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Vowel categorization during word recognition in bilingual toddlers

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ABSTRACT

Toddlers' and preschoolers' knowledge of the phonological forms of words was tested in Spanish-learning, Catalan-learning, and bilingual children. These populations are of particular interest because of differences in the Spanish and Catalan vowel systems: Catalan has two vowels in a phonetic region where Spanish has only one. The proximity of the Spanish vowel to the Catalan ones might pose special learning problems. Children were shown picture pairs; the target picture's name was spoken correctly, or a vowel in the target word was altered. Altered vowels either contrasted with the usual vowel in Spanish and Catalan, or only in Catalan. Children's looking to the target picture was used as a measure of word recognition. Monolinguals' word recognition was hindered by within-language, but not non-native, vowel changes. Surprisingly, bilingual toddlers did not show sensitivity to changes in vowels contrastive only in Catalan. Among preschoolers, Catalan-dominant bilinguals but not Spanish-dominant bilinguals revealed mispronunciation sensitivity for the Catalan-only contrast. These studies reveal monolingual children's robust knowledge of native-language vowel categories in words, and show that bilingual children whose two languages contain phonetically overlapping vowel categories may not treat those categories as separate in language comprehension.

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1. Introduction

Over the course of the first year of life, infants learn about the speech sound categories (consonants and vowels) that are constituents of their native language's phonological system. Infants improve in differentiating similar sounds that are used in their language (Kuhl et al., 2006; Narayan, Werker, & Beddor, in press; Tsao, Liu, & Kuhl, 2006) and worsen in differentiating sounds that are not used in their language (Best & McRoberts, 2003; Bosch & Sebastián-Gallés, 2003a, 2003b; Kuhl, Williams, Lacerda, Stevens, & Lindblom, 1992; Polka & Werker, 1994; Werker & Tees, 1984). In principle, this perceptual tuning should be of considerable help in language acquisition because it should lead infants to recognize words more accurately. For example, better categorization of vowels like /i/ and /e^{I}/ should help English-learning children differentiate words like *wheel* and *whale*. Decreased attention to distinctions not made in the language should also help by preventing children from misinterpreting different instances of the same word as distinct words.

But the in-principle benefits of phonetic learning might, in fact, be of limited use in the word learning and word recognition process, if children's encoding of words in memory is very vague, or if children cannot separate the linguistically relevant aspects of words, like their consonants and vowels, from formally irrelevant aspects, like whose voice produced the word, how quickly he was talking, whether he was mumbling. The purpose of speech sound categorization is to recognize words, but if the words of the child's vocabulary are encoded in memory with few phonological details intact, or with an overabundance of irrelevant experiential detail, infants' sound-categorization skills do not imply accurate identification and differentiation of words. To make an analogy to adult performance, the ability to perfectly categorize the sounds in a person's name ("*Hi – I'm Ellen*") does not, alas, guarantee recovery of the name the next day ("*Eileen. . . Ellen. . .Helen. . .Emily?*"). Children's speech discrimination performance may substantially overestimate their actual memory representations of words. If so, children's linguistic representations might be qualitatively different from those of adults—indeed, to take an extreme view, they might be so different that phonetic categorization experiments on infants are largely irrelevant to young children's word recognition.

The goal of much work on the early development of phonological perception is to characterize the format with which children store the sound forms of words, and to determine how children make use of this knowledge in interpreting language. Do children represent words in terms of the speech sound categories they learned as infants, or in a more holistic way, with phonological categories (which are tied to linguistic interpretation by definition) emerging only in middle childhood? The present paper addresses this issue in monolinguals and bilinguals by comparing children with varying language backgrounds.

First, we ask whether monolingual toddlers from two different language environments differ in language-particular ways in their responses to changes in words' pronunciations. Toddlers learning a language that treats two sounds as falling into separate categories should respond differently to words spoken with the normal pronunciation and words (mis)spoken using the other sound. However, toddlers learning a language that treats those two sounds as falling into the same category should treat the two realizations as equivalent. This pattern would be consistent with a model in which words are stored in terms of phonological categories specific to the language. Alternative patterns in which children of both language backgrounds respond the same way, by either ignoring the sound change or detecting it, would be consistent with models in which children's knowledge of words is more language-generic, and either vague (if both groups ignore small changes in words, even when linguistically relevant) or overly precise (if both groups respond to small changes, even when linguistically irrelevant).

Second, we ask whether bilingual toddlers show the same pattern as monolinguals. Bilinguals face a complex learning problem, because no two languages use exactly the same set of phonetic categories. Learning two systems of categories is not simply a matter of having to learn more sounds. To see why, consider the fact that languages tend to position phonological categories within the space of possible speech sounds in a way that maximizes the distinctiveness of the categories; for example, languages with only three vowels tend to use the very distinct sounds /i/, /u/, /a/ (as in *heat*, *hoot*, *hot*), and not, for example, the neighboring sounds /e/, /ɛ /, /æ/ (as in *hate*, *head*, *hat*; Liljencrants & Lindb-