

Perception of tonal register contrast in Chinese Wu dialects

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1.Introduction Chinese Wu dialects use redundant cues in tonal register contrast (Zhang & Yan, 2015; Jiang & Kuang, 2016). The upper register is associated with higher pitches and modal phonation and the lower register is associated with lower pitches and breathy phonation. Moreover, in a contour tone, the steepness of the contour shape differs in the two registers in many Wu varieties (e.g. Chen & Gussenhoven, 2015). In other words, the tonal register contrast in Wu is cued in three dimensions: voice quality, pitch, and contour shape.

Zhu (2010) argues that breathiness in Wu dialects is weak compared with other phonatorily contrastive languages, and later studies found that Shanghai Wu is in the process of losing breathiness (e.g. Gao & Hallé, 2013). This study examines two Wu varieties, Shanghai and Jiashan, and aims to answer following questions: do listeners from both dialects use breathiness to perceive the register contrast? If so, how important it is compared to other cues? In addition, given Shanghai Wu is less breathy, do Shanghai listeners have different cue weighting?

2.Methods The current study used a forced-choice lexical decision task to examine how listeners make register categorization in different phonetic contexts. A native speaker produced a pair of monosyllabic word /ka/ (/ka 34/ vs. /ka 23/ for Shanghai and /ka 53/ vs. /ka 31/ for Jiashan) and were used in the experiment. A five-step pitch continuum was first manipulated using the PSOLA method in Praat (Boersma & Weenink, 2016) with the two endpoints being the two natural productions. A five-step phonation continuum was generated in TANDEM STRAIGHT (Kawahara et. al, 2008) again using the two natural production as endpoints. Each step in the pitch continuum was matched to the phonation continuum, creating 25 stimuli. The two contours were later superimposed on all the stimuli, which doubled the stimuli. Each stimulus was repeated five times and was played in a random order. A total of 35 Shanghai participants and 34 Jiashan participants participated in the study and listened to their own dialect.

3.Results The responses were fitted using mixed-effects logistic models for each dialect. All three cues are significant for both dialects, suggesting that listeners use all three cues for register contrast. While breathiness is weighted to be the least important for both dialects ($\beta = 0.359$ for Shanghai; $\beta = 0.888$ for Jiashan), it has a larger effect in Jiashan than Shanghai. Surprisingly, the primary cue is different: Shanghai listeners weight pitch the most important while Jiashan listeners weight contour the most important. Moreover, as indicated by the significant interactions between the cues, in Jiashan Wu, the effect of breathiness is smaller at higher pitches and with steeper contour, and the effect of pitch is smaller with steeper contour. Shanghai Wu, on the other hand, does not show a different effect of cues at various contexts.

4.Discussion The results show that while both listeners attend to all three cues, the primary cue is different. It could be the case that Jiashan has a more complex tone inventory than Shanghai, and heavily relying on pitch is less ideal to distinguish among the lower tones. It is also possible that Chinese listeners are more sensitive to falling tones (used in Jiashan) than rising tones (used in Shanghai) (Jongman et al., 2016), which makes contour a more important cue for Jiashan. In addition, Jiashan listeners who produce larger breathy-modal distinction indeed rely more on breathiness than Shanghai listeners perceptually. Moreover, Jiashan listeners display larger individual variation than Shanghai listeners, yet such variation can be captured by the correlation between pitch and breathiness: listeners who pay more attention to pitch also pay more attention to breathiness, and those who use pitch less also use breathiness less.

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