Developing sensitivity to native language sound patterns

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Abstract: During the second half of their first year, English-learning infants begin to show sensitivity to the structure and organization of native language sound patterns. In particular, they give evidence of recognizing the phonetic, phonotactic, and prosodic characteristics of native language words. Moreover, their sensitivity to these features of native language sound organization appears to play a critical role in infants' abilities to segment words from fluent speech. Evidence for the use of this language-specific information in words segmentation by infants is presented. In particular, we focus on changes in the development of word segmentation abilities between 7.5- and 10.5-months of age. In addition, findings are considered that suggest that infants' representations of the sound patterns of words are detailed both in terms of their phonetic and indexical features.

DISCOVERING THE SOUND ORGANIZATION OF THE NATIVE LANGUAGE

The sound structures of languages differ in many ways. In their segmental organization, languages differ in which phonetic elements are included in their basic sound inventories. They also differ in how the phonetic elements can be combined and sequenced in words (i.e. their phonotactics). In their suprasegmental organization, languages differ in prosodic organization (e.g. whether word stress patterns are fixed or variable.) Thus, regardless of any innate speech perception capacities, infants must learn the characteristic sound patterns of their native language. English-learners begin to discover many of these aspects of native language sound organization between 6- and 9-months of age.

Jusczyk et al. [1] examined when English- and Dutch-learning infants respond to the segmental organization of words in their native language. The prosodic structure of words in these languages is very similar [2, 3]. However, these languages differ in their phonetic elements and phonotactic constraints. The [r] found in English words is very different from the [r] in Dutch words. Also, whereas English allows word-final voiced stops such as [d], Dutch does not. Dutch has word-initial consonantal clusters such as [zw] and [kn] which are absent from English. Jusczyk et al. had a bilingual talker record lists of low-frequency, 2- and 3-syllable Dutch and English words. American 6-month-olds tested on these lists listened as long to the Dutch as to the English lists. However, English-learning 9-month-olds listened significantly longer to the English lists, whereas Dutch 9-month-olds listened longer to Dutch lists. To determine whether phonetic and phonotactic differences were the source of this preference, Jusczyk et al. low-pass filtered the word lists to remove the critical phonetic and phonotactic cues. The 9-month-olds now displayed no significant preferences, suggesting that they responded to the phonetic and phonotactic properties in the earlier study.

Similar developmental changes in English-learners occur for sensitivity to native language prosodic patterns. Jusczyk et al. [4] explored sensitivity to the predominant stress patterns of English content words. Previously, Cutler and Carter [5] found that a high proportion of content words in English begin with a stressed syllable. On the basis of this finding, it was suggested that English listeners may adopt a Metrical Segmentation Strategy (MSS) whereby the location of stressed syllables is used to indicate the onsets of words in fluent speech [6]. For language-learners to use this strategy in word segmentation, they must first learn the predominant stress pattern. Jusczyk et al. tested American infants on lists of low-frequency bisyllabic words, with either Strong/weak (Sw) or Weak/strong (Ws) stress patterns. Nine-month-olds, but not 6-month-olds, displayed clear preferences for Sw words over Ws words. Hence, sensitivity to the predominant stress patterns of English words develops between 6- and 9-months.

THE BEGINNINGS OF WORD SEGMENTATION BY INFANTS

A critical task for language-learners is how to locate the beginnings and endings of words in speech. To explore word segmentation by English-learners, Jusczyk and Aslin [7] familiarized infants with pairs of words (such as "bike" and "feet") and examined whether they listened longer to passages with these familiarized target words than to ones with novel targets. They found that 7.5-month-olds, but not 6-month-olds, listened longer to the passages with the familiarized target words. A follow-up study demonstrated that infants had responded to the whole words rather than to salient features such as vowel quality. So, 7.5-month-olds are showing the beginnings of word segmentation.
Infants appear to use their knowledge of English sound organization to segment words. They may initially rely on predominant word stress patterns to locate the boundaries of words in speech. Newsome and Jusczyk [8] found that English-learning 7.5-month-olds familiarized with Sw words such as "hamlet" and "kingdom" listen significantly longer to passages with these target words than to ones with novel Sw words. In contrast, infants familiarized with Ws target words such as "beret" and "device" did not listen longer to passages with these target words than to ones with novel Ws words. Thus, English-learning 7.5-month-olds are better at segmenting words beginning with stressed syllables than ones beginning with unstressed syllables. This pattern is what might be expected if English-learners are following some version of MSS. An additional experiment offered further support for this hypothesis. Infants familiarized with just the strong syllable of Ws items (e.g. "tar" and "vice" from "guitar" and "device") did show significant listening preferences for passages containing "guitar" and "device".

Complete reliance on a strategy that identifies word onsets in English with the occurrence of stressed syllables would lead to missegmentations of words beginning with unstressed syllables. Hence, English-learning infants need to draw on other potential cues to word boundaries. However, parsing the input into smaller chunks based on the occurrence of stressed syllables could facilitate the process of learning to use allophonic and phonotactic cues to word boundaries. There is some evidence that this occurs for English-learners. For example, Houston et al. [9] found that English-learning 10.5-month-olds familiarized with targets such as "guitar" and "device" do listen significantly longer to passages with these words than to ones with novel Ws targets. Hence, these infants have developed some means of segmenting such words from fluent speech. Second, there are indications that although English-learning 9-month-olds do not use allophonic cues in segmenting words from fluent speech, 10.5-month-olds do.

Finally, what is the nature of infants' earliest representations of sound patterns of words? A recent investigation suggests that these representations may encode information particular to the talker who produced them. Houston et al. [11] found that, although English-learning 7.5-month-olds showed some tendency to generalize across tokens of target words produced by talkers of the same gender, their long-term memory of familiarized targets is much better 24 hours later for targets in passages produced by the same talker rather than by a different talker of the same gender.

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