Individual differences in second language speech perception across tasks and contrasts

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Purpose: A growing body of research has focused on individual differences in speech perception. Research has examined different aspects of individual variability including native listeners’ cue weighting strategies (Kong & Edwards, 2011), stability of individual cue weights over time (Idemaru et al., 2012), and second language (L2) learners’ use of acoustic cues (Wanrooij et al., 2013). Individual differences are especially evident in L2 speech perception in which learners show different cue weighting strategies in phonetic categorization (Schertz et al., 2015). However, little is known about whether the individual differences in cue weighting strategies are related across perceptual tasks and contrasts. The present study aims to further our understanding of individual differences in L2 speech perception by examining whether learners’ perceptual cue weighting strategies are related to their discrimination abilities and how individual cue weights are related across contrasts for individual learners of English. We predict that learners who rely more on spectral cues, which is consistent with native listeners’ strategies (Kondaurova & Francis, 2008), will show better discrimination abilities with naturally recorded words than those who rely more on duration. Furthermore, we predict that individual learners’ cue weighting strategies are stable across different vowel contrasts.

Method: Twenty-four native Korean learners of English participated in cue weighting experiments and an AX discrimination test after one year of residence in Canada. All the participants were involved in a longitudinal study on the acquisition of L2 sound contrasts as part of a larger project over the course of a year. For perceptual cue weighting, stimuli were resynthesized speech continua based on natural recordings of the endpoints of both /bɪ/ /bɪt/ and /bæt/-/baɪt/ contrasts produced by a male native speaker of Canadian English. Five steps varying in formant frequency (TANDEM-STRAGHT, Kawahara et al., 2009) were crossed with 5 duration steps (PSOLA in Praat) and presented in a two-alternative forced-choice identification task. To test learners’ ability to discriminate L2 vowels, a two-talker AX discrimination task was employed, where participants heard natural recordings by two female native speakers and judged whether they heard “same” or “different” stimuli. Linear mixed-effects models were used to examine the potential relationship between individual learners’ cue weighting strategies (β) and their discrimination abilities in the discrimination task (d’). Correlation analyses were carried out to examine the relation between individual learners’ cue weights across vowel contrasts.

Results: Relations between cue weights and discrimination performance are shown in Figure 1. There was a significant effect of Contrast (β = –0.45, p = 0.01), suggesting that the learners’ discrimination abilities were overall better for the /ɪ/-/ɪ/ contrast than the /ɛ/-/æ/ contrast. A significant effect of Spectrum was found (β = 1.05, p < 0.001); that is, learners who attended more to spectral information in categorizing vowels were more sensitive to the phonological contrast. However, individual learners’ vowel duration weight was not correlated with discrimination performance (β = 0.10, p = 0.68), suggesting that attending to vowel duration (which is a secondary cue for native listeners) did not affect discrimination performance. A marginally significant interaction between Contrast and Spectrum was found (β = 0.63, p = 0.07), suggesting that the effect of Spectrum on discrimination abilities differed across contrasts. That is, the learners’ spectral weight had a greater influence on their discrimination performance for the /ɪ/-/ɪ/ contrast than the /ɛ/-/æ/ contrast. Figure 2 shows correlations between cue weights across vowel contrasts for each of the cues. The correlation analysis showed that the learners’ cue weights were correlated across contrasts for both cues (Spectrum: r = 0.60, p = 0.001, Duration: r = 0.55, p = 0.004). That is, learners who showed greater spectral reliance on the /ɪ/-/ɪ/ contrast also relied more on the same cue for the /ɛ/-/æ/ contrast. The same pattern was also observed for the duration cue.
Figure 1 The relation between individual L2 learners’ cue weights and discrimination abilities

Figure 2 The relation between individual L2 learners’ perceptual weights across contrasts

**Conclusion:** The findings of this study suggest that the perceptual cue weighting strategies in individual L2 learners for a given phonological contrast are also manifested in these same individuals’ discrimination performance for that contrast. In other words, more native-like performance in a cue weighting task is related to better recognition of naturally produced vowels. We also found that individual learners’ perceptual weighting strategies are stable across contrasts. Thus, the present results confirm earlier reports that individual L2 learners vary greatly in the extent to which they rely on particular phonetic cues. However, we further demonstrated that these individual differences are not random, but reflect how well individual L2 learners discriminate contrasts and indicate that individual learners use a stable cue weighting strategy across contrasts.

**References**