Individual differences in second language speech perception across tasks and contrasts

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Introduction

L2 learners have difficulties in perceiving L2 sound contrasts.

- Native listeners pay more attention to certain acoustic cues over others to categorize speech sounds, which is referred to as perceptual cue weighting [1].
- L2 perceptual difficulties might be due to learners' paying attention to less relevant acoustic-phonetic cues [1, 2].

Individuals differ in L2 speech perception.

- Listeners show a large amount of individual differences in cue weighting and overall group patterns tend to mask important differences across individuals [4].
- Little is known about whether individual differences in cue weighting strategies are related across speech sound contrasts and whether individual differences in L2 cue weights are directly related to success in perceiving L2 contrasts.

Research Questions

Do individual differences in L2 learners' perceptual cue weighting strategies reflect systematic abilities?

1. **How are individual cue weights related across two difficult front vowel contrasts (/ɪ/-/i/ and /ɛ/-/æ/) for Korean learners of English?**
2. **Are learners' cue weights linked to their ability to discriminate naturally produced words?**

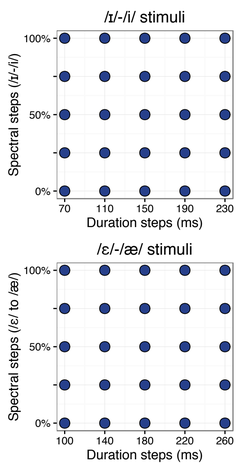
Methods

Participants

- 24 native Korean learners of English

Identification task

- Two-alternative forced choice identification
- 5 spectral steps (TANDEM-STRAIGHT) [3] x 5 duration steps (PSOLA in Praat) from natural endpoints of *bit-beat* and *bet-bat*



Discrimination task

- Two-talker AX discrimination
- 18 minimal pairs of English words

Contrasts	Words
/ɪ/-/i/	*sit-seat, dip-deep, chick-cheek, live-leave, chip-cheap, fit-feet*
/ɛ/-/æ/	*set-sat, beg-bag, dead-dad, said-sad, pen-pan, bed-bad*
Fillers	*fool-full, pool-pull, Luke-look, bowl-ball, coat-caught, low-law*

References

[1] Escudero, P., Benders, T., & Lipski, S. C. (2009). Native, non-native and L2 perceptual cue weighting for Dutch vowels: The case of Dutch, German, and Spanish listeners. *Journal of Phonetics, 37, 452–465.*
[2] Holt, L. L., & Lotto, A. J. (2006). Cue weighting in auditory categorisation: Implications for first and second language acquisition. *Journal of the Acoustical Society of America*, *119*(5), 3059–3071.
[3] Iverson, P., Kuhl, P. K., Akahane-Yamada, R., Diesch, E., Tohkura, Y., Kettermann, A., & Siebert, C. (2003). A perceptual interference account of acquisition difficulties for non-native phonemes. *Cognition, 87*(1), B47–B57.
[4] Kawahara, H., Takahashi, T., Morise, M., & Banno, H. (2009). Development of exploratory research tools based on TANDEM-STRAIGHT. *Proceedings of Asia-Pacific Signal and Information Processing Association, 2009 Annual Summit and Conference.* 111–120.
[5] Schertz, J., & Cho, T., Lotto, A., & Warner, N. (2015). Individual differences in phonetic cue in production and perception of a non-native sound contrast. *Journal of Phonetics, 52, 183–204.*

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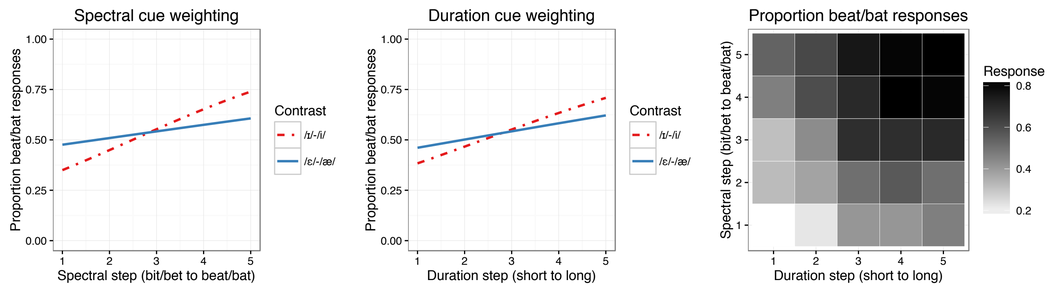
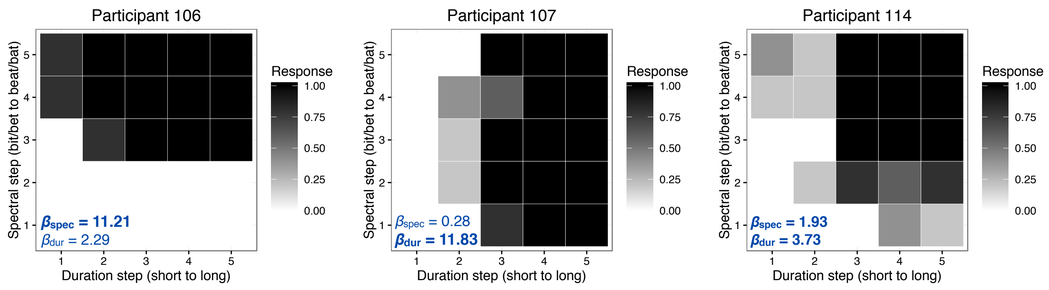
Results

Perceptual cue weighting: Group



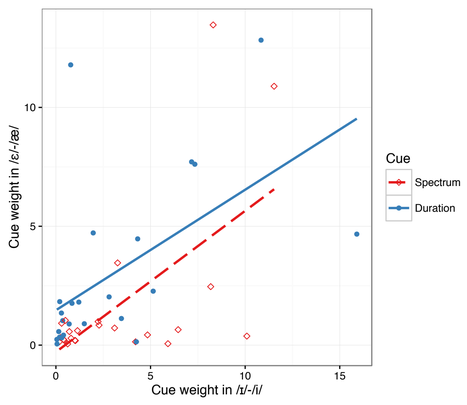
- Both spectral and duration dimensions significantly contributed to participants' categorization responses (Spectrum: $\beta = 1.67$, $p = 0.003$, Duration: $\beta = 1.58$, $p = 0.001$).

Perceptual cue weighting: Individual



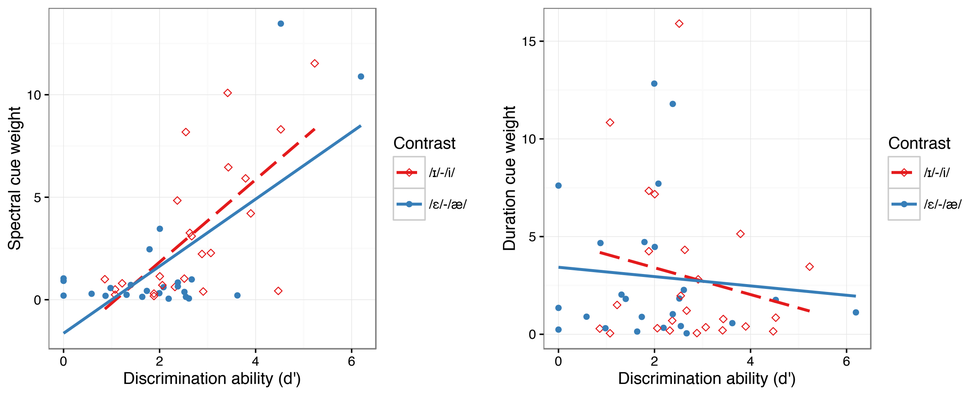
- Individual weights from logistic regression analyses fitted to each learner's responses.
- There were considerable differences in individual learners' cue weighting strategies.
- The overall group patterns masked substantial individual differences.

Relation across vowel contrasts



- Learners' cue weights were correlated across contrasts for both cues (Spectrum: $r = 0.60$, $p = 0.001$, Duration: $r = 0.55$, $p = 0.004$).
- Learners who weighted a certain acoustic cue for one vowel contrast tended to rely more on that cue for the other vowel contrasts.

Relation between cue weights and discrimination



- Only learners who attended more to spectral information (a primary cue for native listeners) in categorizing vowels were sensitive to the phonological contrast ($\beta = 1.03$, $p < 0.001$).

Discussion

Individual learners' use of spectral and duration differences as cues to the vowel contrasts were systematic in two ways.

- **Cue weights were correlated across contrasts.**
  - Individual learners' perceptual cue weighting strategies are stable across contrasts.
- **Cue weights were correlated with performance on the natural vowel discrimination task at an individual level.**
  - More native-like performance in the cue weighting task, namely the use of spectral differences over duration, was associated with better recognition of naturally produced vowels.