Symbolic flexibility during unsupervised word learning in children and adults

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ABSTRACT

Considerable debate in language acquisition concerns whether word learning is driven by domain-general (symbolically flexible) or domain-specific learning mechanisms. Prior work has shown that very young children can map objects to either words or non-linguistic sounds, but by 20 months of age this ability narrows to only words. This suggests that although symbolically flexible mechanisms are operative early, they become more specified over development. However, such research has been conducted only with young children in ostensive teaching contexts. Thus, we investigated symbolic flexibility at later ages in more referentially ambiguous learning situations. In Experiment 1, 47 6- to 8-year-olds acquired eight symbol–object mappings in a cross-situational word learning paradigm where multiple mappings are learned based only on co-occurrence. In the *word* condition participants learned with novel pseudowords, whereas in the *sound* condition participants learned with nonlinguistic sounds (e.g., beeps). Children acquired the mappings, but performance did not differ across conditions, suggesting broad symbolic flexibility. In Experiment 2, 41 adults learned 16 mappings in a comparable design. They learned with ease in both conditions but showed a significant advantage for words. Thus, symbolic flexibility decreases with age, potentially due to repeated experiences with linguistic materials. Moreover, trial-by-trial analyses of the microstructure of both children's and adults' performance did not reveal any substantial differences due to condition, consistent with

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the hypothesis that learning mechanisms are generally employed similarly with both words and nonlinguistic sounds.

Introduction

An ongoing debate in language development is whether children's excellent abilities to acquire language are underpinned by domain-general or domain-specific mechanisms (Frank, Slemmer, Marcus, & Johnson, 2009; Lalonde & Werker, 1995; Marcus, Vijayan, Bandi Rao, & Vishton, 1999; Samuelson & McMurray, 2017). Such debates have been seen at every level of language from the acquisition of sound structure (e.g., Maurer & Werker, 2014) to word learning (e.g., Markman, 1990; Samuelson & McMurray, 2017) and grammar (e.g., Frank et al., 2009; Hauser, Chomsky, & Fitch, 2002; Marcus et al., 1999).

In word learning, domain-specific accounts suggest that vocabulary acquisition is facilitated by innate biases or constraints that are geared to the demands of acquiring words. For example, under mutual exclusivity, children assume that a word has one meaning, reducing the number of potential word–object mappings in any situation (Markman, 1990). In contrast, domain-general accounts argue that attention, statistical learning, association, novelty, and ecological factors may facilitate word learning (Samuelson & McMurray, 2017). In this view, competition between candidate referents (McMurray, Horst, & Samuelson, 2012; Yurovsky, Yu, & Smith, 2013) or attention to novel objects (Horst, Samuelson, Kucker, & McMurray, 2011; Mervis & Bertrand, 1994) could give rise to behaviors that look like mutual exclusivity. Children may also use domain-general mechanisms initially and adopt domain-specific solutions with experience (Hollich et al., 2000).

One aspect of domain generality in word learning is *symbolic flexibility.* This refers to the issue of whether children can map a range of symbols (e.g., gestures, nonlinguistic sounds) to objects or whether their learning mechanisms are tuned to accept only linguistic elements (e.g., words). Symbolic flexibility concerns the deep issue of what counts as a potential referential or symbolic unit and, therefore, is worthy of learning. Debates over symbolic flexibility are intertwined, but not isomorphic, with the debates around domain specificity; whereas a domain-specific account may be more consistent with a symbolically inflexible system, one could imagine a domain-general mechanism (e.g., statistical learning) that operates only on valid symbols or one in which linguistic symbols are better encoded or receive more attention and, thus, can undergo more (domain-general) learning. At the same time, it is hard to imagine a flexible system that is not in some ways domain general.

Studying symbolic flexibility throughout development can offer insights into the extent to which "specialization" occurs and how word learning may or may not change with development. Investigating symbolic flexibility, therefore, is a critical dimension toward understanding contributions of domain-specific and domain-general mechanisms in language acquisition.

Symbolic flexibility in word learning

Early studies on symbolic flexibility asked whether words facilitate object categorization better than other types of labels. Some studies show evidence for an early word advantage (Balaban & Waxman, 1997; Fulkerson & Waxman, 2007; Xu, 2002), whereas others do not (Roberts, 1995; Roberts & Jacob, 1991). However, this work is somewhat peripheral to the current question because it focuses on whether labels help to form categories, not on how labels are associated with categories.

Three studies have investigated the latter issue and suggest rapid specialization, although they differ on the time course. Mackenzie, Graham, and Curtin (2011) investigated this with 12-month-olds in a switch task. They found that infants dishabituated to a novel pairing only if they had been trained on words but not with nonlinguistic sounds. This suggests that word learning is characterized by symbolic inflexibility by 1 year of age. Namy and Waxman (1998) examined 18- and 26-month olds.