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Young children's fast mapping and generalization of words, facts, and pictograms

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ABSTRACT

To test general and specific processes of symbol learning, 4- and 5-year-old children learned three kinds of abstract associates for novel objects: words, facts, and pictograms. To test fast mapping (i.e., one-trial learning) and subsequent learning, comprehension was tested after each of four exposures. Production was also tested, as was children's tendency to generalize learned items to new objects in the same taxon. To test for a bias toward mutually exclusive associations, children learned either one-to-one or many-to-many mappings. In Experiment 1, children learned words, facts (with or without incidental novel words), or pictograms. In Experiment 2, children learned words or pictograms. In both of these experiments, children learned words slower than facts and pictograms. Pictograms and facts were generalized more systematically than words, but only in Experiment 1. Children learned one-to-one mappings faster only in Experiment 2, when cognitive load was increased. In Experiment 3, 3- and 4-year-olds were taught facts (with novel words), words, and pictograms. Children learned facts faster than words; however, they remembered all items equally well a week later. The results suggest that word learning follows non-specialized memory and associative learning processes.

Introduction

There is an ongoing debate concerning whether children have specialized mechanisms for word learning (Deák, 2000; Golinkoff, Mervis, & Hirsh-Pasek, 1994; Markman, 1994). Arguments for special-

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ization point to the efficiency of word learning. For example, "the adolescent vocabulary of ... up to 60,000 words is achieved with little effort" and "children build the lexicon so [fast] that [it implies] an independently evolved mechanism" (Hauser, Chomsky, & Fitch, 2002, pp. 1575–1576). Some researchers argue that such speed would be impossible without specialized mechanisms (Gleitman, Cassidy, Nappa, Papafragou, & Trueswell, 2005).

Claims of selective mechanisms for word learning are associated with *fast mapping*, that is, inferring a word's meaning from very few exposures (Carey & Bartlett, 1978). Children's ability to fast map words (Dollaghan, 1987; Heibeck & Markman, 1987) is treated as proof of the extraordinary efficiency of early word learning. Yet fast mapping can be considered as the outcome of a complex word-learning system. Within this system, other specialized mechanisms have been proposed to facilitate word learning (Markman, 1994). Some are *learning biases* or probabilistic assumptions that learners make about unfamiliar words. Two biases have garnered considerable attention: the *mutual exclusivity* bias, a disinclination to assign two words to one referent (Markman & Wachtel, 1988; Merriman & Bowman, 1989), and the *taxonomic bias*, an assumption that a new word refers to a category of referents rather than the named exemplar (Golinkoff et al., 1994; Markman, 1994).

We investigated whether and how fast mapping, and the mutual exclusivity and taxonomic biases, are specialized for word learning. To avoid complicating questions about when and how these skills or biases emerge (Liittschwager & Markman, 1994; Namy & Waxman, 1998; Smith, 1999), we tested 3- to 5-year-old children. By this age children know, and are learning, many hundreds of words (Anglin, 1993) and show fast mapping as well as behaviors consistent with both biases (Markman, 1994).

With respect to specialization, several questions remain unaddressed. With respect to fast mapping, Markson and Bloom (1997) found that children can fast map a word *or* a fact equally well. Yet other studies suggest that children do not fast map facts just the same as words but rather tend to generalize them differently (Waxman & Booth, 2000). In addition, it is unclear whether children fast map nonverbal stimuli. Similarly, although the mutual exclusivity bias might not be specific to word learning (Markman, 1994), little research has tested how children apply it to words and nonwords. The question of specialization remains unanswered. Finally, although a "taxonomic bias" certainly goes beyond words—children generalize various properties to categories (e.g., Deák & Bauer, 1996)—it is possible that children tend to treat words as special "markers" of categories. For example, Waxman, Philippe, and Branning (1999) claimed, "Children [have a] specific expectation that count nouns ... refer to object categories" (p. 65), yet empirical support for this claim remains equivocal.

These questions, although unanswered, have been addressed in previous work on fast mapping and on the mutual exclusivity and taxonomic biases.

Fast mapping appears to be specialized because it seems to diverge from common incremental learning trajectories (Thorndike, 1911). However, this assumption is questionable; models of incremental learning would predict that in a sample of to-be-learned associations, learning times should be normally distributed (McMurray, 2007). That is, children will learn most associations after an intermediate number of exposures, but a small proportion will be learned after one or two exposures (i.e., fast mapping) and a few will be learned very slowly. Notably, Deák and Wagner (2003) found that 4- and 5-year-olds learned some words quite slowly, requiring many exposures. Thus, fast mapping might simply describe the short tail of a normal distribution of learning times. Consequently, we cannot assume that fast mapping is a robust word-learning phenomenon. However, if fast mapping *is* specialized for words, children should fast map a higher proportion of words than other items. To test this, we taught children one of several kinds of stimuli, either words or nonwords, and tested learning after each exposure. If more words than nonwords are learned after one or two exposures, it will indicate specialization. Otherwise, it will support the simpler hypothesis that fast mapping is a by-product of general learning processes (Sloutsky, Lo, & Fisher, 2001; Xu & Tenenbaum, 2007; Yu, 2008).

Several studies have used this logic to investigate whether fast mapping is specialized. Behrend, Scofield, and Kleinknecht (2001) and Waxman and Booth (2001) confirmed Markson and Bloom's (1997) finding that preschoolers can fast map new facts as well as words. Several other studies reported that toddlers learn symbolic gestures or melodic sequences as readily as words (Campbell & Namy, 2003; Childers & Tomasello, 2002, 2003). However, Namy and Waxman (1998) reported that by their second year of life, children map words faster than nonverbal gestures. This implies that fast mapping might become more efficient for words. Alternately, however, fast mapping might become