The effect of second-language learning experience on Korean listeners' use of pitch cues in the perception of Cantonese tones

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Past studies have found the linguistic experience of previously acquired languages, for instance, one's native-language (L1) and second-language (L2) learning experience, modulates the perception of novel sounds from an unfamiliar language (i.e., a third language, L3). It remains unclear whether L1 or L2, or both, is the source of transfer in the very beginning stage of L3 acquisition [1,2]. Lexical tone is a good case for testing the influence of L1 or L2, as listeners with different language backgrounds have a different cue-weighting pattern in tone perception [3]. While tone language (i.e., Chinese) listeners rely more on *pitch contour* (different tone shapes; rising vs. falling tones), non-tone language (e.g., English) listeners often use *pitch height* (difference in height; high vs. low tones). To test the influence of L1 or L2 on the perception of L3 tones, Qin and Jongman [4] examined how English-speaking L2 learners of Mandarin employed pitch contour and pitch height in their perception of Cantonese tones. The results showed that while Mandarin listeners used pitch contour more than pitch height, English listeners who were naïve to lexical tones did not show a difference in their use of pitch cues. Crucially, the L2 learners showed a pattern like Mandarin listeners. The finding suggests an influence of the L2 instead of the L1 in the perception of L3 tones. However, another interpretation of the results would be that the functional use of pitch to lexical contrasts is quite limited in English and the L1 influence was thus not borne out clearly.

The present study is motivated to disambiguate the hypotheses by testing speakers of a language that fully employs pitch cues for lexical contrasts. To that end, we focus on Korean-speaking L2 learners of Mandarin whose L1 (variety) is either Seoul Korean (SK) or Kyungsang Korean (KK). SK is neither tonal nor stressed and does not use pitch to mark lexical prosody [5]. In contrast, KK uses pitch differences to realize lexically contrastive words (e.g. [ka^{L}.tɕi^{H}] 'eggplant' vs. [ka^{H}.tɕi^{H}] 'branch') [6]. If the influence of the L1 is predominant, the two groups of Korean-speaking learners are expected to show different performances, with KK-speaking-L2 learners patterning more like Mandarin listeners by virtue of the contrastive pitch cues in their L1 variety [7]. If the L2 learning experience is more integral in the way L3 prosody is processed, both groups are expected to show greater sensitivity to pitch contour than to pitch height.

The participants completed an AX forced-choice tone discrimination task. 20 intermediate-to-advanced SK-speaking and 15 KK-speaking L2 learners of Mandarin, who were matched in their proficiency in Mandarin and music experience, were recruited as target groups. 15 SK-speaking and 15 KK-speaking (also with limited exposure to SK) participants, who were naïve to any tone languages, were recruited as control groups. As illustrated in Figure 1, four Cantonese tones, that is, one contour tone (Tone 2; T2-rising) and three level tones (T1-high; T3-mid; T6-low), were used for the perception task. Level-Contour (T1-T2; T6-T2) and Level-Level (T1-T6; T3-T6) tonal contrasts were target tone pairs, allowing for testing the *primary* use of pitch contour versus pitch height, respectively [4]. The stimuli were produced by a female native speaker of Cantonese.

Mixed-effects regression models were run on response accuracy (1 for correct and 0 for incorrect). The models were fitted in R using the lme4 package with predictors (cues, groups, and L1 variety) deviation coded (−0.5, 0.5) to test the main effects. The model results, illustrated in Figure 2, showed that naïve Korean listeners, regardless of their L1 varieties, had a greater sensitivity to pitch height than to pitch contour ($\beta = 0.23$, SE = 0.09, $z = 2.55$, $p = .01$). In contrast, L2 learners, independent of their L1 varieties, showed greater sensitivity to pitch contour than to pitch height ($\beta = -0.51$, SE = 0.08, $z = -6.19$, $p < .001$), consistent with the pattern of Mandarin listeners [4].

Aligned with the cue-weighting theory of speech perception [3, 7], the findings provide evidence for a developmental change in which Korean-speaking L2 learners had *a perceptual cue shift* from pitch height to pitch contour through their L2 experience in Mandarin. Since there is no level tone contrast in Mandarin, subtle differences in pitch height might become within-categorical differences for L2 learners (and Mandarin listeners), resulting in reduced sensitivity to Cantonese level tones [4]. In contrast, the prosodic system of L1 varieties appears to have little influence on L2 learners in their perception of novel tones, which can be potentially explained by the L3 acquisition theory. For instance, the L2 Status Factor Model [1] predicts that L2 plays a privileged role in language transfer due to its non-native cognitive status analogous to L3. The Typological Primacy Model [2], on the other hand, proposes that the source language (L1 or L2) of transfer is determined by the typological similarity between languages. When applied to the current case, L2, rather than L1, is likely to influence the perception of L3 tones either because Mandarin is an L2 or because Mandarin is more typologically similar to Cantonese in that both languages have tone-bearing units as syllables while KK does not [5, 6]. Future studies need to tease apart the two accounts by including other language pairings (e.g., L1 and L3 are both tonal languages).

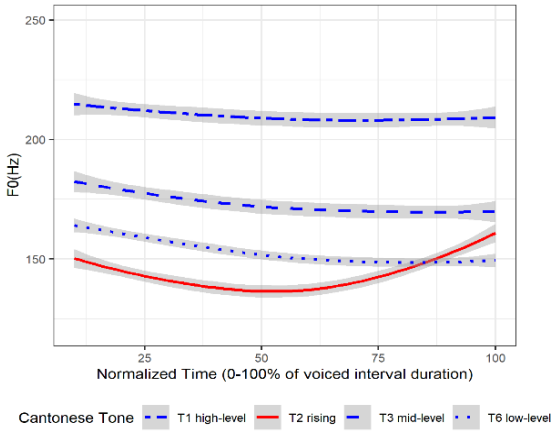

Fig. 1 Time-normalized pitch tracks of a contour tone (T2) in red and three level tones (T1, T3, T6) in blue

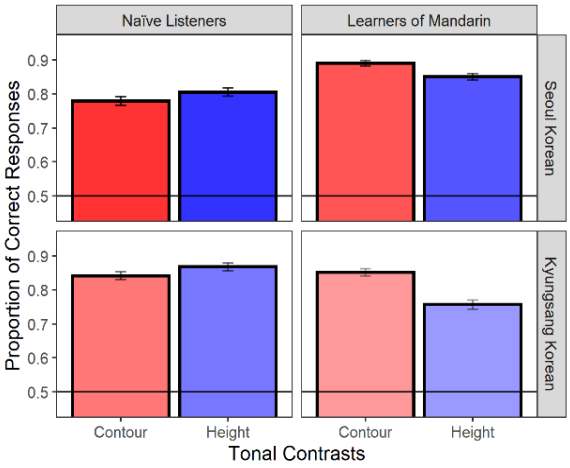

Fig. 2 Discrimination accuracy of Cantonese tones contrasting in pitch contour (red) and pitch height (blue) by SK-speaking (top) and KK-speaking (bottom) naïve listeners (left) and L2 learners of Mandarin (right); the error bars represent 1 SE above/below the mean; the horizontal line represents chance performance (0.5).

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