

Acoustic cue weights quantify how much a listener relies proportionally on the spectral and durational information in a range of vowel stimuli in a forced-choice categorization task. Some results suggest that listeners will rely upon cues (e.g. duration) that do not play a role in determining phonological contrasts in the native language (e.g. Spanish). If they don't use it in the native language, it is not clear how they can use it when categorizing second language vowels. Some hypothesize different modes of perception may play a role when a speaker is confronted with non-native stimuli. The results of my pilot suggest that these cues, whether contrastive or not, are relied upon in perceiving the native language, and that modes of perception do play a role in perception.

Bohn(1995) produced a continuum of English vowels from /i/ to /I/ in a frame syllable of [bVt]. When native Spanish speakers, as well as Mandarin speakers, categorized the stimuli as English /bit/ or English /bIt/, they were shown to have relied upon the duration of the stimuli more than on the spectral information contained within the stimuli. Bohn suggested that this may have been because he only varied duration in three steps, as opposed to the eleven steps along the spectral continuum, and duration may have been relied upon because it was the least varying cue. This variable was not controlled. Likewise, Escudero (2000) produced a continuum of Scottish English vowels from /i/ to /I/, and found that the native Spanish speakers of her study categorized it with different reliances and cue weights. Some relied heavily on duration, and some relied heavily of the spectral information. Escudero did not control for the native Spanish speakers' dialectal variance. It is likely that different dialects have different vowel spaces, and this might explain the variance in cue weights among the different native Spanish speakers.

In my pilot, native speakers of Spanish with knowledge of English categorized a continuum along three dimensions (F1, F2, and duration) from Spanish /di/ ('di') to Spanish /de/ ('de') in a forced-choice task. The continuum was based on native Spanish production data. They were asked to categorize each stimulus as either Spanish 'di' (imperative form of verb 'say') or 'de' (preposition meaning 'of'), and they were also asked to give goodness ratings for each stimulus. Cue weights for a subset of the data showed that these listeners relied more heavily on the spectral information than on the durational information in an area closer to the prototypical values (calculated from the goodness ratings. See Kuhl 1993) of Spanish /i/; the stimuli that fell in the middle of Spanish /i/ and Spanish /e/, they gave more weight to the durational information. This suggests that native Spanish speakers do rely upon the duration of vowels of their native language, and explains how they are able to do so when presented with non-native vowel stimuli.

Independent vowel space phenomena has been positively correlated with listeners' goodness ratings of vowel stimuli when categorizing it (see Kuhl 1993 and Strange et al. 1998). This suggests that goodness ratings add insight into the shape of vowel categories. This seems to be the case in my study as well; The listeners relied more on duration in a portion of the vowel space that corresponded to low goodness ratings, and that they relied upon the spectral information to a greater degree in a portion of the vowel space that received higher goodness ratings. This suggests that the cue relied upon varies according to where in the vowel space an individual token falls. More specifically, closer to the prototypical vowel center, a listener seems to rely more on the spectral information of the vowel stimulus, while farther away from this prototypical vowel center, the reliance shifts to the durational information determining the category to which it belongs.

These results offer a possible explanation Bohn's (1995) and Escudero's (2000) results. The portion of the vowel space that was tested in their studies was not near a prototypical vowel center of the categories in question, and the listeners therefore relied on duration to a greater degree than spectral information. As Escudero's native Spanish speakers were from other dialectal regions, this could have influenced the shape of their vowel space, and therefore their categorization responses to the non-native stimuli.

In conclusion, cue weights depends on the shape of the listener's vowel. The positive correlation between goodness ratings and cue weights adds credence to this conclusion: the cue most relied upon changes according to where a vowel stimulus falls in relation to the prototypical vowel center.

### References

- Bohn, O.-S. 1995. Cross-language speech perception in adults: First language transfer doesn't tell it all. In *Speech Perception and Linguistic Experience: Issues in Cross-Language Research* (ed. W. Strange). Timonium, MD: York Press, pp. 279-304.
- Escudero, P. 2000. *Developmental patterns in the adult L2 acquisition of new contrasts: The acoustic cue weighting in the perception of Scottish tense/lax vowels in Spanish speakers*. Unpublished M.Sc. thesis, University of Edinburgh.
- Kuhl, P. K. 1993. Early linguistic experience and phonetic perception: implications for theories of developmental speech perception. *Journal of Phonetics* 21: 125-139.
- Strange, W. R. Akahane-Yamada and R. Kubo, S. A. Trent, K. Nishi and J. Jenkins. 1998. Perceptual assimilation of American English vowels by Japanese listeners. *Journal of Phonetics* 16: 311-344