

Cross-linguistic difference in dimensional reweighting during sound category learning in English and Korean listeners

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Listeners adapt to unfamiliar accents by adjusting how strongly they rely on acoustic dimensions that cue speech categories. Previous work [1][2] has shown that listeners reduce reliance on a previously informative dimension, such as voice onset time (VOT), and increase reliance on a secondary cue, such as F0, only when the secondary cue is reliably predictable, which is referred to as dimensional reweighting. We tested the predictions of a computational model of dimensional reweighting developed in [4], which combined a reinforcement learning account of dimensional reweighting [3] with imperfect perception and cue reassociation.

The model predicted that a narrower distance between F0 values would support stronger learning because closely spaced cue values imply a steep categorization slope. However, both perceptual acuity and dimensional weights are affected by the listeners' prior language experience. We therefore asked whether Korean listeners would show different patterns of dimensional reweighting from American English listeners. English listeners are known to rely primarily on VOT to distinguish English voiced and voiceless stops, and have difficulty perceiving F0 differences faithfully. They are therefore expected to have difficulty upweighting F0, while Korean listeners rely on F0 in distinguishing English voiced and voiceless stops [5][6]. Therefore, it was anticipated that Korean listeners would show stronger F0 upweighting than American English listeners when adapting to a new English accent in which F0 is the primary cue, and that they may show stronger upweighting of F0 when the meaningful F0 difference is small

A total of 240 participants were recruited online: 120 native American English speakers and 120 native Korean speakers. Participants completed a pre-test, training task, post-test, and F0 discrimination task. The auditory stimuli were based on the English beer-pier-continuum manipulated along VOT and F0. In the pre- and post-tests, listeners were asked to choose either the beer or pier picture for sounds with VOT values of 10 or 60 ms and F0 values of 165 or 275 Hz. During training, participants were assigned to one of three conditions: Close F0 (VOT: 20/50 ms; F0: 180/260 Hz), Far VOT (VOT: 0/70 ms; F0: 180/260 Hz), or Far F0 (VOT: 20/50 ms; F0: 150/290 Hz). Across all training conditions, F0 was informative in that higher F0 stimuli were associated with the voiceless response, pier, and lower F0 stimuli were associated with beer, regardless of VOT. Feedback was provided after each response in the training. After the post-test, participants completed an F0 discrimination task where they judged whether two sequentially presented sounds had the same or different pitch.

The results showed evidence of dimensional reweighting after training, and the pattern differed across cue distances and language groups. Both language groups increased reliance on F0 from pre-test to post-test, upweighting F0. As expected, this increase was significantly stronger for Korean listeners than for American English listeners. Korean listeners also showed robust F0 upweighting across training conditions, with no reliable condition difference, which suggests that they were generally prepared to attend to F0. In contrast, American English listeners showed stronger F0 upweighting in the Far F0 condition than in the Close F0 condition, and they showed lower accuracy at perceiving F0 differences than Korean listeners, especially the difference in the Close F0 condition. These findings suggest that the accuracy in perceiving the values of the to-be-upweighted dimension is the dominant factor in determining how much the dimension can be upweighted.

References

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Tables and Figures

Table 1. Significant fixed effects from the F0 model

	Estimate	SE	z	p	Interpretation
F0 x Posttest	0.74	0.21	3.55	< .001	English listeners upweighted F0 after training
F0 x Korean	2.83	0.38	7.49	< .001	Korean listeners relied more strongly on F0 overall
F0 x Posttest x Korean	2.30	0.44	5.24	< .001	Korean listeners showed greater F0 upweighting than English listeners
F0 x FarF0 x Posttest	0.92	0.30	3.04	.002	English listeners showed greater F0 upweighting in Far F0 condition

Figure 1. Predicted voiceless responses by F0, training condition, and language group

