001$, two-tailed. This advantage for nouns disappeared entirely in the +LI condition, where adult participants performed at ceiling. We also asked whether there were performance differences within a grammatical class (e.g., basic-level nouns vs. non-basic-level nouns, action verbs vs. mental verbs), but found no such differences in this or any subsequent analyses. Therefore, all noun data were collapsed and all verb data were collapsed.

Because this 'generous' approach represents only a portion of the data, we went on to conduct a more comprehensive analysis based on the full set of participants' guesses. To begin, we considered the possibility that participants might have been more successful in identifying nouns simply because more of the guesses that they offered were nouns. To address this possibility, we tallied the number of nouns and verbs offered as guesses in each condition. A (2) condition × (2) word class repeated measures analysis of variance (ANOVA) on the number of nouns and verbs offered as guesses revealed main effects of word class, $F(1, 22) = 11.9$, $p = .002$, and condition, $F(1, 22) = 27.7$, $p < .001$, as well as an interaction effect, $F(1, 22) = 6.29$, $p = .02$. An analysis of the

[1]Although several of our target words could, in principle, be interpreted as either nouns or verbs (e.g., *book, head, nose, picture, love, play, talk,* and *want*), each word has one interpretation that predominates in children's speech and in child-directed speech. For example, children are unlikely to hear *book* used as a verb or to use *talk* as a noun. In fact, it was always obvious to our coders from the context whether a child was producing a noun or a verb.

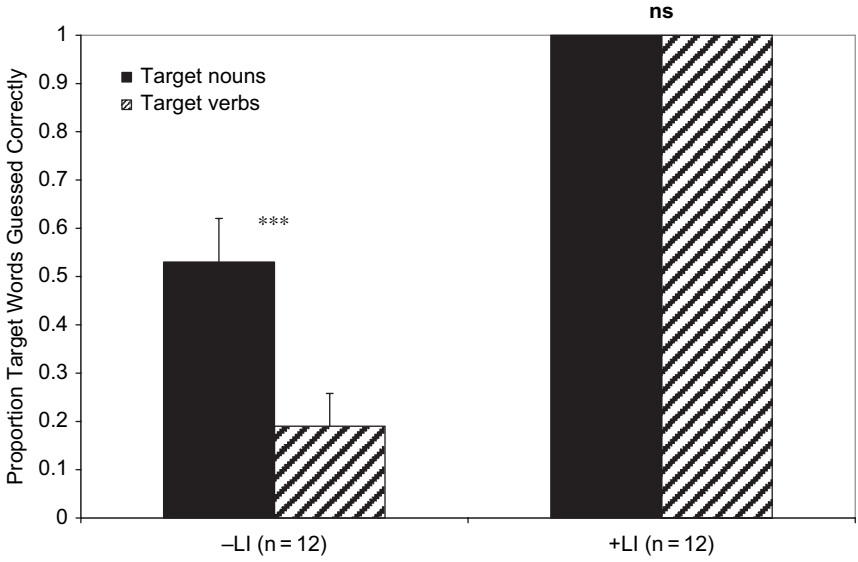

FIGURE 1 Mean proportion of target words guessed correctly by adults in Experiment 1. Vertical bars depict 95% confidence intervals on the means. ***$p < .001$.

simple main effects indicated that participants offered more noun guesses than verb guesses in the –LI condition (nouns = 314, verbs = 187, $p < .001$) but not the +LI condition (nouns = 348, verbs = 328, $p = .5$). Thus, when denied access to linguistic information, adults offered predominantly nouns as guesses (48%) and their remaining guesses were distributed as follows: 28% verbs, 7% adjectives, and 17% other categories. In contrast, participants in the +LI condition offered a more balanced distribution of nouns and verbs. In this condition, where the linguistic information usually made clear the grammatical form—if not the identity—of the target word, participants offered nouns and verbs at the same rate (51% and 48%, respectively), with only .3% adjectives, and .6% other categories.

Using this distributional information, we were able to consider all of a participant's guesses within a target word class and calculate the proportion of these guesses that were correct, independent of the frequency of guesses offered within each word class. We did this by dividing the number of correct noun guesses and verb guesses for each participant by the total number of nouns and verbs offered by that participant, respectively. Unlike the 'generous' analysis, which examined the number of target words guessed correctly at any point during a trial, the comprehensive analysis examined the number of guesses that were correct across trials within each word class.

A (2) condition × (2) guess word class repeated measures ANOVA with condition (–LI vs. +LI) as a between-subjects factor and guess word class (noun versus verb) as a within-subjects factor, using the proportion of correct guesses as the dependent variable, yielded a main effect of word class, $F(1, 22) = 12.5$, $p = .002$, and a main effect of condition, $F(1, 22) = 843$, $p < .001$, both of which were mediated by a significant interaction, $F(1, 22) = 19.7$, $p < .001$. An analysis of the simple main effects revealed that adults in the –LI condition were more successful at identifying nouns ($M = .339$, $SD = .141$) than verbs ($M = .125$, $SD = .0819$), $p < .001$, but that adults in the +LI condition were equally successful at identifying nouns ($M = .934$, $SD = .0579$) and verbs ($M = .958$, $SD = .0428$), $p = .5$. Thus, even after adjusting for varying rates of noun and verb guessing, the pattern of results from the more lenient measure remained intact: Adults in the –LI condition were more likely to identify nouns than verbs, while those in the +LI condition were equally successful at identifying nouns and verbs (Figure 2).

In summary, when presented with observational evidence alone (–LI condition), adults were more successful at identifying nouns than verbs, but when observational evidence was supplemented with full linguistic information (+LI condition), this noun advantage disappeared. This finding supports the view that although many nouns can be learned on the basis of observation alone, linguistic

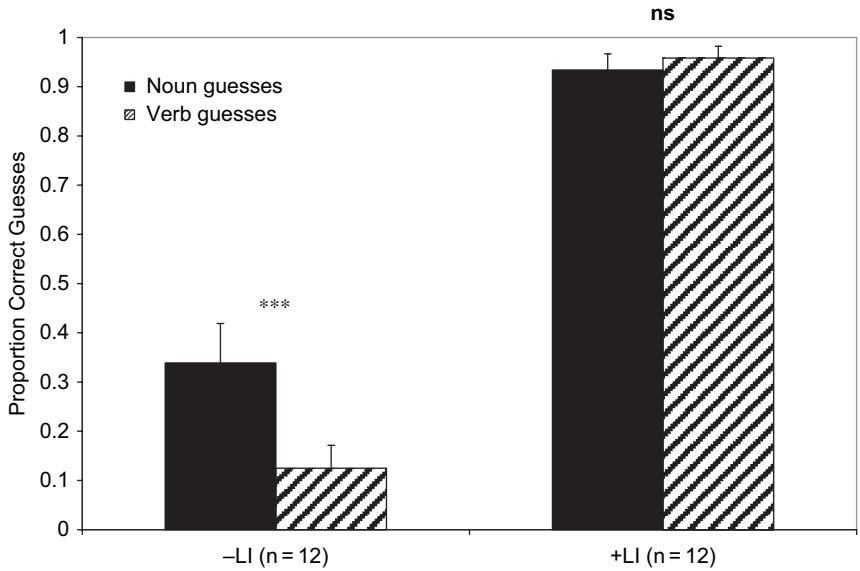

FIGURE 2 Mean proportion of correct guesses by adults in Experiment 1. Vertical bars depict 95% confidence intervals on the means. ***$p < .001$.

support is critical to identifying the meaning of most verbs. Moreover, adults' response patterns in the current experiment, based on input from Sesame Street episodes, were strikingly similar to the patterns reported in previous implementations of the HSP, based on input from mother-toddler interactions. This robust pattern of results set the stage for the next step, in which we examined children's performance in the very same task.

EXPERIMENT 2: THE VALUE OF LINGUISTIC INFORMATION FOR CHILDREN

The goal of this experiment was to examine children's performance in the HSP. We approached the experiment with two broad sets of questions. First, we considered the value of linguistic information in the acquisition of nouns and verbs. Specifically, when children are presented with observational evidence alone (–LI condition), do they (like adults) successfully identify more nouns than verbs? Further, when observational evidence is supplemented with linguistic information (+LI condition), how does this influence their identification of nouns and verbs? Our second area of inquiry concerned the strategic demands of this task. Although we had modified the task to accommodate children, several questions remained, such as whether children had the requisite capacity to generate a set of possible words for each scene and update their ongoing judgments over successive scenes. In essence, at issue was whether child learners could take advantage of the cross-situational evidence provided in this 'simulation' to converge on a single word for a given trial.

We selected 7-year-olds as 'simulations' for several reasons. First, they are readily engaged by guessing games and, like adults, have sufficient lexical knowledge to permit them to match up scenes they observe with candidate words in their existing lexicon. Second, pilot work indicated that this was the youngest age at which children would consistently offer single words as guesses. This is consistent with a large body of research, which suggests that prior to age 7, children lack explicit awareness of the concept of 'word' (Ehri, 1975; Tunmer, Bowey, & Grieve, 1983; Bowey & Tunmer, 1984; Bialystok, 1986; Kolinsky, Cary, & Morais, 1987; Gombert, 1992; Edwards & Kirkpatrick, 1999; Nippold, 2002).

Finally, perhaps the most compelling reason for including 7-year-olds is that although children at this age are fluent language users, they nevertheless lack the strategic sophistication that characterizes adult problem solving (Flavell et al., 1970; Markman, 1979; Patterson & Kister, 1981; Bonitatibus, 1988; Courage, 1989; Siegler & Jenkins, 1989; Kreutzer et al., 1992; Flavell, 1996; Klahr & MacWhinney, 1998). If 7-year-olds' relative successes at guessing nouns and verbs mirrored those of adults', despite such differences in strategy

and approach, this would demonstrate that the power of linguistic information in the HSP does not depend upon the sophisticated metacognitive support which adults bring to this task. More specifically, a noun advantage in the –LI condition would reveal that children (like adults) depend more heavily on linguistic information to identify the meaning of novel verbs than nouns; an attenuation of this noun advantage in the +LI condition would reveal that they are able to glean the necessary linguistic information to support the discovery of verb meaning.

Method

Participants

Twenty-four normally developing English-speaking 7-year-olds (15 girls) were recruited from a public school in Chicago. The children (mean age = 7;2, ranging from 6;6 to 7;11) were randomly assigned to either the 'no linguistic information' (–LI, $n = 12$) or 'full linguistic information' (+LI, $n = 12$) condition, and tested individually in a quiet area of their school.

Materials

The materials were identical to those used in Experiment 1.

Procedure

The procedure was identical to that of Experiment 1, except that the task was described as a word guessing game that involved watching some movies in which '. . .something silly happened to the people, and now sometimes when they try to say a word, a beep comes out instead, like this: BEEP! We have to guess what word they were trying to say.' In cases where children offered complete phrases or sentences instead of a single word, the experimenter prompted, 'Can you guess *one* single word?'

Results and Discussion

The results of this experiment reveal two main findings. First, children's relative rates of success at guessing nouns and verbs converged beautifully with the patterns of the adults in Experiment 1. When presented with observational evidence alone (–LI), children were more successful at identifying nouns than verbs, but when observation was supplemented with linguistic information (+LI), this noun advantage was attenuated. Second, despite these similarities in outcome, there were striking differences between adults' and children's approaches, differences that reflect children's metacognitive challenges in this task.

The value of linguistic information

As with the adults, we began with a 'generous' analysis, examining the proportion of target words that were guessed correctly at least once in a series of clips (Fig. 3). A (2) condition × (2) target word class repeated measures ANOVA with condition (–LI vs. +LI) as a between-subjects factor and target word class (noun vs. verb) as a within-subjects factor yielded main effects of condition, $F(1, 22) = 182$, $p < .001$, and target word class, $F(1, 22) = 100$, $p < .001$. An interaction effect, $F(1, 22) = 15.2$, $p = .001$, revealed that although children in both the –LI and +LI conditions were more successful at identifying nouns than verbs, this noun advantage was significantly less pronounced in the latter condition than in the former condition. As in Experiment 1, no differences were found within each grammatical class, and therefore all noun data were collapsed and all verb data were collapsed.

We next asked whether children might have successfully identified more nouns simply because more of their guesses were nouns. A (2) condition × (2) word class repeated measures ANOVA on the number of nouns and verbs offered as guesses revealed main effects of word class, $F(1, 22) = 13.8$, $p = .001$, and condition, $F(1, 22) = 9.63$, $p = .005$, as well as an interaction effect, $F(1, 22) = 16.2$, $p = .001$. An analysis of simple main effects indicated that children offered

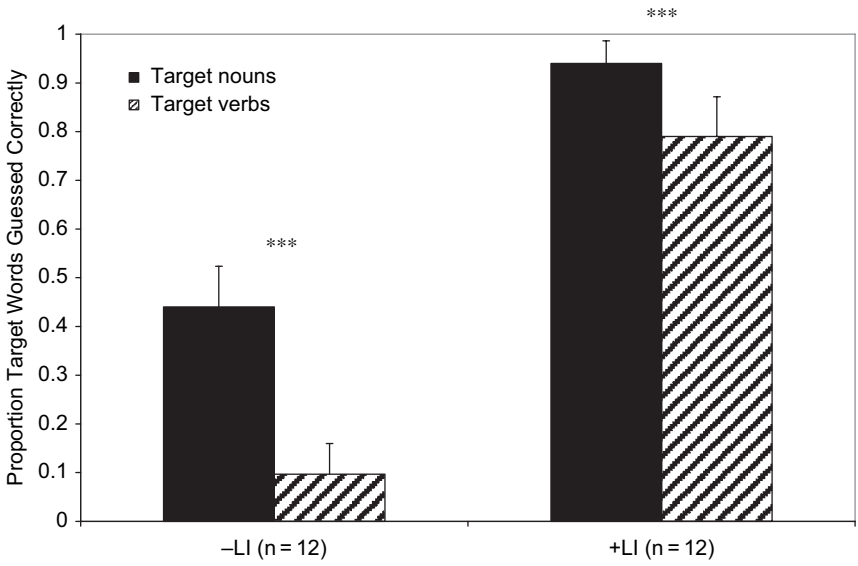

FIGURE 3 Mean proportion of target words guessed correctly by children in Experiment 2. Vertical bars depict 95% confidence intervals on the means. ***$p < .001$.

more noun guesses than verb guesses in the –LI condition (nouns = 344, verbs = 157, $p < .001$) but not the +LI condition (nouns = 296, verbs = 303, $p = .8$). Thus, in the absence of any linguistic cues, children in the –LI condition (like their adult counterparts) were more likely to guess nouns than any other single word class. Children's guesses were comprised of 51% nouns, 24% verbs, 10% adjectives, and 14% other categories. In contrast, children in the +LI condition (like their adult counterparts) offered comparable numbers of nouns and verbs as guesses. Children's guesses in this condition were comprised of 46% nouns, 47% verbs, 2.5% adjectives, and 5.1% other.

As in Experiment 1, we calculated a proportion of correct guesses, to compensate for the elevated tendency to guess nouns relative to verbs (Figure 4). We submitted this comprehensive measure to a (2) condition × (2) guess word class repeated measures ANOVA with condition (–LI vs. +LI) as a between-subjects factor and guess word class (noun vs. verb) as a within-subjects factor. This analysis yielded main effects for guess word class, $F(1, 22) = 27.1$, $p < .001$, and for condition, $F(1, 22) = 97.6$, $p < .001$, and no interaction, $F(1, 22) = 1.12$, $p = .3$. That is, children identified nouns more successfully than verbs, and they identified words in the +LI condition more successfully than in the –LI condition.

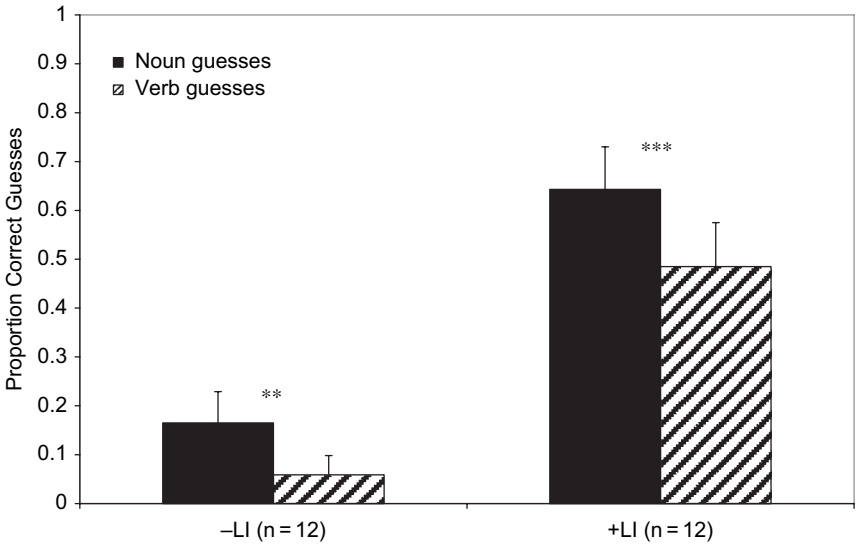

FIGURE 4 Mean proportion of correct guesses by children in Experiment 2. Vertical bars depict 95% confidence intervals on the means. $^{**}p < .01$, $^{***}p < .001$.

Comparing the accuracy of adults and children

A comparison of Figures 2 and 4 suggests that although the guessing patterns of children and adults were largely convergent, children were generally less accurate than adults. Therefore, to compare the influence of linguistic information on adults and children directly, we developed a measure that would take into account children's lower accuracy overall. To accomplish this, we computed a noun advantage score for each participant by dividing the number of correct guesses that were nouns by the total number of correct guesses of either grammatical class (Figure 5). If linguistic information is crucial to children's as well as adults' identification of verbs, then for both age groups, a noun advantage should be observed in the –LI condition, and should be attenuated in the +LI condition. A (2) age × (2) condition between-participants ANOVA, with noun advantage score serving as the dependent variable, confirmed this prediction. A main effect for condition, $F(1, 44) = 58.6$, $p < .001$, revealed that for both children and adults, the noun advantage score was significantly greater in the –LI condition than in the +LI condition. This outcome is consistent with the argument that for both children and adults, linguistic information is instrumental in identifying target words, particularly (but not exclusively) verbs.

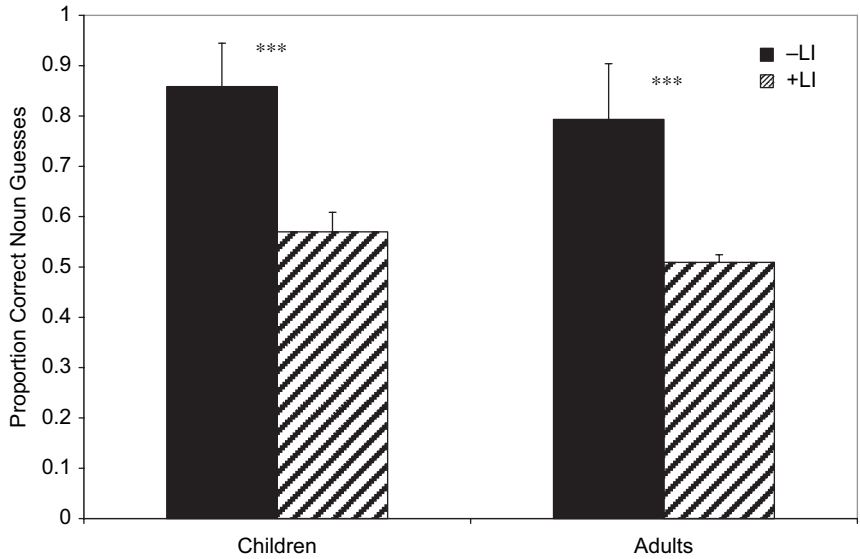

FIGURE 5 Mean proportion of correct noun guesses ('noun advantage scores') for children in condition –LI ($n = 12$), children in condition +LI ($n = 12$), adults in condition –LI ($n = 12$), and adults in condition +LI ($n = 12$). Vertical bars depict 95% confidence intervals on the means. ***$p < .001$.

Comparing the strategies of adults and children

In the next series of analyses, we examined adults' and children's strategies in approaching the task. Our intuition was that children tended to consider each clip in isolation, despite the experimenter's repeated reminders that all clips within a series represented the very same word. Our impression was that as a result of this strategy, children not only arrived at the correct guess later within a trial than did adults, but that once they did arrive at the correct guess, they continued to offer different guesses on each subsequent clip within that trial. In contrast, adults seemed to use evidence across the clips within a trial to 'zero in' on the correct target word more quickly, and having determined what they felt was the correct target word, they would continue to guess that word for the remainder of the trial. We pursued each of these two observations in turn.

Arriving at the correct guess. First, we asked whether, in fact, children did arrive at the correct guess later in a trial than adults. We reasoned as follows: If children are strategically less adept at resolving uncertainty and less effective when it comes to holding in mind and comparing alternatives gleaned successively over clips within a trial, then they should arrive at the correct guess for a particular target word more slowly than adults. Furthermore, if verb meanings are more dependent on linguistic information accumulated across exposures than are noun meanings, then participants should arrive at the correct guess for verbs more slowly than for nouns. To explore these predictions, we examined the serial position of the first correct guess for participants within each trial using a (2) condition × (2) age group × (2) target word class repeated measures ANOVA. Main effects of age group and word class indicated that as predicted, children (M = 2.49, SD = 1.56) required more guesses to arrive at their first correct guess than did adults (M = 1.92, SD = 1.25), $F(1, 44) = 7.68$, $p = .008$, and participants across both age groups required more guesses to correctly guess verbs (M = 2.67, SD = 1.86) than nouns (M = 1.73, SD = .535), $F(1, 44) = 23.0$, $p < .001$. There was also a main effect of condition, indicating that participants required more guesses to arrive at their first correct guess in the –LI condition (M = 2.86, SD = 1.76) than the +LI condition (M = 1.55, SD = .455), $F(1, 44) = 40.3$, $p < .001$. These main effects were mediated by a three-way interaction, $F(1, 44) = 5.01$, $p = .03$.

An analysis of simple main effects localized this interaction within the –LI condition. In the +LI condition, children required just under two guesses, on average, to arrive at a correct guess, with no reliable difference in the rate at which they first correctly guessed verbs (M = 1.75, SD = .454) and nouns (M = 1.93, SD = .404). Adults revealed a similar (but swifter) pattern, demonstrating no difference in the rate at which they first correctly guessed verbs (M = 1.13, SD = .176) and nouns (M = 1.38, SD = .226). However, in the –LI condition, the number of guesses required to arrive at the first correct guess for verbs exceeded

that for nouns. This difference held up in both age groups, but was more pronounced for children (M_{verb} = 4.63, SD = 1.75; M_{noun} = 1.64, SD = .562), $p < .001$, than for adults (M_{verb} = 3.17, SD = 1.86; M_{noun} = 1.99, SD = .653), $p = .004$. As predicted, in the absence of linguistic information, both children and adults more readily guessed nouns than verbs.

Switching from a correct guess. We next considered how likely participants were to change their guess after having arrived at the correct guess on a given trial. Our impression was that children had a tendency to focus on each individual scene to formulate a guess, and that as a result, they were more likely than adults to switch their guesses after arriving at the correct target word. To test this impression, we tabulated for each participant and each trial the number of distinct incorrect guesses that followed the first correct guess, and divided this by the total number of guesses that followed the first correct guess. The resulting proportions could range from 0 (if a participant did not switch at all and offered the same correct guess for every clip following the first correct guess) to 1 (if a participant offered a different incorrect guess for every clip following the first correct guess). With this calculation we were able to adjust for the fact that in general, adults arrived at the correct guess earlier in a trial than did children.

A (2) condition × (2) age group ANOVA yielded a main effect for age group. As predicted, even after arriving at the correct answer, children (M = .530, SD = .333) did indeed switch their guesses more often than adults (M = .169, SD = .208), $F(1, 44) = 34.1$, $p < .001$. In addition, there was more switching in the –LI condition (M = .526, SD = .333) than the +LI condition (M = .173, SD = .214), $F(1, 44) = 32.4$, $p < .001$. There was no interaction, $F(1, 44) = .468$, $p = .5$.

These analyses provide support for our intuition that children approached the HSP task differently—and less strategically—than did adults. Children required more guesses than adults to arrive at the correct target word, and even when children did arrive at the correct word, they were more likely than adults to switch their guess on subsequent clips. Taken together, these results converge well with evidence suggesting that children take a more ‘local’ approach in problem-solving tasks. For example, in a twenty-questions game, 7-year-olds were as likely to guess individual items as to ask more comprehensive questions to effectively rule out several alternatives at once (Courage, 1989). Similarly, in the current task, children took a more ‘local’ approach: In seeking the best guess for each individual clip, they were less likely than adults to integrate their guess for the current clip with information gleaned over the previous clips. Despite these strategic differences, both groups demonstrated a clear noun advantage in the absence of linguistic information.

GENERAL DISCUSSION

The experiments reported here represent a first step toward bridging a gap between evidence drawn from simulations (in which either computers or adults 'simulate' a child word learner) and evidence from young word learners themselves. Our goal was to discover how children, who have yet to develop the metacognitive and strategic sophistication of adults, would fare in the Human Simulation Paradigm (HSP) word guessing task. Using observation alone, 7-year-olds identified nouns more readily than verbs. When observation was supplemented with linguistic information, the children were able to recruit this information and apply it to their verb identification such that this noun advantage was attenuated. Importantly, the presence of linguistic information served to facilitate verb mapping to a greater degree than it did noun mapping. This pattern of responses was evident for both adults (Experiment 1) and children (Experiment 2).

The patterns of performance exhibited by adults in our task mirror those reported in previous implementations of the HSP (Gillette et al., 1999; Snedeker, Gleitman, & Brent, 1999; Snedeker, 2000; Snedeker & Gleitman, 2004; Kako, 2005; Lavin et al., 2006). These parallels are striking, given that we introduced several modifications to render the task more appropriate and engaging for children. Specifically, we utilized different stimuli, different target words, and a slightly different procedure from that which had been employed in previous HSP studies. Even in the face of these modifications, the importance of linguistic cues to the discovery of verb meaning for both children and adults was clearly demonstrated, a testament to the robustness of this phenomenon.

Nevertheless, there were important strategic differences in the ways that the 7-year-olds and adults approached our task. Children tended to adopt a 'local' view, basing their word guesses primarily on the information available within a given scene, which is consistent with evidence regarding children's approaches to resolving uncertainty in other problem-solving tasks (e.g., Denney & Connors, 1974; Denney, Jones, & Krigel, 1979; Courage, 1989). Adults, in contrast, took a more 'global' approach, collecting information across multiple scenes to converge on the correct answer. As a result, adults arrived at the correct answer sooner than children, and having arrived at the correct answer, adults were more likely than children to stick with the correct answer in subsequence guesses. Despite these differences in strategic approach, the success patterns of the two groups were comparable. This constitutes the first demonstration that the power of linguistic information in the HSP does not depend on the sophisticated metacognitive support, which adults bring to the task.

The current results also broaden the range of circumstances under which adults' reliance on linguistic information is evident. Adults' use of linguistic information is not limited to one style of input, but is sufficiently robust to occur

in contexts involving naturalistic mother-child interactions (Gillette et al., 1999) as well as the scripted, well-choreographed scenes that characterize Sesame Street. One avenue for future research will be to identify the differences between these styles of input, and to ascertain whether any such differences influence patterns of acquisition in younger word learners.

The current findings also raise several important developmental issues, such as the place of simulations in developmental work. Although there is considerable developmental continuity between our adult and child word learner 'simulations', it is important to bear in mind that neither the HSP nor *any* simulation is intended to mimic precisely the processes underlying acquisition. Certainly the challenges facing adults or children in the HSP differ considerably from those facing infant word learners. For example, participants in the HSP must select a word from their existing lexicon that provides the best match for the target word. Infant learners, in contrast, have no existing lexicon to consult, and they must therefore marshal the accumulating evidence in order to establish brand new mappings between novel words and their meanings. The current HSP results provide a demonstration proof that when learners (both adults and 7-year-olds) are denied access to linguistic information, they exhibit a noun advantage that mirrors that seen in infants' earliest lexicons.

Although this research goes a long way toward bridging the gap between adult and child word learners, perhaps the most compelling questions in lexical acquisition concern infants. Evidence from 7-year-old children cannot tell us whether infant learners rely more on linguistic information for verb learning than for noun learning, or whether this reliance plays a contributing role in the predominance of nouns in their early vocabularies. There is reason to suspect that in the earliest stages of word learning, infants do not yet distinguish among different grammatical form classes (Waxman & Lidz, 2006) and are as yet unable to take advantage of syntactic and linguistic cues to establish word meanings (Gleitman, 1990; Waxman & Lidz, 2006). An important aim for future research, then, will be to discover when linguistic information begins to convey its benefits to word learning, and how access to linguistic information unfolds from infancy through the toddler years. Recent evidence suggests that children as young as four years of age are able to identify the meaning of a novel verb in a word-guessing paradigm if they are provided with sufficient linguistic and contextual support (Papafragou, Cassidy, & Gleitman, as cited in Gleitman et al., 2005). This suggests that a version of the HSP may provide a means for examining this question.

Another set of questions is focused more squarely on the conceptual and linguistic components underlying the acquisition of different *kinds* of words. Consider first the acquisition of words in the grammatical category *noun*. Clearly, some kinds of nouns are acquired earlier than others. For example, when a count noun is applied ostensibly to an individual (e.g., a *dog*), the most natural interpretation for both adults and children is that it refers to the basic level

category (e.g., *dog*) (Rosch, Mervis, Gray, Johnson, & Boyes-Braem, 1976; Waxman & Senghas, 1992; Waxman & Markow, 1995). Establishing non-basic level interpretations appears to require additional information. To establish a superordinate level interpretation (e.g., *animal*), this additional information involves either some form of explanation (Callanan, 1991) or evidence that individuals from different basic level categories (e.g., a dog, a horse, a duck) are all labeled with the same noun (e.g., 'These are all animals') (Waxman & Gelman, 1986; Waxman, 1991; Waxman & Markow, 1995; Waxman & Braun, 2005). To establish a subordinate level interpretation (e.g., *collie*), this additional information may involve the observation that distinct individuals from the same basic level category (e.g., a collie, a terrier, a poodle) take distinct names (e.g., 'This one is a collie, but that one is a poodle') (Waxman, 1991; Waxman, Lynch, Casey, & Baer, 1997). For other kinds of nouns, especially the context-restricted nouns (e.g., *passenger*), life phase-restricted nouns (e.g., *puppy*), and relational nouns (e.g., *uncle*, *gift*, *predator*), different sources of information may be required (MacNamara, 1986; Hall & Waxman, 1993).

Thus, some nouns (e.g., those referring to basic level categories) may be acquired on the basis of a single observation, while others (e.g., those referring to non-basic level categories or to object parts) may require more extensive information. Consistent with this observation, Kako (2005) has demonstrated that within the HSP task, adults are more successful at identifying basic than non-basic level nouns. In the current experiments, we did not find a difference in participants' success in identifying basic as compared to non-basic level nouns. However, our experiments included only three basic and three non-basic level nouns. We suspect that if we had examined a larger set of nouns, or if we had provided our participants with less supportive learning conditions, differences in ease of identification may have been evident.

It will also be important to consider differences within the grammatical class *verb*, and the sources of information that are required to establish meaning. Some kinds of verbs tend to be acquired earlier than others. For example, motion verbs are acquired earlier than transfer verbs (Bloom, Lightbown, & Hood, 1975). This developmental trajectory may reflect the fact that some kinds of events or relations are more readily gleaned from observation than others. Interestingly, in the current experiments, mental verbs (whose meaning cannot be gleaned from observation) were no more difficult to identify than action verbs. As in the case of nouns, we suspect that had we examined a larger set of verbs, such differences may have emerged. Identifying the sources underlying this developmental trajectory in the verb lexicon will be a topic for future research.

In closing, the results of the experiments reported here reveal that for children as well as for adults, access to linguistic information is crucial to the establishment of word meaning, and that this is more dramatically so when it comes to mapping verbs than nouns to meaning. Within each experiment, we held conceptual

capacity roughly constant in order to focus on the contributions of observation (visual inspection of the scenes) and linguistic factors underlying the establishment of meaning. Although we have not addressed the contribution of conceptual factors in word learning, we certainly do not claim that they play no part. The claim that we make here is more measured. The infant literature suggests that young word learners have access to at least some of the concepts underlying verb meaning; this being the case, the hindrance for early verb acquisition is not a frank inability to represent such concepts, but rather an inability to cull the linguistic information that is necessary to establish the mapping between a given verb and its concept. Interpreted in this way, the task before us is to discover which kinds of information are available to learners at various developmental moments, and to better specify whether and how this information supports the acquisition of various kinds of words.

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