Lexical competition affects Cantonese tone mergers in word recognition

Rachel Soo & Molly Babel

Cantonese has a rich inventory of 6 lexical tones, though researchers have observed that some of these may be merging (e.g., Kej et al., 2002). Mok et al. (2013) show that tones 2 and 5, 3 and 6, and 4 and 6 are merging, becoming less distinct in production and perception (Mok et al., 2013; see Fig. 1), and the degree of merger in these tones is influenced by phonetic similarity (Khouw & Ciocca, 2007; Soo & Monahan, 2017) and type frequency (Mok et al., 2013). Cross-linguistically, minimal pairs inhibit mergers (Wedel et al. 2013), and pressure from listeners' perceptual processes encourages or inhibits gradual phonetic change to maintain recognition accordingly in models of diachronic change (Hay et al. 2015; Todd et al., 2019). Given this, in the face of these mergers-in-progress, how does lexical competition structure phonetic variability synchronically? We examine the merging Cantonese tone categories by assessing listener categorization of tones with and without lexical competitors. In line with Todd et al., (2019), we predict that lexical competition will result in the maintenance of distinct tone categories, manifested with a steeper categorization function in items with lexical competitors than those without.

Methods. Early Cantonese-English bilingual listeners (n=20, mean age = 21 years) participated in two experiments (Exp 1: Categorization task, Exp 2: Lexical decision task). Participants were familiarized with the talker who does not have the tone mergers by listening to a short Cantonese story prior to each task. For the categorization task, listeners were presented items sampled from an 11-step continua (Kawahara et al., 2008) for 4 minimal pairs in each of the following tone pairs: 2-5, 3-6, 4-6 (Merging) and 2-3, 5-6 (Control, non-merging). Continua endpoints were Cantonese real words matched for frequency (e.g. /se4/ *snake* - /se6/ *to shoot*) pictured on either side of the screen. Listeners categorized individual tokens according to these pictures. For the lexical decision task, 11-step continua were again created for 4 minimal pairs in above Merging and Control tone pairs. However, in these pairs, the endpoints of the continuum were either words or nonwords (e.g. /tim4/ *sweet* - */tim6/; */dej4/ - /dej6/ *the ground*) and they were pictured on either side of the screen with a thumbs up or down image. Listeners heard individual tokens randomly sampled from the tone continua and responded via button-press as to whether they heard a real or nonword.

Results. Hierarchical generalized logistic models were used with maximally warranted structure. Tone type (Control vs. Merging) and continuum step (centered, scaled) were fixed effects. The dependent variables were proportion of responses for the tone at step 1 (Exp 1) and proportion of word responses (Exp 2). There was a significant interaction between step and tone type for pairs with lexical competitors in Exp 1 (β=1.12, SE=0.31, z=3.60, p<0.001) and for pairs without lexical competitors in Exp 2 (β=0.24, SE=0.12, z=2.24, p=0.02), suggesting that the categorization function for the Control pairs may be steeper than that for the Merging pairs. Analyses comparing categorization functions across experiments established an interaction between continuum step and the presence of a lexical competitor for Control items (β=0.95, SE=0.21, z=4.58, p<0.001), but not Merger items. This suggests that Cantonese listeners may maintain more discrete tone categories for items with tonal competitors for stable, but not for merging tones. While these findings are interpreted as the result of lexical competition, the presence of a lexical competitor was confounded with the experimental task (i.e., the lexical decision task only used words without a lexical competitor and the picture identification task had lexical competitors). To address this and to complement the current results, we are currently using a goodness rating paradigm, subjecting all items to the same task. We discuss these results in terms of the interplay between category variability, the lexicon, and models of phonology.

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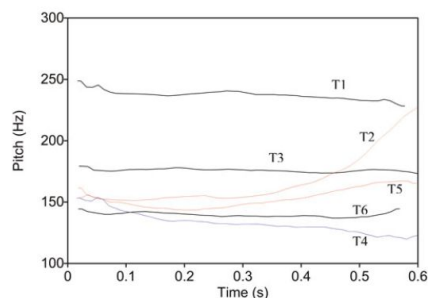## Rachel Soo & Molly Babel

Figure 1. 6 lexical tones of Cantonese produced on the syllable /ji/ by a female speaker (taken from Mok et al., 2013). Tones (T) 2 and 5, 3 and 6, and 4 and 6 have been reported to be merging.
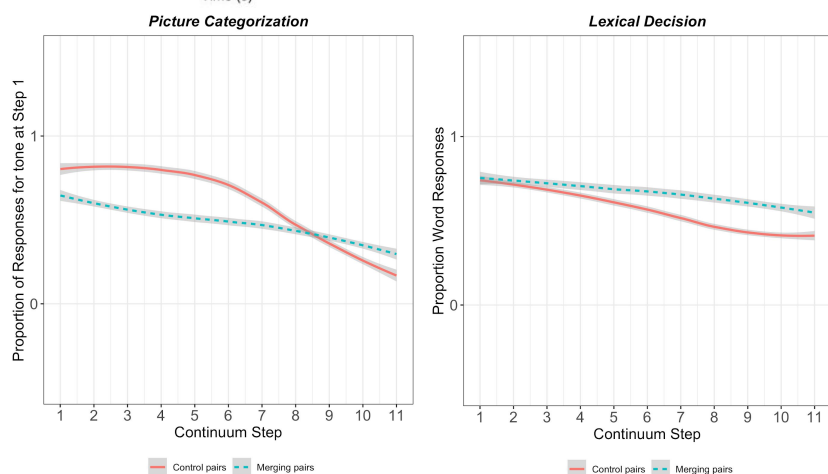

Figure 2. Results of the picture categorization (left) and the lexical decision task (right). Merging pairs are in blue dashed lines and Control pairs are in pink solid lines.

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