Effects of frequency on phoneme processing

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Traditionally, the idea of contrastiveness was defined as a grammatical quality, with a binary definition: two sounds were either contrastive or not. Linked with the idea of contrastiveness is phonemicity. A sound is either a phoneme, contrasting with other phonemes, or it is an allophone of some other sound. But more recently, we have begun to think of contrastiveness in a more gradient fashion (Silverman 2006, Hall 2009). After all, the acoustic space is continuous, so it makes sense that sounds might occupy overlapping regions of this space, and that listeners may form flexible generalizations from exemplars in this space. Phonemicity is therefore not a property of the sound or of the language alone, but must be assigned or derived by the language user, based on his/her experience with the sound as it is used in the language. For this reason, the frequency of sounds, sound patterns, and words, may be very important to constructing phonemic categories.

There are multiple ways of investigating whether two sounds are contrastive. One could look at the grammar of the language to see if the two sounds contrast in any position. This assumes the distinctiveness of the two sounds and looks at the pattern of their distribution. Another way would be to examine the sounds acoustically to see if the two sounds are reliably different in contrastive environments. Another way, which is more faithful to the usage-based theoretical framework described above, would be to see if language users process the two sounds as two phonemes, or as variants of one phoneme.

One pair of phonemes that presents a special challenge is /ð/ and /θ/. The contrast produces very little functional load. Many words containing one sound may allow a variant pronunciation with the other sound (e.g., sheath/sheathe). In production, they display substantial overlapping variation along multiple dimensions. Two experiments were conducted to look at the relationship between /ð/ and /θ/, and compare it to the relationship between /z/ and /s/.

A phoneme monitoring experiment revealed that /ð/ and /θ/ are highly confusable, and that it is a more difficult task to identify /ð/ than /θ/. This result suggests that /ð/ may at least sometimes be processed as an allophone of /θ/ rather than a phoneme in its own right. It also supports the hypothesis that lexical candidates containing both /ð/ and /θ/ are activated during processing, as a result of the phonetic overlap between the two sounds in natural speech. Faster response times for syllables containing /θ/ may be a result of the higher type frequency of words containing /θ/. Or this may be an artifact of the greater amount of variation found in the production of /ð/.

Identification and discrimination tasks, using a continuum blended from the words *thy* and *thigh*, revealed a strong bias for /θ/; that is, more tokens were chosen as instances of /θ/, even though *thy* and *thigh* occur with roughly the same frequency. This may also be may be an indirect result of the higher type frequency of words containing /θ/. When encountering a word with an indistinct sound, which has multiple possible candidates, we may use type frequency to guess the correct sound, if token frequency does not resolve the ambiguity. One tentative explanation is that /θ/ is the dominant phoneme of the pair due to its higher type frequency, which gives /ð/ a quasi-allophonic status. Whatever the case, the results of these experiments indicate that the processing of /ð/ and /θ/ is just as fuzzy as the production.

References

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