Stages of Tonogenesis: Evidence from Modern Burmese

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SOUTHEAST ASIAN LINGUISTICS SOCIETY

Outline

Background
 Production study and results
 Perception study and results
 Discussion, synchronic model
 Summary

Background • Stages of Tonogenesis

Maran (1973: 107) "The manner in which a tonal system takes over is gradual..."

Stage 1 • Atonal

- Stage 2 "Attendant pitch characteristics" without functional load
- Stage 3 "Full redundancy intermediate stage" codas and pitch perturbation side-by-side
- Stage 4 "Advanced depletion of finals" with contrast mainly by prosodic features

Stage 5 • Tonal features = lexical property

Background • Stages of Tonogenesis

Huffman (1976), Registrogenesis
 Stage 1 • onset distinction, same vowel
 Stage 2 • onset distinction, redundant register split
 Stage 3 • optional onset distinction, distinctive registers

Stage 4 • full loss of onset distinction

Background • Mazaudon & Michaud (2008)

Tone in (Risiangku) Tamang



Background • Mazaudon & Michaud (2008)

Tone in (Risiangku) Tamang



Background • Phonetic descriptions

Descriptions in Firth (1936), Okell (1969), Bradley (1982), Wheatley (1987), Watkins (2001, 2005).

Tone	Duration	Intensity	Pitch	Voice Quality	Syll. Type
High	long	moderate	high rise or fall	breathy or plain	CV or CVN
Low	long, moderate	low	low level	plain, modal	CV or CVN
Creaky	short	high	high sharp fall	creaky, weak glottal closure	CV or CVN
Checked	extremely short	highest	initial high fall	abrupt, complete glottal closure	CVO

Background • redundant → singular contrast

Tone development in Pseudo-Burmese



Background

Question: What is the synchronic contrast at this intermediate stage?

- Phonetically?
- Phonologically?

Background • Plan

Demonstrate that...

- Both pitch and voice quality are necessary to identify the four tones of Burmese.
- Pitch contours are independent of phonation features in modern Burmese...
- ...but not previously.

Historical development > modern contrast

Background • Proposal

High tone: CV^[H]
 Low tone: CV^[Ø]
 Creaky tone: CV^{[H][c.g.]}
 Checked tone: CV^[H]

CV^{[H][c.g.]} as a tone-register contour "tone"
 Register contours in Chong (Thongkum 1988, DiCanio 2009)

Data Collection • Overview

Ten Subjects 6 female, 4 male All U.S. residents, relocated from Rangoon Acoustic pressure signal EGG (glottal waveform) Aerodynamic waveform Perception - Identification Task

Data Collection • Subject pool

	Subject	Gender	Age	Years in U.S.	proficiency
L	А	f	61+	30+	Chinese
	В	f	41-50	9	
	С	f	41-50	15	
	D	f	41-50	15	
	E	f	41-50	5	Japanese
	E	f	21-30	<1	French
	G	m	51-60	9	
	н	m	51-60	15	
	- L (m	41-50	10	
	J	m	31-40	2	

Data Collection • Script

Nonsense phras	Nonsense phrases with permutations of /ta/			
	CV	CVN	CVO	
Low	ta	taN	-	
High	tá	táN	-	
Creaky	tà	tàN	-	
Checked	_	-	tà?	

>	Tokens recorded in eight controlled contexts				
	• citation	• low_low	• low_high	• high_low	
	• low#	• high#	• lowminor	• highminor	

Data Collection • Measures

Acoustic waveform measured for...

- Duration
- F0 at ten even intervals
- H1-H2, H1-A3 at ten even intervals

EGG (glottal waveform) measured for... – Open Quotient (OQ), also as deciles

Recordings made with Waveview software, Behringer ECM8000 microphone, and EG2-PCX electroglottograph (Glottal Enterprises, Inc.)

Data Collection • Measures

Airflow measured for...

- mean ml/s airflow over 1st, 2nd half of vowel
- mean ml/s airflow for 75ms after vowel

Recordings made with circumferentially-vented (CV) Rothenberg mask; Aeroview 1.3 software (Glottal Enterprises, Inc.).



Results • F0, OQ (citation, final)



Results • F0, OQ (medial forms)



Results • F0, OQ Summary

- High, Creaky, and Checked tone syllables bear high pitch peak regardless of OQ.
- Pitch on Creaky and Checked tones falls further the "creakier" the vowel is.

	Compa	ared Ranges	Tone	<i>R</i>
Late	<mark>0Q</mark> (70	0-100%) to F0 High	Checked	139
			Creaky	083
			High	084
			all	.0125
(OQ:F0	at 70%, 80%, 90%	Checked	.561, .605, .550
			Creaky	.534, .571, .590
(OQ:F0	at 70%, 80%, 90%	Checked Creaky	.561, .605, .550 .534, .571, .590

Results • Citation Forms, 2 speakers



Results • Low_Low forms, 2 speakers



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Results • Airflow in citation utterances

Rates of oral airflow at timepoints



Results • Rates of oral airflow in 3 phrases



Perception Experiment • Design

- Forced-choice identification
- Single speaker: 40+ year-old female

15+ years of US residency

- ≥240 stimuli tokens: [la] or [lɛ]
 - 24 natural
 - 216 re-synthesized (with Praat 5.1.03)
- Re-synthesized to controlled levels of...
 - F0
 - Duration
 - Voice Quality
 Intensity

Perception Experiment • Stimuli synthesis

Intensity: standardized to 77dB for [la], 75dB [lε]

➢ Voice Quality: Modal | Breathy | Creaky Not synthesized, but produced by speaker. Thus, 6 base syllables → 216 synthesized tokens.

Duration (syllable): 175 ms | 250 ms | 325 ms Levels match speaker's Creaky (175) and High (325) elicited data.

Perception Experiment • Stimuli F0

160Hz | 180Hz | 200Hz | 220Hz | 240Hz > 4 Falling contours Gradual: (1) 240-200-175hz (2) 220-190-175hz (3) 240-240-175hz Late: (4) 220-220-175hz 3 Rising contours Gradual: (5) 160-190-220hz (6) 220-230-240hz (7) 160-160-220hz Late:

5 Even F0 traces



Perception Experiment • Presentation

Forced-choice selections between four Burmese orthographic symbols.



Perception Results • Overview

- Natural stimuli: 89% successful identification.
 No primary cue that functions across all 4 tones.
- Two-way voice quality contrast
 - Modal and Breathy stimuli prompt similar listener responses.
 - Creaky stimuli overwhelmingly identified as Creaky tone.
- F0 height more important than F0 contour

Perception Results • Even Contours



Perception Results • Even Contours

Creaky Stimuli



Summary

Phonation distinction in Burmese is two-way:

More constricted Creaky and Checked tones

VS.

- More open, lax High and Low tones
- Reflected in both production and perception data
- Neutralized phrase-medially

Pitch provides clear 3-way contrast in all contexts:

- Even, moderate pitch (Low)
- Early high pitch with an ensuing fall (Creaky, Checked)
- High pitch with varying location (High)

Summary

Pitch contours are independent of phonation High pitch is independent of phonation Falling pitch is not a consequence of creak \geq [H] is underlying to tone (contra Lee (2007)) \succ [c.g.] is presupposed by [?] High tone: CV^[H] Low tone: CV^[Ø] Creaky tone: CV^{[H][c.g.]} Checked tone: CV?^[H]

Conclusion

- Modern Burmese = Stage 3 of Huffman (1976): "optional distinction paired with distinctive register or tone"
 - ...but more precisely, context dependent distinction (register) paired with distinctive tone.
- Merger of breathy~modal voice qualities
- Diachronically constructed grammar, synchronically interpreted by speakers
- Future work:
 - Perception in context
 - Tone alternations; sandhi

Thank you!

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References

- Boersma, Paul and David Weenink. 2007. Praat: doing phonetics by computer (Version 5.1.03) [Computer program]. Retrieved April 16, 2007, from http://www.praat.org/.
- Bradley, David. 1982. Register in Burmese. In D. Bradley (Ed.) *Tonation* (Pacific Linguistics Series A-62), 117-132. Canberra: Australian National University.
- DiCanio, Christian. 2009. The phonetics of register in Takhian Thong Chong. *Journal of the IPA* 39.2: 162 188. UK: IPA.
- Firth, J.R. 1936. Alphabets and Phonology in India and Burma. *Bulletin of the School of Oriental Studies*, vol. **8.2**, 517-546.
- Huffman, Franklin. 1976. The register problem in fifteen Mon-Khmer languages. *Oceanic Linguistics special publication: Austroasiatic Studies*, part 1(13): 575-589.
- Lee, Seunghun. 2007. The effects of glottal stops on tone in Burmese. In the *Proceedings of the* 43rd Chicago Linguistics Society.
- Maran, Laraw. 1973. On Becoming a Tone Language: A Tibeto-Burman Model of Tonogenesis. In Hyman, Larry (ed.), Consonant Types and Tone, Southern California Occasional Papers in Linguistics, 1: 98 - 114. Los Angeles: USC Linguistics.

References

- Mazaudon, Martine and Alexis Michaud. 2008. Tonal Contrasts and Initial Consonants: A Case Study of Tamang, a 'Missing Link' in Tonogenesis. *Phonetica* 65: 231-256. Basel: Karger.
- Okell, John. 1969. A Reference Grammar of Colloquial Burmese. 2 volumes. London: Oxford Univ Press
- Thongkum, Theraphan. 1988. Phonation types in Mon-Khmer languages. In Osamu Fujimura (ed.), *Vocal Physiology: Voice production, mechanisms, and functions*, 319-333. New York: Raven Press.
- Watkins, Justin. 2001. Illustrations of the IPA: Burmese. *Journal of the International Phonetic Association* 31/2: 291-295.
- Watkins, Justin. 2005. Notes on *creaky* and *killed* tone in Burmese. *SOAS Working Papers in Linguistics 10*: 139-149. London: Department of Linguistics, SOAS.
- Wheatley, Julian. 1987. 'Burmese', in B. Comrie (ed.) *The Major Languages of East and South-East Asia*. London: Routledge, pp. 106-126.