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Learning builds on learning: Infants' use of native language sound patterns to learn words



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ABSTRACT

The current research investigated how infants apply prior knowledge of environmental regularities to support new learning. The experiments tested whether infants could exploit experience with native language (English) phonotactic patterns to facilitate associating sounds with meanings during word learning. Infants (14-month-olds) heard fluent speech that contained cues for detecting target words; the target words were embedded in sequences that occur across word boundaries. A separate group heard the target words embedded without word boundary cues. Infants then participated in an object label learning task. With the opportunity to use native language patterns to segment the target words, infants subsequently learned the labels. Without this experience, infants failed. Novice word learners can take advantage of early learning about sounds to scaffold lexical development.

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Introduction

A fundamental process in language acquisition is to map the sounds of words to their meanings. This requires forming a sound representation and a meaning representation and then linking the two. Acquiring new words is a formidable task for novice language learners. Initially, vocabulary acquisition proceeds slowly and effortfully. By 2 years of age, infants typically become skilled and efficient word learners (Bloom, 2000; Fenson et al., 2007; McMurray, 2007). Essential to this developmental progression is the way that learning builds on prior learning. Infants must detect the environmental cues that are available to support word learning and must learn how to effectively exploit these cues.

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Infants' experiences shape how they learn, a process that is illustrated by the acquisition of the shape bias in word learning. One key task in word learning is to determine the range of items that a new word refers to. Smith and colleagues proposed that infants use consistent patterns in their environments to solve this problem (e.g., Samuelson & Smith, 1999; Smith, 2000; Smith, Colunga, & Yoshida, 2010). One such pattern is that the object categories and names that infants encounter tend to be organized around shape (Gershkoff-Stowe & Smith, 2004; Samuelson & Smith, 1999; Smith, Jones, Landau, Gershkoff-Stowe, & Samuelson, 2002); for example, within the categories of balls and cups, items not only share a label but also have similar shapes. When infants learn the shared name for items within a category, they have the opportunity to detect this name–shape relation. Moreover, when infants perform the larger scale generalization that “___s are ___-shaped” (Smith et al., 2002, p. 14), they can infer how new object names map onto entire groups of items with the same shape. Importantly, the experience of learning the names for many shape-based categories induces the shape bias; the shape bias, in turn, produces more efficient vocabulary acquisition (Smith et al., 2002). In fact, the shape bias can be induced in the laboratory by enriching infants' experience with shape-based categories. Following this enrichment, infants experience accelerated vocabulary growth (Smith et al., 2002). Learning about environmental patterns creates changes in how infants approach new learning problems.

The shape bias demonstrates how infants can detect a cue to structure in their environments and then apply the cue to promote further learning—how learning begets learning. In this case, the information helps infants to focus on the appropriate meanings for new words. Here, we ask whether the same general mechanism operates when infants learn about the sound sequences that form potentially meaningful units in the ambient language. How do infants identify the sound sequences in fluent speech that correspond to individual words that can be associated with meanings? A substantial literature has established that infants learn a remarkable amount about native language sound structure even before they start to produce their first words (reviewed in Saffran, Werker, & Werner, 2006). The next crucial step is to determine how infants apply this learning about linguistic sounds to learn new words.

A significant challenge in forming sound representations is to segment individual words from fluent speech. Before a listener has a substantial vocabulary, it is difficult to identify where each word starts and stops because the speech signal lacks reliable acoustic word boundary markers (Brent, 1999). However, the ability to segment fluent speech is essential for word learning because one cannot associate a word with its meaning unless the word has been identified. The linguistic environment provides infants with patterns that they can use to solve this problem (see reviews in Brent, 1999; Jusczyk, 1999). One source of information for segmenting words comes from phonotactic patterns, which include the frequency with which phonemes and phoneme combinations occur in a given language as well as the frequency with which they occur at particular word positions. Phonotactic information marks word boundaries because, in a given language, some phonemes do not occur at certain word positions or do not occur within words in certain combinations. For example, English words do not begin or end with the consonant cluster /vt/. When a listener encounters this sequence, knowledge of English phonotactics should suggest how to parse the utterance; thus, the phrase “give to” is heard as /glv tu/, not /glvt u/ or /gl vtu/. Accordingly, adults identify words in fluent speech more rapidly when phonotactic word boundary cues are present than when they are absent (McQueen, 1998).

Thus, infants' linguistic input provides cues to cohesive word units just as it provides cues to shape-based category structures. In both cases, learners must detect the regularities in the input in order to take advantage of them to promote further learning. During early language acquisition, there is evidence of sensitivity to phonotactics. Mattys and Jusczyk (2001) reported that infants can use phonotactics to detect words. In their experiment, 9-month-olds listened to target words embedded in sentences with good phonotactic cues to word boundaries. That is, at word onset and word offset, the target words were embedded in phoneme combinations that do not tend to occur within English words but do occur across word boundaries. During testing, infants listened longer to repetitions of the target words than to novel words, suggesting that they recognized the target words when presented in isolation. When infants heard target words embedded in sentences without phonotactic segmentation cues, they did not seem to recognize the words but rather treated them like entirely novel words (i.e., they showed no listening preference). Although listening preferences do not demonstrate

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