Testing Korean L2 learners of English on the use of acoustic cues to the /i/-/ɪ/ contrast in English spoken word recognition

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This study examined the use of spectral and durational cues in the recognition of spoken English words containing /i/ or /ɪ/ by native English listeners and Korean L2 learners of English.

Whereas English has the /i/-/ɪ/ contrast and English listeners rely more on spectral cues than on durational cues to perceive this contrast (Escudero, 2000; Flege et al., 1997), Korean has only the vowel /i/ (Cho & Jeong, 2013; Yun, 2014) and Korean L2 learners of English were found to rely more on durational cues than on spectral cues when perceiving the English /i/-/ɪ/ contrast (Kim et al., 2017, 2018; Lee, 2009). However, it is unclear whether the same findings would hold true of spoken word recognition, as previous studies on this topic used *offline* perception tasks (e.g., forced-choice identification) that encouraged listeners to explicitly attend to acoustic cues. *Online* processing tasks (e.g., a cross-modal priming) would elucidate how L2 learners' implicit use of spectral and durational cues affect the degree of the activation of words that (mis)match these cues, measured by the degree of priming between auditory primes and visual targets.

Native English listeners in the US (n=14; data collection ongoing) and Korean L2 learners of English in Korea (n=37) completed an *online* cross-modal priming task that tested how spectral and durational cues would affect their recognition of spoken English words containing /i/ or /ɪ/ and whether English proficiency would impact L2 learners' use of these cues. Auditory primes were created with the manipulation of spectral cues (/i/ and /ɪ/) and durational cues (a long vowel duration typical of /i/ and a short vowel duration typical of /ɪ/). The prime either matched or mismatched the spectral and/or durational cues expected of two types of visual targets (/i/ and /ɪ/). For example, the /i/-target *geese* ([gis]) could follow a prime in one of five priming conditions: [giːs] (spectral cue match-durational cue match), [gis] (spectral cue match-durational cue mismatch), [gɪːs] (spectral cue mismatch-durational cue match), [gɪs] (spectral cue mismatch-durational cue mismatch), and [bɛd] (unrelated control), with the reverse being true of /ɪ/-targets. Participants heard a prime, saw a target, and made a lexical decision on the target. Reaction times (RTs) for correct responses were measured and log-transformed before being analyzed statistically with linear mixed-effects models.

A significant interaction between priming conditions and listener groups was found. English listeners' mean RTs were significantly faster when targets followed primes with matching spectral cues compared to control primes for both /i/-targets and /ɪ/-targets (Fig. 1; Tables 1 and 2) while Korean L2 learners' mean RTs were faster when targets followed primes in all experimental priming conditions compared to the control condition for both targets (Fig. 2; Tables 3 and 4). When experimental priming conditions excluding the control condition were examined for acoustic cue effects, a significant interaction between spectral cues and listener groups was found. English listeners' mean RTs were faster when targets followed primes with matching spectral cues compared to primes with mismatching spectral cues for both targets (Fig. 3; Tables 5 and 6). For Korean L2 learners, the model with the best fit did not include fixed effects of spectral cues, durational cues, or English proficiency (measured by LexTALE scores; range=47.5–91.3%; mean=69.1%; SD=10.6%; Lemhöfer & Broersma, 2012).

These findings suggest that English listeners were able to use acoustic cues by relying more on spectral cues than on durational cues, whereas Korean L2 learners of English were unable to use either spectral or durational cues effectively to the /i/-/ɪ/ contrast during English spoken word recognition. A possible explanation for the absence of acoustic cue effects in L2 learners' data may be their insufficient exposure to native-like English (since they were tested in Korea).

Selected References

Lee, J. (2009). Perception of English high vowels by Korean speakers of English. *Phonetics and Speech Sciences*, *1*(4), 39–46.

Kim, D., Clayards, M., & Goad, H. (2017). Individual differences in second language speech perception across tasks and contrasts: The case of English vowel contrasts by Korean learners. *Linguistics Vanguard*, *3*(1), 1–11.

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Figures

Figure 1. English listeners' mean log-transformed RTs and RTs (ms) by targets and priming conditions (the error bars represent one standard error above and below the mean).
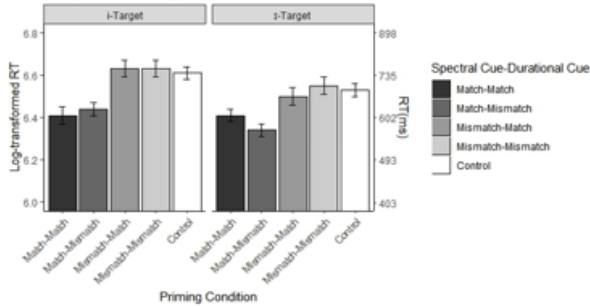

Figure 2. Korean L2 learners' mean log-transformed RTs and RTs (ms) by targets and priming conditions (the error bars represent one standard error above and below the mean).
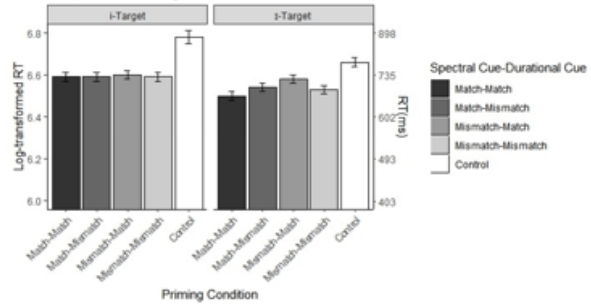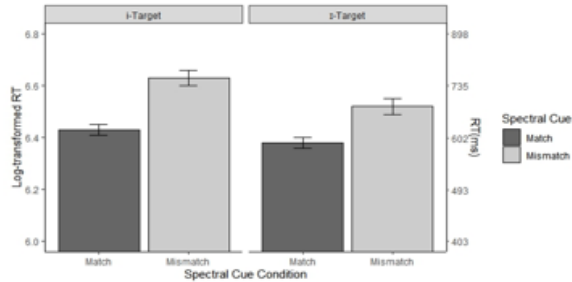

Figure 3. English listeners' mean log-transformed RTs and RTs (ms) by targets and spectral cue conditions of match and mismatch (the error bars represent one standard error above and below the mean).

Tables

Table 1. English listeners' results of the linear mixed-effects model with the best fit for the experimental priming conditions compared to the control condition for /i/-targets (with the control prime condition as baseline).

	Estimate	Std. Error	df	t-value	p-value
Intercept	6.62	0.07	21.10	98.85	< .001
Prime match-match	−0.20	0.04	533.80	−4.82	< .001
Prime match-mismatch	−0.16	0.04	528.96	−3.80	< .001
Prime mismatch-match	0.03	0.04	531.26	0.66	0.51
Prime mismatch-mismatch	0.02	0.04	536.38	0.53	0.60

Table 2. English listeners' results of the linear mixed-effects model with the best fit for the experimental priming conditions compared to the control condition for /ɪ/-targets (with the control prime condition as baseline).

	Estimate	Std. Error	df	t-value	p-value
Intercept	6.55	0.06	23.67	109.04	< .001
Prime match-match	−0.14	0.04	538.88	−3.45	< .001
Prime match-mismatch	−0.21	0.04	531.99	−5.11	< .001
Prime mismatch-match	−0.04	0.04	529.76	−1.00	0.32
Prime mismatch-mismatch	−0.01	0.04	535.30	0.13	0.90

Table 3. Korean L2 learners' results of the linear mixed-effects model with the best fit for the experimental priming conditions compared to the control condition for /i/-targets (with the control prime condition as baseline).

	Estimate	Std. Error	df	t-value	p-value
Intercept	6.81	0.04	108.90	163.30	< .001
Prime match-match	−0.20	0.03	1366.05	−6.58	< .001
Prime match-mismatch	−0.18	0.03	1367.16	−5.93	< .001
Prime mismatch-match	−0.18	0.03	1366.25	−6.01	< .001
Prime mismatch-mismatch	−0.19	0.03	1366.66	−6.37	< .001

Table 4. Korean L2 learners' results of the linear mixed-effects model with the best fit for the experimental priming conditions compared to the control condition for /ɪ/-targets (with the control prime condition as baseline).

	Estimate	Std. Error	df	t-value	p-value
Intercept	6.68	0.04	98.51	174.00	< .001
Prime match-match	−0.15	0.03	1400.51	−5.57	< .001
Prime match-mismatch	−0.12	0.03	1401.41	−4.57	< .001
Prime mismatch-match	−0.09	0.03	1402.43	−3.39	< .001
Prime mismatch-mismatch	−0.12	0.03	1399.77	−4.81	< .001

Table 5. English listeners' results of the linear mixed-effects model with the best fit for the experimental priming conditions with matching spectral cues compared to the experimental priming conditions with mismatching spectral cues for /i/-targets (with the experimental priming conditions with mismatching spectral cues as baseline).

	Estimate	Std. Error	df	t-value	p-value
Intercept	6.64	0.06	16.02	104.50	< .001
SpectralCue match	−0.21	0.03	424.59	−6.81	< .001

Table 6. English listeners' results of the linear mixed-effects model with the best fit for the experimental priming conditions with matching spectral cues compared to the experimental priming conditions with mismatching spectral cues for /ɪ/-targets (with the experimental priming conditions with mismatching spectral cues as baseline).

	Estimate	Std. Error	df	t-value	p-value
Intercept	6.53	0.06	18.36	114.67	< .001
SpectralCue match	−0.15	0.03	423.12	−5.37	< .001