

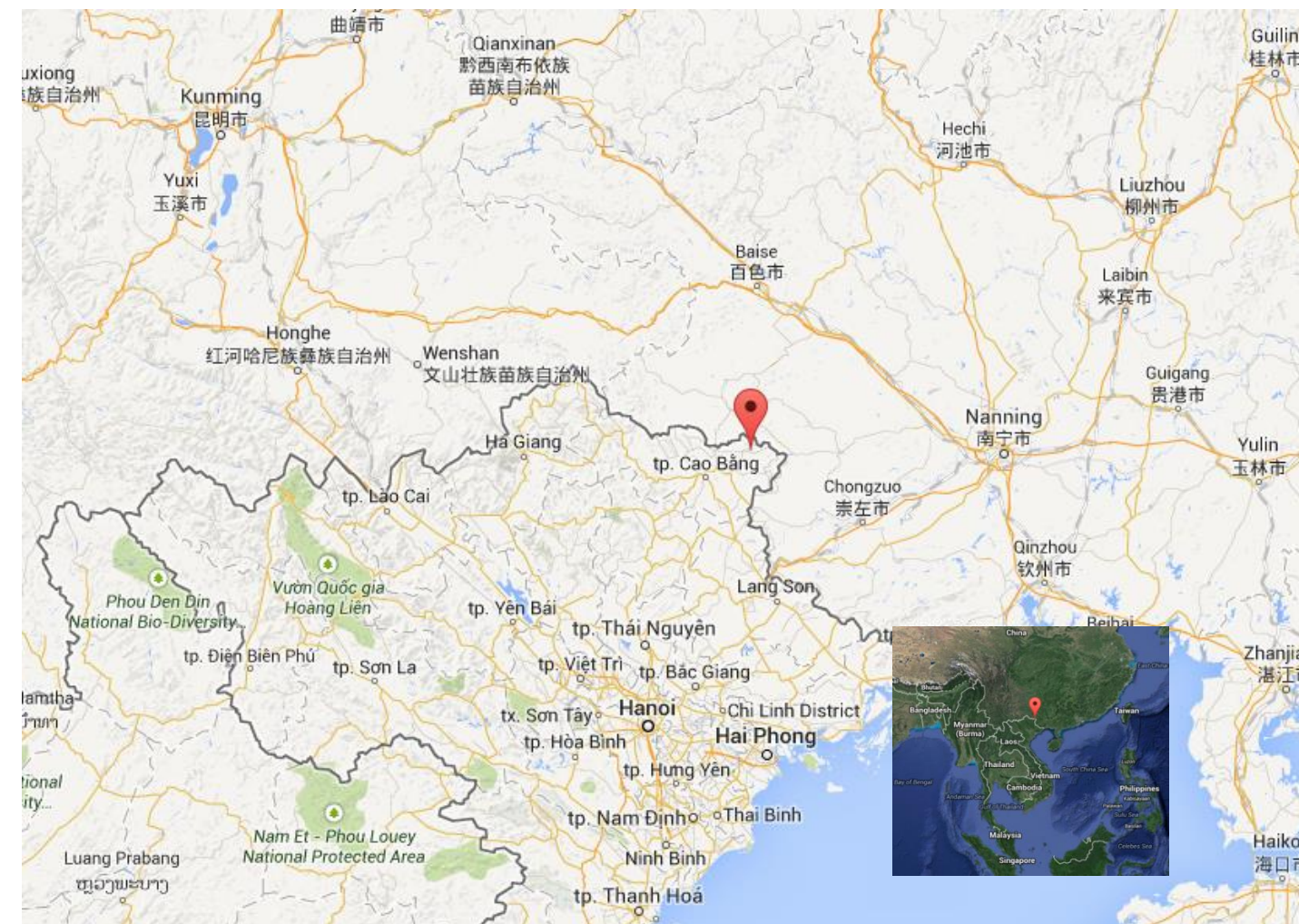
Laryngeal and tonal contrasts in the Tai dialect of Cao Bang

INTRODUCTION

Voice quality and tone

- Voice quality plays an important role in transphonologization of segments into tones
- Breathiness typically arises as a redundant phonetic cue to onset voicing
- Subsequent loss of onset voicing results in new tonal categories

What role does breathiness play at a stage when tonal contrasts are fully established, but the initial laryngeal contrasts have not yet been neutralized?



Cao Bang Tai (CBT)

- Central Tai (Tai; Kra-Dai)
- Spoken in Trung Khanh district, Cao Bang province Vietnam
- Stage III in Pittayaporn's (2009) schema

Stage I	$*n-$, $*t-$	$*A$, $*B$, $*C$, $*D$	phonetic effect of phonation
	$*n-$, $*d-$		type on tonal realization

Stage II	$*n-$, $*t-$	$*A1$, $*B1$, $*C1$, $*D1$	categorical but redundant
	$*n-$, $*d-$	$*A2$, $*B2$, $*C2$, $*D2$	pitch registers

Stage III	$*n-$	$*t-$, $*A1$, $*B1$, $*C1$, $*D1$	phonemic registers in sonorants
		$*A2$, $*B2$, $*C2$, $*D2$	

Stage III	$*n-$	$*t-$	$*A1$, $*B1$, $*C1$, $*D1$	pitch registers not predictable
			$*A2$, $*B2$, $*C2$, $*D2$	from onsets

Further tonal splits and mergers

(from Pittayaporn 2009, p. 248)

- Phonological analysis based on Hoang (1997) and Pittayaporn (2009)
- 4-way laryngeal contrast in the syllable onset
- 6 contrastive tones in sonorant-initial syllables
 - Co-occurrence restriction of tones and laryngeal properties in obstruent-initial syllables

*sonorants	PT *A	PT *B	PT *C	*obstruents
sonorant $*hm-$ > m	T1 /ma:1/ 'dog'	T3 /ma:3/ 'soak'	T5 /ma:5/ 'develop'	Voiceless aspirated (*p- > p-) Voiceless unaspirated (*p ^h - > p ^h -) Plain voiced (*b- > b-)
sonorant $*m-$ > m	T2 /ma:2/ 'come'	T4 /ma:4/ 'foggy'	T6 /ma:6/ 'horse'	Breathy voiced (*b- > b ^h -)

RESEARCH QUESTIONS

How are tonal and laryngeal contrasts signaled phonetically?

What is the status of breathiness within the overall tone system?

METHODS

Speakers

- Three CBT speakers: HVH (male), HVM (male), LTD (female)

Materials

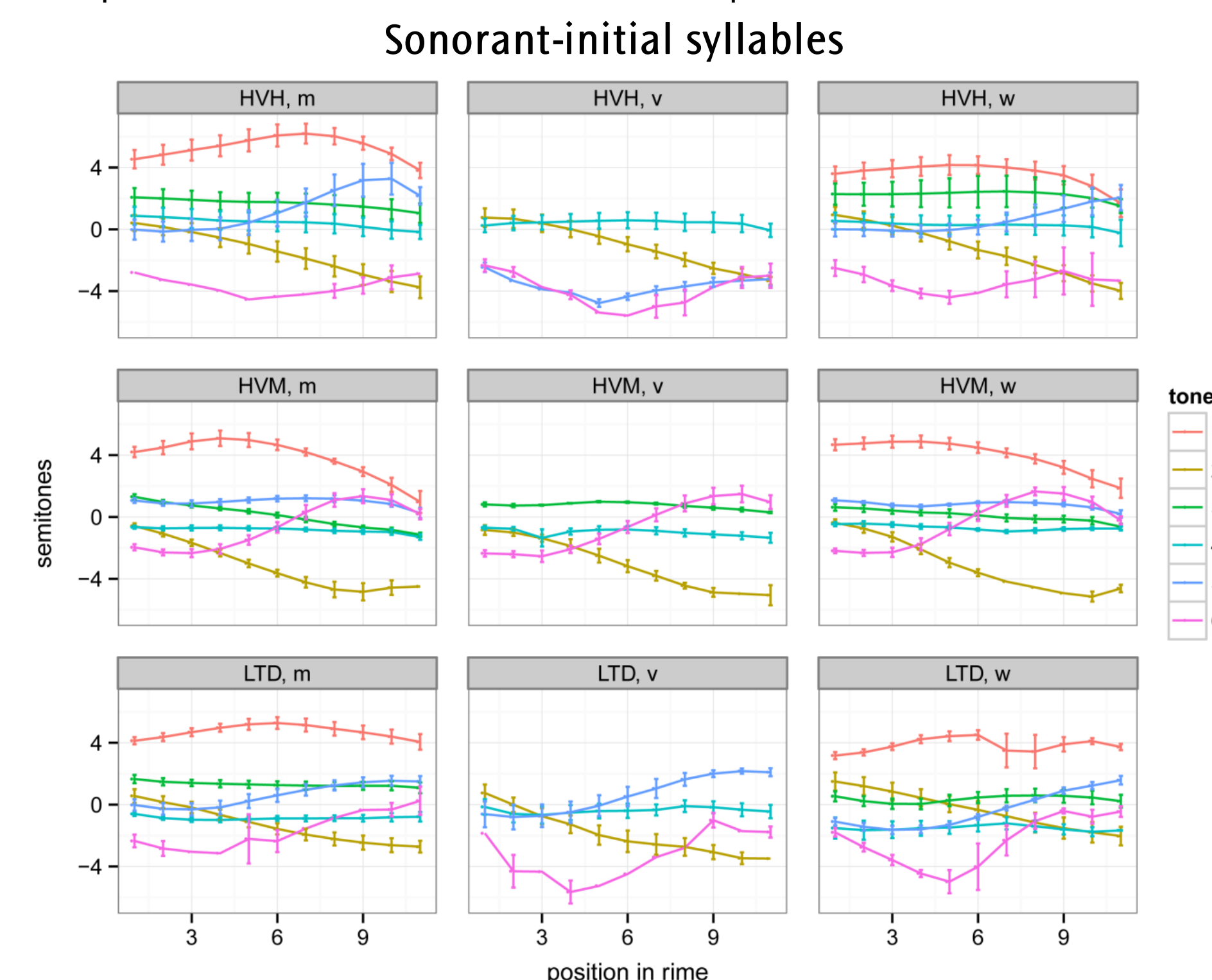
- All attested labial-initial open syllables with /a/ or /a:/ as nucleus
- In frame sentence /k^hɔj⁵ p^huɔj³ ____ la:m¹ pxj³/ 'I say ____ three times'
- Three tokens for each word
- Recorded using Marantz PMD660 digital recorder and Shure SM10A head-mounted microphone

Measurements

- Pitch on vowel: f0 at 11 equidistant points
- Voice quality of vowel: H1*-H2* (Iseli and Alwan 2004) at 11 equidistant points
- H1*-A3* (Iseli and Alwan 2004) at 11 equidistant points
- Phonation type of onset: VOT (Lisker and Abramson 1964)

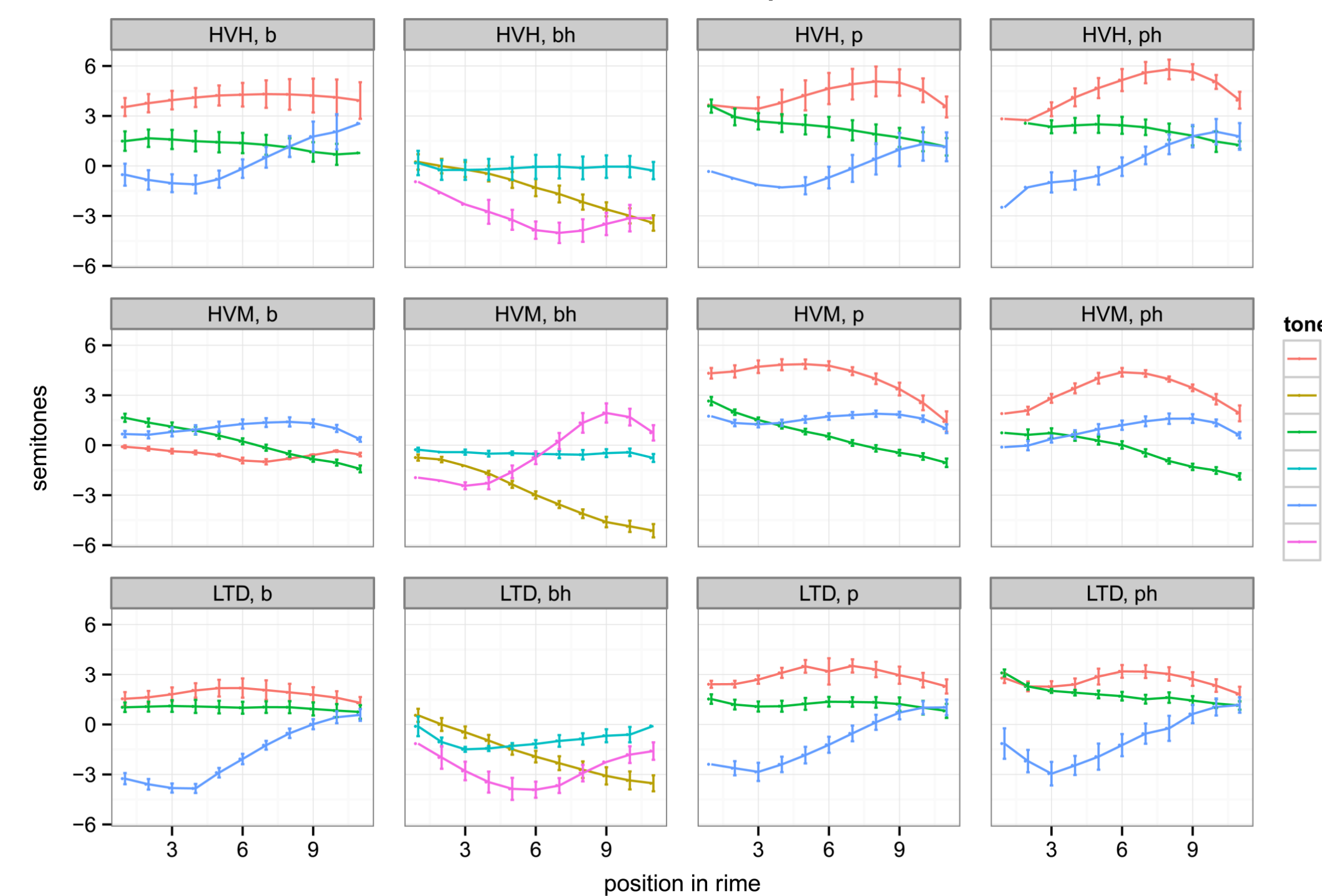
RESULTS: f0

- Interspeaker variation in tonal contour shapes



- Tone 5 is flat in HVM contrasting with the rising contour in HVH and LTD
- Tone 6 does not rise as much in HVH contrasting with HVM and LTD

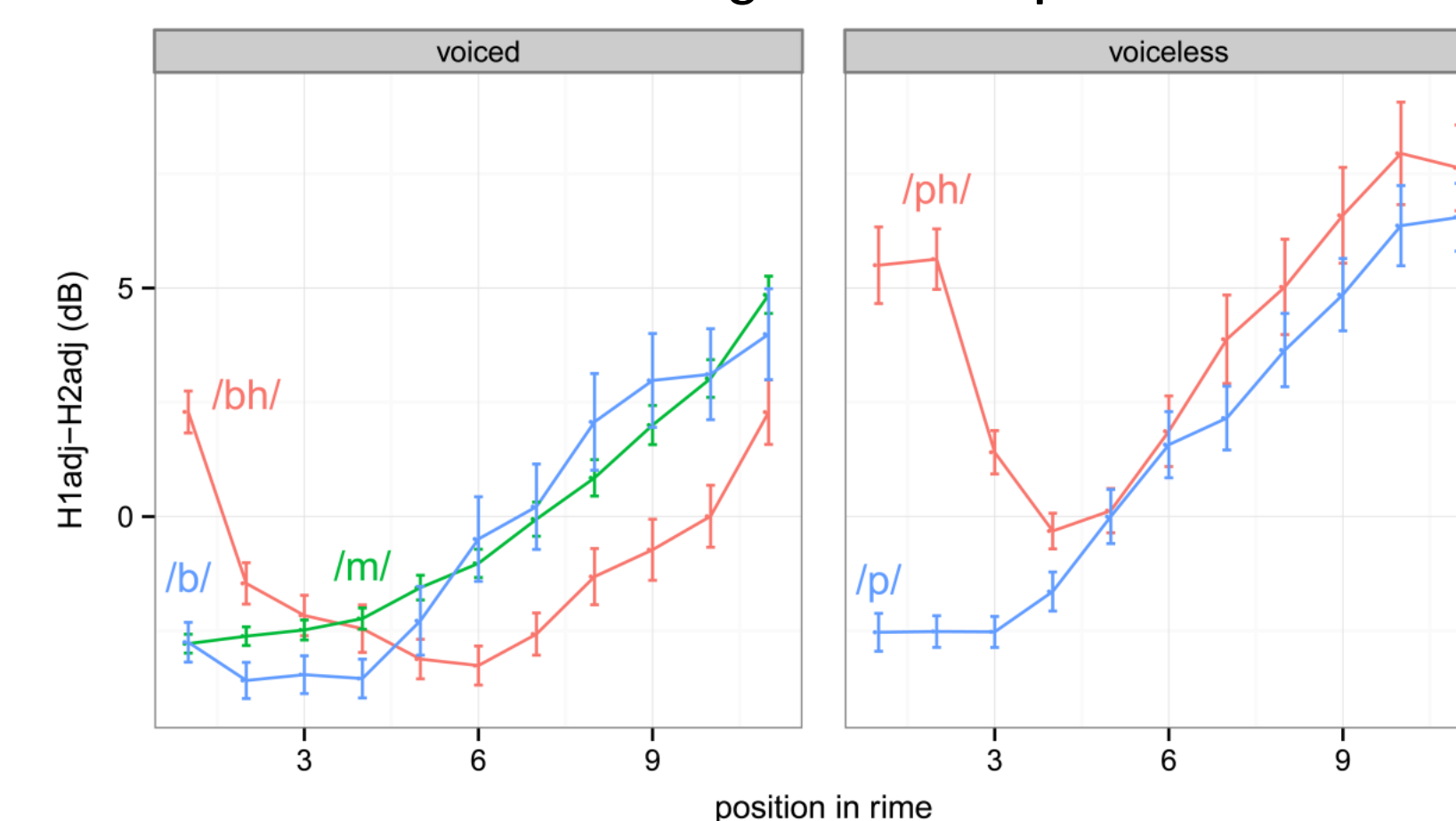
Obstruent-initial syllables



- Tone 1 is markedly different when occurs in syllables with plain voiced stop as onset
 - Intermediate between Tone 1 and Tone 2
 - Ambiguous phonological status

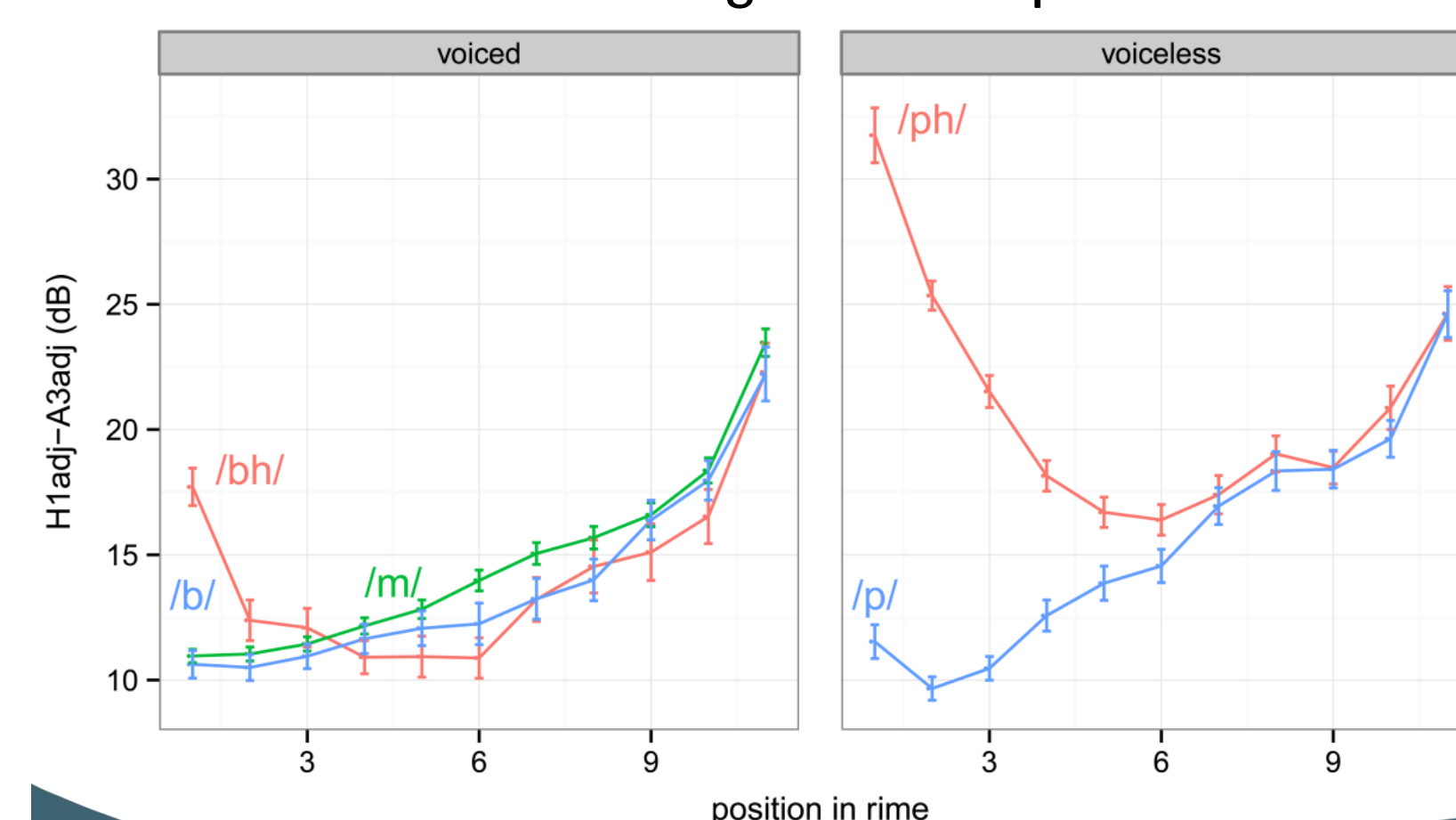
RESULTS: Voice quality

H1*-H2* averaged across speakers



- H1*-H2* higher at the beginning of vowels following aspirated and breathy onsets
- H1*-H2* lower in the latter half of the vowels following breathy onsets

H1*-A3* averaged across speakers

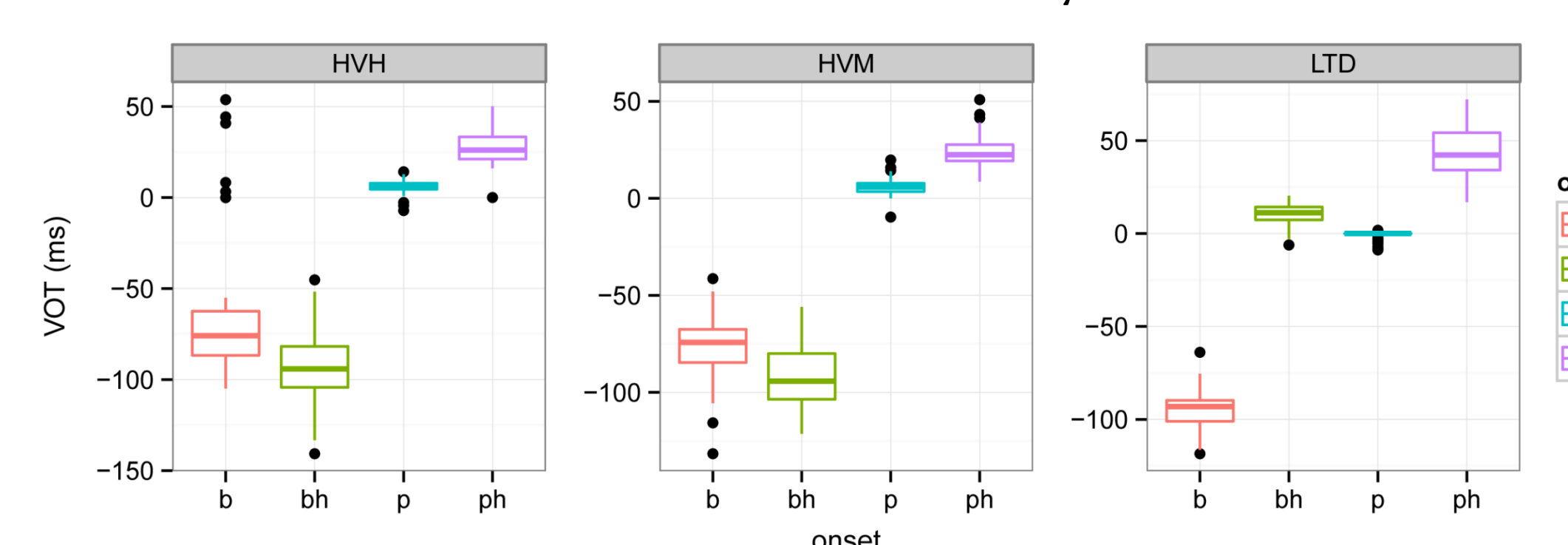


- H1*-A3* higher following aspirated and breathy onsets at the beginning of the vowel

RESULTS: VOT

- Interspeaker variation in VOT

VOT in obstruent-initial syllables



- LTD consistently produces /bh/ without prevoicing and with very little voice lag
- The four categories are kept statistically distinct for all speakers

Pittayawat Pittayaporn¹ & James Kirby²

¹Chulalongkorn University

¹Pittayawat.P@chula.ac.th

²University of Edinburgh

²j.kirby@ed.ac.uk

RESULTS: Linear Discriminant Analysis (LDA)

- By-speaker models containing only onset and offset as predictors have accuracy rates of around 75%
- However, while adding H1*-H2* as a predictor only slightly improves overall accuracy for obstruent-initial syllables, its inclusion dramatically increases accuracy for particular tones

Accuracy in tone identification

Tone	HVH		
	Without VQ	With VQ	Compare
1	63.16%	68.42%	5.26%
2	90.48%	90.48%	0.00%
3	72.22%	83.33%	11.11%
4	100.00%	100.00%	0.00%
5	86.67%	86.67%	0.00%
6	75.00%	75.00%	0.00%

Tone	HVM		
	Without VQ	With VQ	Compare
1	62.50%	80.00%	17.50%
2	88.00%	84.00%	-4.00%
3	86.11%	88.89%	2.78%
4	100.00%	100.00%	0.00%
5	42.86%	54.29%	11.43%
6	91.67%	91.67%	0.00%

Tone	LTD		
	Without VQ	With VQ	Compare
1	67.35%	65.31%	-2.04%
2	88.00%	88.00%	0.00%
3	41.67%	61.11%	19.44%
4	33.33%	83.33%	50.00%
5	71.88%	65.63%	-6.25%
6	52.94%	47.06%	-5.88%

- The improvements are for different tones for different speakers
- For sonorant-initial syllables, including voice quality **decreases** prediction accuracy

DISCUSSION

- Different speakers use different strategies to signal the same contrasts
- Breathiness is absent in syllables with initial sonorants
- LTD seems to represent a “newer” system, which is moving toward neutralization of onset voicing

CONCLUSION

- Breathiness plays a dual role in the sound system of Cao Bang Tai
 - Signaling laryngeal category of the onset
 - Contributing to identification of a subset of tones
- Tone is not only about pitch, but involves a complex of laryngeal features

REFERENCES

- Hoang, V. M. (1997). The sound system of the Tay language of Cao Bang, Province. In J. A. Edmondson and D. B. Solnit. (Eds), *Comparative Kadai: the Tai branch* (pp. 221-231). Dallas, TX : Summer Institute of Linguistics ; [Arlington] : University of Texas at Arlington.
- Iseli, M., & Alwan, A. (2004, May). An improved correction formula for the estimation of harmonic magnitudes and its application to open quotient estimation. In *Proc. ICASSP*. Paper presented at The 2004 IEEE International Conference on Acoustics, Speech, and Signal Processing.
- Lisker, L. and Abramson, A. S. (1964). A cross-language study of voicing in initial stops: acoustic measurements. *Word*, 20, 384-422.
- Pittayaporn, P. (2009). *Phonology of Proto-Tai* (Doctoral dissertation). Cornell University.

ACKNOWLEDGEMENT

This research is supported by the Ratchadaphiseksomphot Endowment Fund of Chulalongkorn University (RES560530179-HS).