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Learning about sounds contributes to learning about words: Effects of prosody and phonotactics on infant word learning

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ABSTRACT

This research investigates how early learning about native language sound structure affects how infants associate sounds with meanings during word learning. Infants (19-month-olds) were presented with bisyllabic labels with high or low phonotactic probability (i.e., sequences of frequent or infrequent phonemes in English). The labels were produced with the predominant English trochaic (strong/weak) stress pattern or the less common iambic (weak/strong) pattern. Using the habituation-based Switch Task to test label learning, we found that infants readily learned high probability trochaic labels. However, they failed to learn low probability labels, regardless of stress, and failed to learn iambic labels, regardless of phonotactics. Thus, infants required support from both common phoneme sequences and a common stress pattern to map the labels to objects. These findings demonstrate that early word learning is shaped by prior knowledge of native language phonological regularities and provide support for the role of statistical learning in language acquisition.

Introduction

Before uttering their first words, infants have learned a remarkable amount about the sound structure of their native language. Infants' speech perception becomes focused on the relevant phoneme contrasts for their language (e.g., Werker & Tees, 1984), and they learn how phonemes typically

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combine within words (e.g., Jusczyk, Luce, & Charles-Luce, 1994). Infants also learn native language rhythmic patterns and several cues for detecting words in fluent speech (e.g., Jusczyk, Cutler, & Redanz, 1993; reviewed in Saffran, Werker, & Werner, 2006). During the second year of life, infants make substantial progress in associating words with their referents and vocabulary development accelerates. A large literature has explored how young children acquire meanings for new words (reviewed in Waxman & Lidz, 2006), and a separate body of work has investigated how infants learn about phonology. However, we know relatively little about how the precocious learning about sound structure is linked to the process of associating sounds with meanings during word learning (e.g., Graf Estes, Edwards, & Saffran, 2011; Werker, Fennell, Corcoran, & Stager, 2002; reviewed in Saffran & Graf Estes, 2006). Understanding this connection is important for explaining how early learning provides a foundation for future learning. Infants detect many sound system regularities in the ambient language, but do these regularities affect learning of higher levels of linguistic structure such as words? In the current research, we addressed how early phonological development contributes to word learning by testing how native language prosodic and phonotactic patterns affect how infants learn new object labels.

Learning about prosody

Prosodic structure is one of the earliest linguistic characteristics that infants are sensitive to, and it remains highly salient through adulthood. Newborns can discriminate their native language from a foreign language based on rhythmic differences (e.g., Mehler et al., 1988; Nazzi, Bertoncini, & Mehler, 1998). Infants can also distinguish lexical stress patterns at very young ages (Jusczyk & Thompson, 1978; Sansavini, Bertoncini, & Giovanelli, 1997). Over time, language experience shapes how infants process lexical stress. For example, the predominant prosodic pattern of English words is trochaic; strong (stressed) syllables precede unstressed (weak) syllables (e.g., BAby, HAppy [capital letters indicate stress]). Iambic words, in which weak syllables precede strong syllables, are less frequent (e.g., guiTAR, toDAY). Between 6 and 9 months of age, English-learning infants develop a listening preference for bisyllabic words with trochaic (strong/weak) stress rather than iambic (weak/strong) stress, indicating that they have learned the common pattern (Jusczyk, Cutler, & Redanz, 1993).

Infants' attention to regularities in lexical stress patterns may help them to segment words in continuous speech. English-speaking adults use strong syllables to identify the beginnings of words in fluent speech (e.g., Cutler & Norris, 1988; McQueen, Norris, & Cutler, 1994), and infants do as well (e.g., Curtin, Mintz, & Christiansen, 2005; Echols, Crowhurst, & Childers, 1997; Morgan, 1996). For example, Jusczyk, Houston, and Newsome (1999) found that 7.5-month-olds segmented trochaic words from fluent speech, but they missegmented iambic words, treating the stressed second syllables as word-initial syllables. At 10.5 months, infants correctly segmented iambic words, possibly by integrating other segmentation cues. Furthermore, several experiments have found that infants weight stress cues more heavily than other segmentation cues, such as patterns of syllable co-occurrence probabilities, when the two cues conflict (Johnson & Jusczyk, 2001; see also Mattys, Jusczyk, Luce, & Morgan, 1999; Shukla, Nespor, & Mehler, 2007). This weighting seems to change over development, with younger infants relying more on syllable probabilities and older infants relying more on stress (Johnson & Seidl, 2009; Thiessen & Saffran, 2003).

Recent experiments have addressed how stress affects infants' representations of new words when they are associated with referents. Curtin (2009) found that English-learning 12-month-olds learned pairs of object labels that differed only in their stress patterns (e.g., *BEdoka* + Object 1 and *beD-Oka* + Object 2). The word forms were segmentally identical, yet infants treated them as separate labels (see also Curtin, 2010). Infants must learn to interpret lexical stress in their native language because languages vary in their use of stress to signify differences in meaning. For example, Spanish uses stress contrastively, but French does not (e.g., Peperkamp, Vendelin, & Dupoux, 2010). English contains some word pairs in which stress distinguishes meanings (e.g., DIScount vs. disCOUNT); however, contrastive stress patterns often indicate grammatical distinctions such as between nouns and verbs (see Cutler, 2008, for a review). A recent study by Curtin, Campbell, and Hufnagle (2012) indicates that infants learn how lexical stress aligns with different word types, which affects how they acquire new words. English-learning 16-month-olds heard bisyllabic labels for actions presented with trochaic or iambic stress. Consistent with the sound pattern of many English verbs (Kelly & Bock,