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Finding patterns and learning words: Infant phonotactic knowledge is associated with vocabulary size

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ABSTRACT

Native language statistical regularities about allowable phoneme combinations (i.e., phonotactic patterns) may provide learners with cues to support word learning. The current research investigated the association between infants' native language phonotactic knowledge and their word learning progress, as measured by vocabulary size. In the experiment, 19-month-old infants listened to a corpus of nonce words that contained novel phonotactic patterns. All words began with "illegal" consonant clusters that cannot occur in native (English) words. The rationale for the task was that infants with fragile phonotactic knowledge should exhibit stronger learning of the novel illegal phonotactic patterns than infants with robust phonotactic knowledge. We found that infants with smaller vocabularies showed stronger phonotactic learning than infants with larger vocabularies even after accounting for general cognition. We propose that learning about native language structure may promote vocabulary development by providing a foundation for word learning; infants with smaller vocabularies may have weaker support from phonotactics than infants with larger vocabularies. Furthermore, stored vocabulary knowledge may promote the detection of phonotactic patterns even during infancy.

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Introduction

Experience shapes learning across development. It promotes specialization for processing the information present in one's own environment, yielding efficient and robust learning and information processing systems. For example, in language acquisition experience underpins infants' tuning to native phoneme categories (e.g., Werker & Lalonde, 1988; Werker & Tees, 1984) and the development of object name learning biases (Byers-Heinlein & Werker, 2013; Smith, Jones, Landau, Gershkoff-Stowe, & Samuelson, 2002). The current research investigated another crucial process in infants' language specialization—learning how sounds are used in words (Saffran & Graf Estes, 2006; Werker & Yeung, 2005).

One aspect of the native language sound system that infants must acquire is phonotactic information, which refers to the constraints on phoneme combinations in a given language as well as the probabilities with which phonemes and phoneme combinations occur. A key component of a language's phonotactic inventory is the distinction between those sound combinations that are attested in the words of the language (i.e., phonotactically legal sequences) and those sound combinations that are unattested (i.e., phonotactically illegal). At a young age, infants distinguish between phonotactically legal and illegal sound sequences. When presented with lists of novel words that consist of phonotactically legal or illegal word forms, 9-month-old infants listen longer to the legal word forms (Friederici & Wessels, 1993; Jusczyk, Friederici, Wessels, Svenkerud, & Jusczyk, 1993; Sebastián-Gallés & Bosch, 2002). Also at 9 months of age, infants can make an even more fine-grained distinction between two types of word forms that are phonotactically legal—those that consist of high-frequency phonemes and phoneme combinations versus those that consist of low-frequency phonemes and phoneme combinations (Jusczyk, Luce, & Charles-Luce, 1994; Nazzi, Bertoncini, & Bijeljac-Babic, 2009; see also Zamuner, 2006). Some experiments have demonstrated increasing sensitivity to native language phonotactics from 6 to 9 months of age (Jusczyk et al., 1993), indicating that phonotactic knowledge develops over time and with increased linguistic experience.

Infants' learning of phonotactic information has great potential to affect language acquisition, particularly vocabulary development. One possible point of influence is on the process of detecting individual words within the fluent stream of speech. Phonotactic patterns provide cues to word boundaries. For example, phonotactic patterns can aid in word segmentation when English speakers hear a phrase such as “give to” (/glv tu/) because phonotactic constraints indicate that the sequence /vt/ does not tend to occur within words. Accordingly, phonotactic patterns suggest that the appropriate parsing is (/glv tu/) rather than /glvt u/ or /gl vtu/. Mattys and Jusczyk (2001) reported that infants can make use of such segmentation cues (see also Mattys, Jusczyk, Luce, & Morgan, 1999). They presented 9-month-olds with target nonce words embedded in phrases with phonotactic cues for segmentation. That is, the phoneme combinations surrounding the target word's onset and offset formed phoneme combinations that frequently occur across word boundaries but not within native language (English) words. Infants displayed evidence of segmenting and recognizing the novel words when good phonotactic cues were present but not when they were absent. This work demonstrates that well before infants amass large vocabularies, their early learning about sound combinations has potential to shape lexical development and contribute to the development of the protolexicon.

Graf Estes (2014) explicitly tested how infants use early phonotactic cues to support the process of linking new word forms with meanings during lexical acquisition. In the experiment, 14-month-old infants listened to passages containing two target words. The target words were embedded in either sentences that contained phonotactic segmentation cues to the target words' locations or sentences that lacked phonotactic segmentation cues (similar to Mattys & Jusczyk, 2001). The infants subsequently participated in a task where the target words were used as object labels; the labels were presented in isolated repetitions, not in fluent speech. The infants exploited phonotactic word segmentation cues to detect words and subsequently associate them with referents. Infants successfully associated the target words with objects only when they had initially heard the words embedded in sentences containing phonotactic segmentation cues to the target words' locations. When the same target words were initially presented in passages without phonotactic segmentation cues, infants failed to learn the object labels. Thus, one mechanism by which early phonotactic knowledge may

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