Perception and Individual variability of a Tonal Register Contrast in Chinese Wu dialects

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Introduction

Multidimensional cues: Chinese Wu dialects use redundant cues to distinguish between upper and lower tonal registers (Cao & Maddieson, 1992; Zhang & Yan, 2015; Jiang & Kuang, 2016)

- Pitch (onset F0): Upper = high, Lower = low
- Phonation: Upper = modal, Lower = breathy
- Contour: steepness/flatness is realized slightly differently

Dialectal difference: Shanghainese is argued to be in the process of losing breathiness (e.g. Gao & Hallé, 2013), lower register is less breathy

Individual variability: Group-level results do not present how individuals use cues differently, and whether there is structured variability (e.g. Kong & Edwards, 2016)

Tone Inventory

Jiashan (JS)	falling	level	rising	checked
Upper	53	44	35	5
Lower	31	13		2

Shanghai (SH)	falling	level	rising	checked
Upper	53	34		5
Lower		23		2

Research Questions

- What is the role of secondary cues (= breathiness etc.) to a multi-cue contrast (= tonal register contrast) — Exp 1
- What are the perceptual difference across individuals (structured?) — Exp 2
- and dialects (SH is less breathy)?

Methods

Task: two alternative forced-choice

Participants: 34 JS; 35 SH

Stimuli:

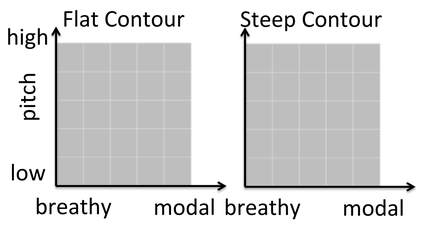
Natural endpoints (/ka/) recorded by one speaker of each dialect

Breathiness continuum: created in TANDEM STRAIGHT (Kawahara et al., 2008)

Pitch continuum: modified in Praat (Boersma & Weenink, 2016)

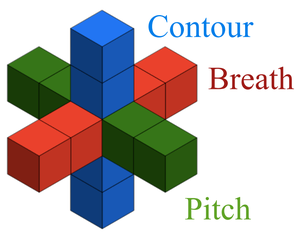
Contour continuum: modified in Praat (Boersma & Weenink, 2016)

Experiment 1 (Different tones)



- 5x5x2 steps
- Each group hears their own dialect

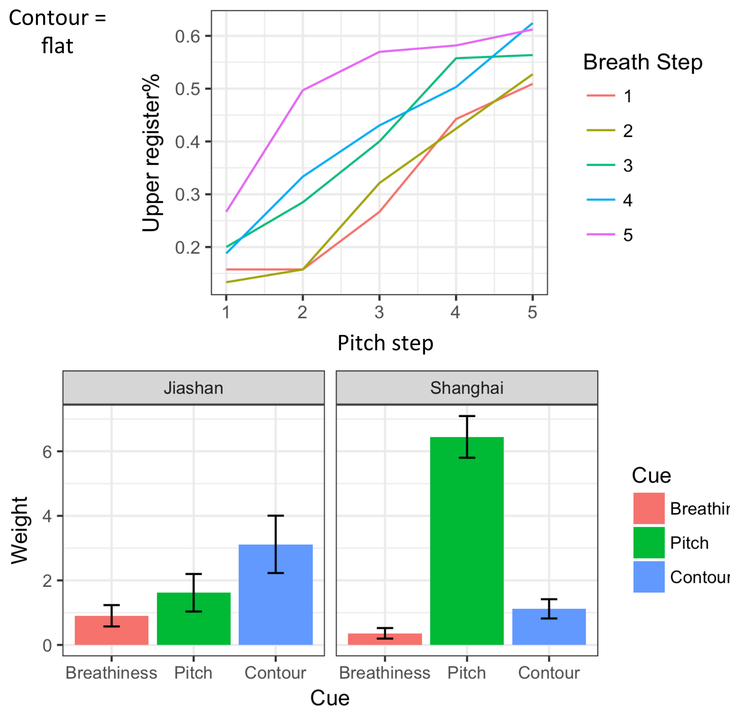
Experiment 2 (Same tone)



- Each continuum 5 steps
- Each group hears both dialects

Results: Group-level

Experiment 1



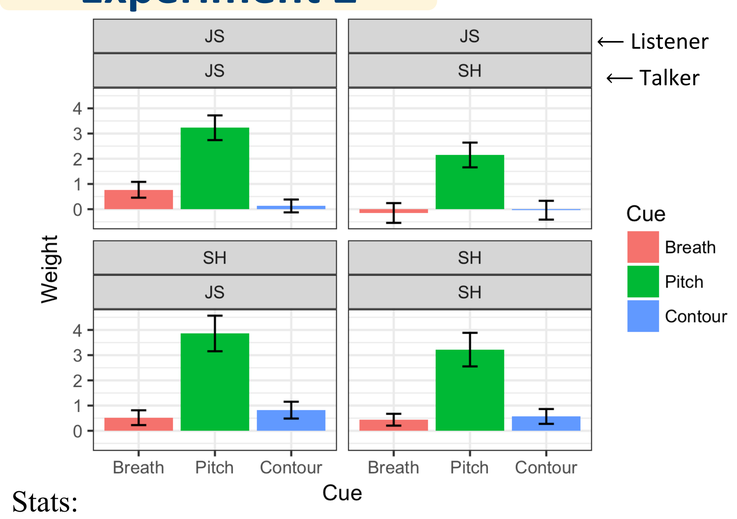
Stats: linear mixed-effects model

- Main effects: Breath × Pitch × Contour
- Random effects: by-participant random intercept and slopes (including two-way interactions)
- Cue weights are main effect coefficient estimates

Experiment 1:

- All three cues significant for JS and SH
- Primary cue: pitch for SH, contour for SH
- JS has higher weight for breathiness

Experiment 2



Stats:

- Main effects: (Breath+ Pitch+ Contour) ×Talker × Listener
- Random effects: by-participant random intercept and slopes (same terms as main effects)

Experiment 2:

- Pitch is always the primary cue for all talker-listener combinations
- JS listeners lower the weight of breathiness when listening to SH (top row)

Discussion: Group

Cue weighting

JS: Contour is the primary cue for falling tone (experiment 1), pitch for checked tone (experiment 2; probably due to short syllable duration)

SH: Pitch is always the primary cue

Dialectal difference

JS: sensitive to breathiness, adjust cue weight according to the saliency of breathy-modal contrast

SH: not sensitive to breathiness, do not adjust weights accordingly

Selected References

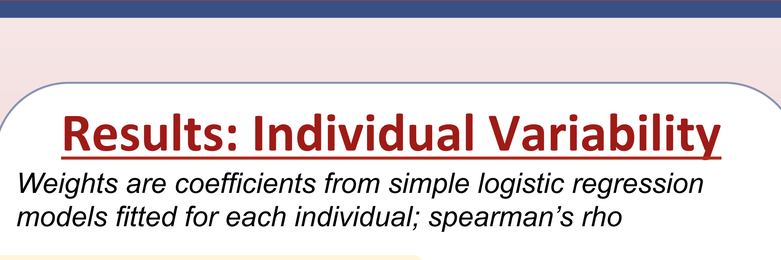
Cao, J., & Maddieson, I. (1992). An exploration of phonation types in Wu dialects of Chinese, Journal of Phonetics, 20, 77-92..; Gao, J., & Hallé, P. (2013). Are young male speakers losing Tone 3 breathiness in Shanghai Chinese? An acoustic and electro-glottographic study. Proc. 2nd ICPLC, 163-166.; Jiang, B. & Kuang, J. (2016). Consonant effects on tonal registers in Jiashan Wu. Proceedings of the Linguistic Society of America, 1, 30-1.; Zhang, J., & Yan, H. (2015) Contextual cue weighting for a laryngeal contrast in Shanghai Wu. In Proceedings of ICPhS (Vol. 18). Kong, E. J., & Edwards, J. (2016). Individual differences in categorical perception of speech: Cue weighting and executive function. Journal of Phonetics, 59, 40-57.

Results: Individual Variability

Weights are coefficients from simple logistic regression models fitted for each individual; spearman's rho

Experiment 1

r= -0.51, p= 0.002 | *r= -0.57, p< 0.001*

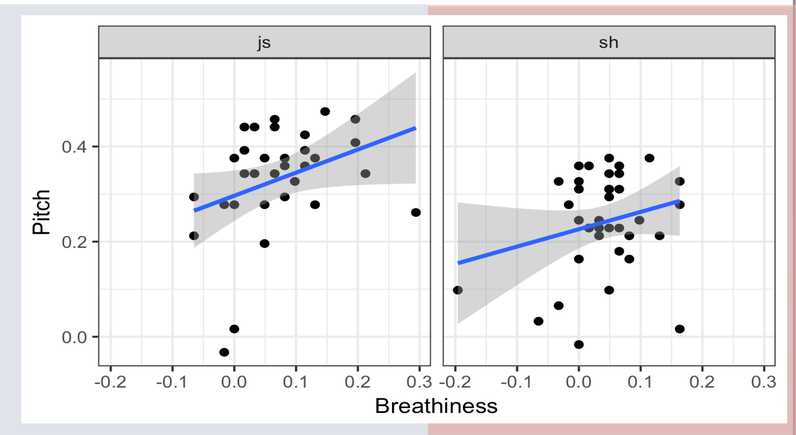


r= 0.83, p< 0.001 | *r= 0.069, p= 0.68*

JS: Positive correlation: pitch ~ breath
Negative correlation: contour ~ pitch + breath

SH: no significant correlation

Experiment 2



r = 0.36, p = 0.04 | *r = 0.11, p = 0.53*

JS: Positive correlation: pitch ~ breath;
No significant correlation with contour

SH: no significant correlation

Discussion: Individuals

Individual differences

JS: positive correlation between physiologically related cues (pitch and breathiness), negative correlation between contour and pitch + breathiness

Conclusion

- **The role of secondary cues**: increase cue weight when other cues are ambiguous; shift cue weight for different tones (Jiashan)
- **Structured individual variability**: the more a Jiashan listener uses pitch, the more they use breathiness (positive correlation), and the less they use contour (negative correlation)
- Indication: listeners first integrate physiologically related cues, and then choose between independent, redundant cues in multidimensional contrasts.
- **Dialectal difference**: Shanghai listeners have smaller weights for breathiness, not sensitive to the degree of breathiness, not much individual variability