

# Tonal developments in Baima

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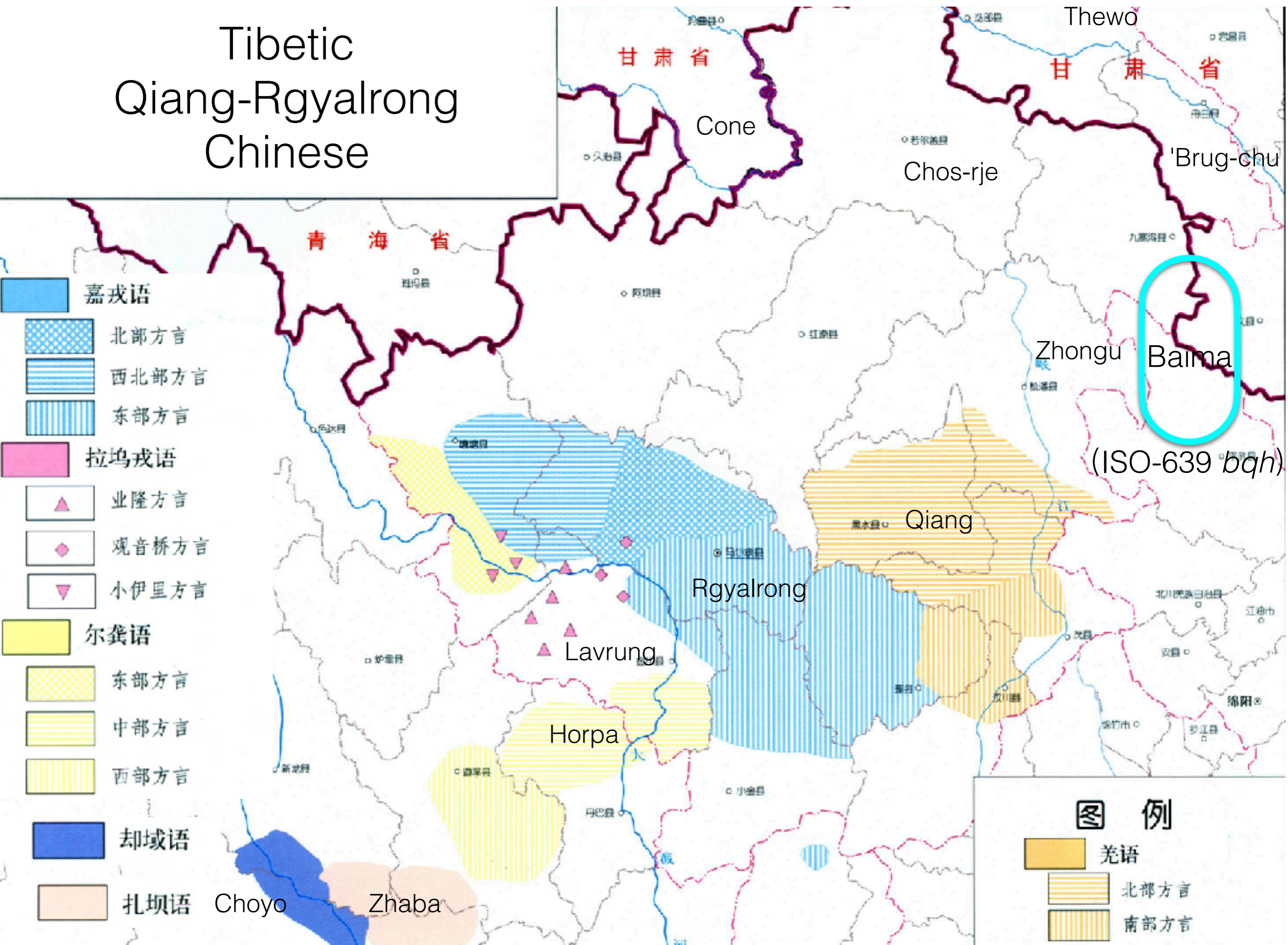
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# Tibetic Qiang-Rgyalrong Chinese



## 图例

- 羌语
- 北部方言
- 南部方言

# Basic facts

- Previous work
  - Sun Hongkai in Nishida & Sun (1990), Sun et al. (2007)
  - Huang Bufan & Zhang Minghui (1995)
  - Phonological history: Zhang Jichuan (1994a,b)
- Syllable structure: (N)(C)V
- NC < (1) OT voiced + *m-*, ‘-’ (e.g. WT ‘*bu* > m**bu**<sup>53</sup> / m**bu**<sup>53</sup> ‘insect’);  
(2) OT voiceless aspirated + *m-*, ‘-’ (e.g. WT ‘*phur* > m**bu**<sup>341</sup> / m**bu**<sup>42</sup> ‘to fly’)
- no nasal vowels (< OT *-m*, *-n*, *-ng*), e.g. ‘tree’, WT *shing* >  $\int^h e^{13}$   
(Sun et al. 2007) /  $\int^h e^{35}$  (Huang & Zhang 1995)

# Previous analysis

- a tone language typified by contrastive pitch
- basic contrast between (high) falling and (mid/low) rising tones
- 4 tones
- different tonal categories, complex correspondences between tone in different analyses

Tone	Sun et al. (2007)	Huang & Zhang (1995)
Falling	<p style="text-align: center;"><b>53</b></p> <p style="text-align: center;"><b>(voiceless obstruent, prenasalized, sonorant)</b></p> <p>‘insect’ WT <i>'bu</i>                      nbo<sup>53</sup></p> <p>‘swallow’ WT <i>mid</i>                      ji<sup>53</sup></p>	<p style="text-align: center;"><b>53</b></p> <p style="text-align: center;"><b>(voiceless obstruent, prenasalized, non-breathy sonorant)</b></p> <p style="text-align: center;">mbu<sup>53</sup></p> <p style="text-align: center;">ji<sup>53</sup></p>
	<p style="text-align: center;"><b>341</b></p> <p style="text-align: center;"><b>(voiced obstruent, prenasalized, sonorant)</b></p> <p>‘to fly’ WT <i>'phur</i>                      nbo<sup>341</sup></p>	<p style="text-align: center;"><b>42</b></p> <p style="text-align: center;"><b>(voiced obstruent, prenasalized)</b></p> <p style="text-align: center;">mbu<sup>42</sup></p>
	<p>‘two’ WT <i>gnyis</i>                      ji<sup>341</sup></p>	<p style="text-align: center;"><b>341 (35~354~55)</b></p> <p style="text-align: center;"><b>(breathy sonorant, voiced, voiceless obstruent)</b></p> <p style="text-align: center;">jfi<sup>341</sup></p>

<b>Tone</b>	<b>Sun et al. (2007)</b>	<b>Huang &amp; Zhang (1995)</b>
Falling		341 (35~354~55)
Rising	13 (different types of initials)	(breathy sonorant, voiced, voiceless obstruent)
	35 (different types of initials; vowel quality differences)	35 (different types of initials; vowel quality differences)

<b>Gloss</b>	<b>WT</b>	<b>SHK et al. (2007)</b>	<b>H&amp;Z (1995)</b>
‘foot’	<i>rkang</i>	ko <sup>35</sup>	ko <sup>35</sup>
‘nest’	<i>tshang</i>	ts <sup>h</sup> ɔ <sup>35</sup>	ts <sup>h</sup> ɔ <sup>35</sup>
‘to pile up’	<i>spung</i>	po <sup>35</sup>	pu <sup>35</sup>
‘to pound’	<i>rdung</i>	du <sup>35</sup>	du <sup>35</sup>

# Tonal history

- Huang & Zhang (1995: 99-102), 399 monosyllabic words

OT rhyme type (韵母的促舒)	Baima tone	Example		
		Gloss	WT	Baima
short < OT $-\emptyset$ ( $\sim -r$ ), $-b$ , $-d$ , $-g$	high falling 高降	illness	<i>nad</i>	ne <sup>53</sup>
		live; sit	<i>bsdad</i>	ne <sup>53</sup>
long < OT $-m$ , $-n$ , $-ng$ , $-s$ , $-l$ ; coalesced syllables	low rising 低升	barley	<i>nas</i>	ne <sup>35</sup>
		seven	<i>bdun</i>	de <sup>35</sup>

<b>Baima initial / Non-nasalized</b>	<b>High falling 高降</b>	<b>Example</b>		
<b>Voiceless obstruent</b>	53			
OT simplex voiced		to itch	<i>za</i>	sa <sup>53</sup>
OT simplex voiceless aspirated		yeast	<i>phab</i>	p <sup>h</sup> u <sup>53</sup>
<b>Voiced obstruent</b>	42			
OT voiced with preradicals		leopard	<i>gzig</i>	zə <sup>42</sup>

<b>Nasalized</b>				
OT voiced + <i>m-</i> , <i>'-</i>	53	insect	<i>'bu</i>	mbu <sup>53</sup>
OT voiceless aspirated + <i>m-</i> , <i>'-</i>	42	to fly	<i>'phur</i>	mbu <sup>42</sup>

<b>Sonorant</b>				
OT simplex sonorant	53	to swallow	<i>mid</i>	ji <sup>53</sup>
		two	<i>gnyis</i>	ɲfi <sup>341</sup>
OT sonorant with preradicals	341 (35~354~55)	to exist	<i>snang</i>	nho <sup>341</sup>
		to weave	<i>slas</i>	zæ <sup>341</sup>

rising tone (35)?

vowel quality differences?



# New analysis

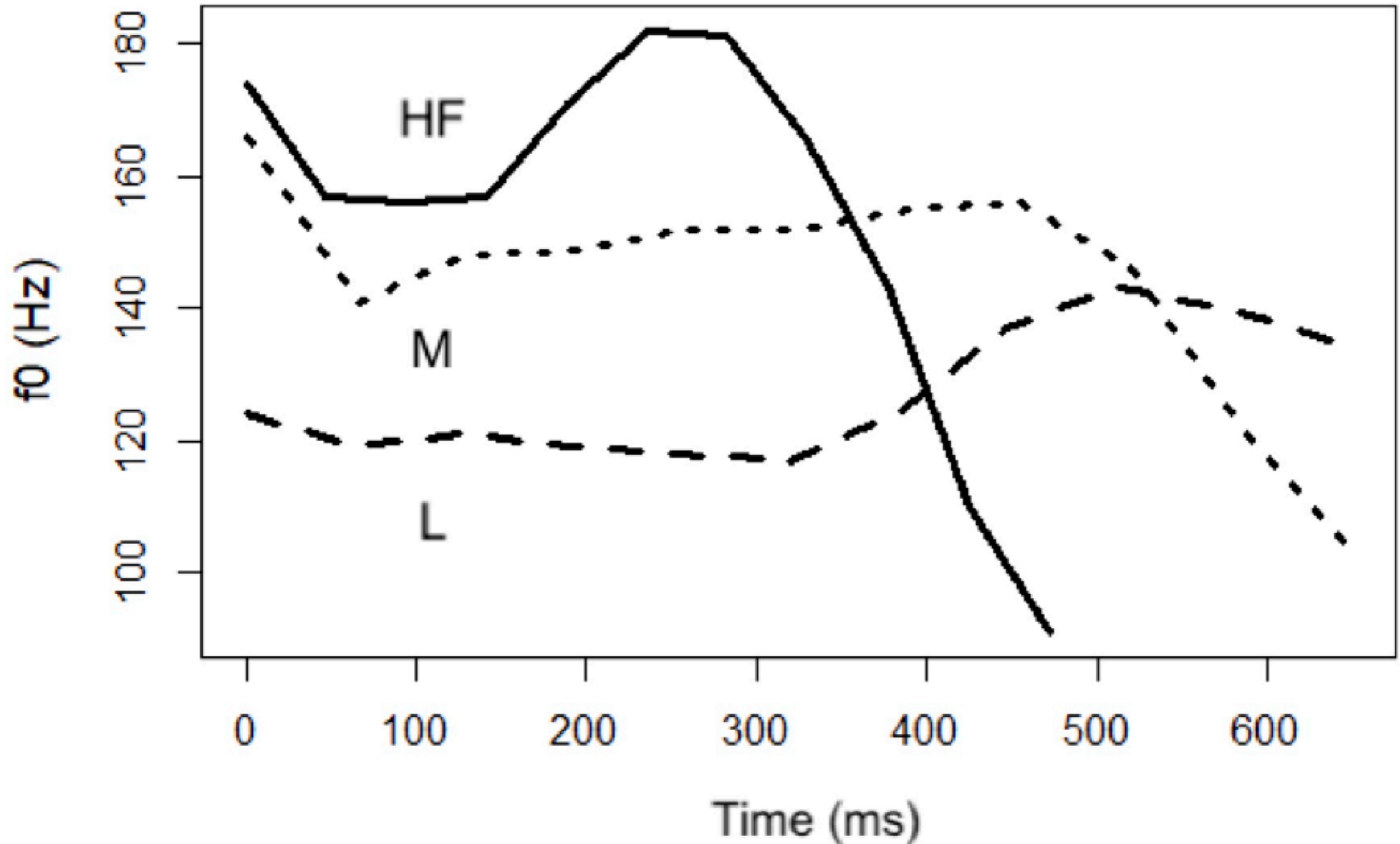
- Chirkova, Katia, Tanja Kocjančič Antolík, & Angélique Amelot. 2021. Baima: Illustration of the IPA. *Journal of the International Phonetic Association*.
- Non-modal phonation type contrasts in consonants and vowels
- A register language typified by contrastive phonation
  - a collection of syllable-level contrasts, involving the redundant use of pitch, voice quality, vowel length, and initial type co-occurrence patterns

# Phonetic correlates of tone

Tone	Phonation	Length	Initial type	Example		Gloss
				Baima	WT	
high falling	tense	short	T, T <sup>h</sup> , D, <b>ND</b> , ND <sup>ʕ</sup> , <b>S</b> , S <sup>ʕ</sup>	ɲê	* <i>mye</i>	fire
mid	modal	long	T, <b>ND</b> , <b>S</b>	ɲē	<i>nyal</i>	sleep
low	lax		T <sup>h</sup> , D, <b>ND</b> , <b>S</b>	ɲè	<i>gnyan</i>	mountain god

T = voiceless unaspirated obstruent, T<sup>h</sup> = voiceless aspirated obstruent, D = voiced obstruent, <sup>N</sup>D = prenasalized stop or affricate, S = sonorant, ʕ = epiglottalization

# Pitch and vowel length



# Voice quality

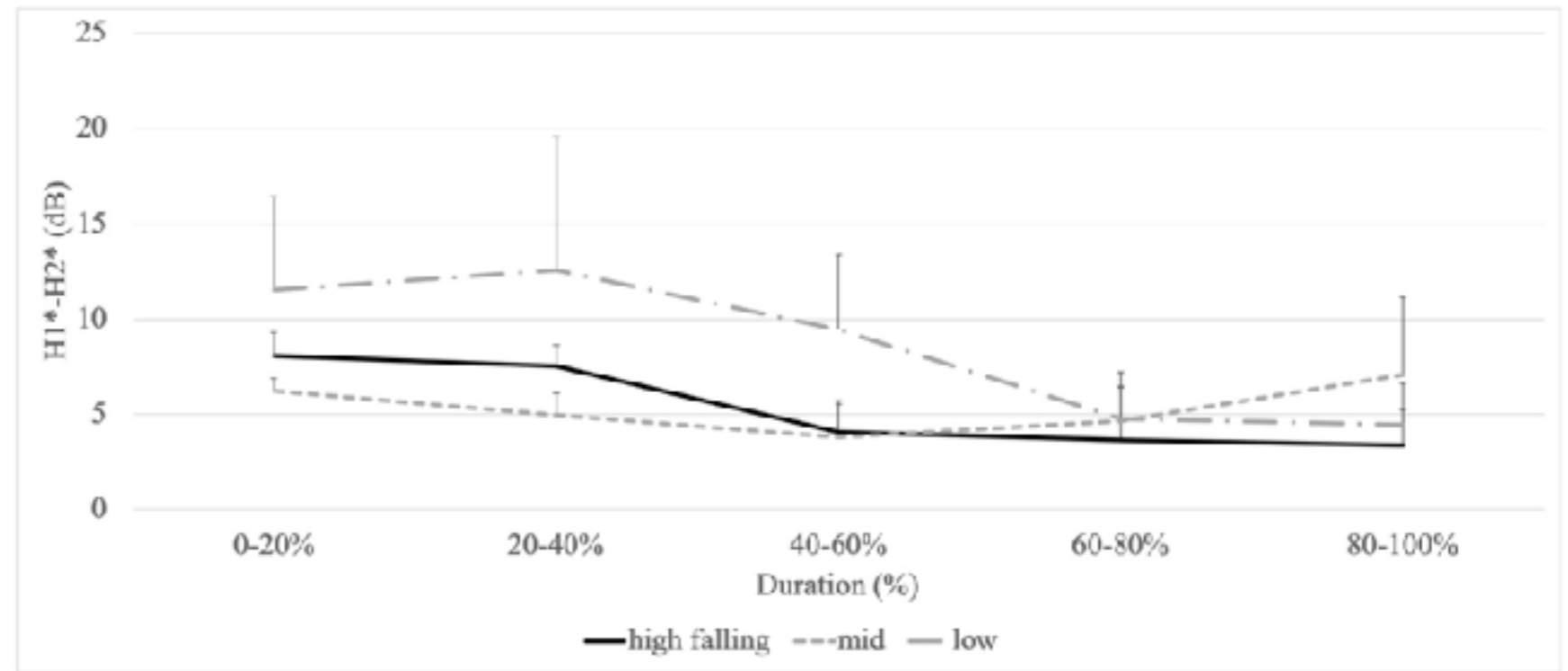
- differences between breathy, modal, and creaky voice qualities can be minimally described in terms of their degree of constriction (or spreading) and noise (e.g. Ladefoged 1971; Gordon & Ladefoged 2001; Garellek & Keating 2011; Keating et al. 2011; Garellek & White 2015; Garellek 2019)
  - Harmonic ratio: difference between the amplitude of the first and second harmonics, corrected for the effects of formants and bandwidths ( $H1^*-H2^*$ )
  - Harmonics-to-noise ratio (HNR): the difference in amplitude between the harmonic and inharmonic components of the source spectrum, as measured in the cepstral domain; measured using harmonics-to-noise ratio below 500 Hz (HNR05)
- these parameters have been estimated from the audio signal with the program VoiceSauce (Shue et al. 2011)

# Phonation types

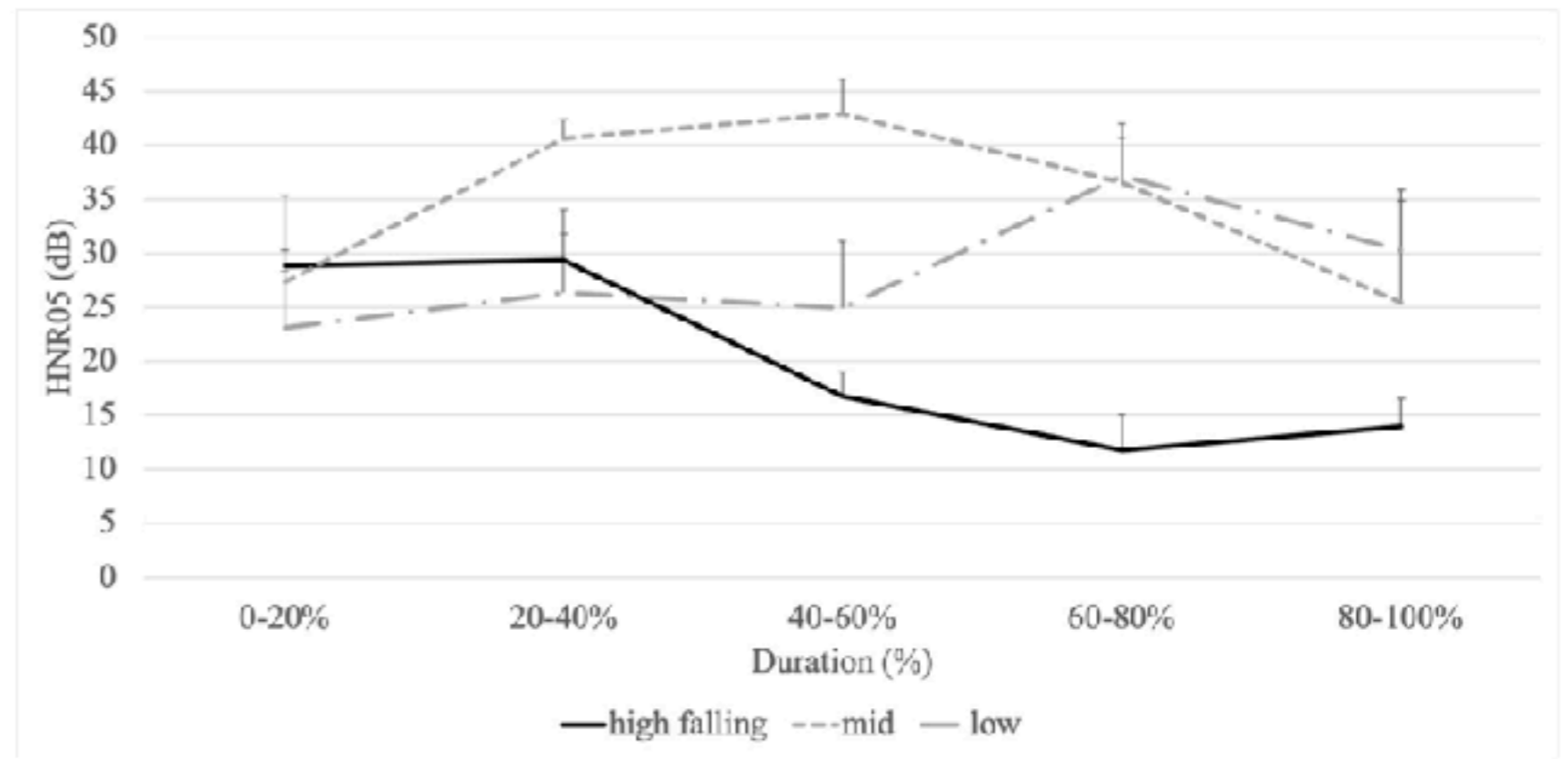
<b>Phonation type</b>	<b>Acoustic correlates</b>	<b>Articulatory correlates</b>	
Modal	High HNR	Negligible noise, periodic voicing	
Breathy	Low HNR	Aspiration noise	noisier
	High H1*-H2*	Open glottis	more spread
Creaky	Low HNR < 500 Hz	Irregular voicing	noisier
	Low H1*-H2*	Glottal constriction	more constricted

Acoustic measures that are important for distinguishing different phonation types (Garellek 2019: 154)

H1\*-H2\* (dB)



HNR05 (dB)



# Phonation contrast in consonants

Consonants	Epiglottalized	Non-epiglottalized
non-nasalized obstruents (stops, affricates, fricatives)	voiced b d g $\widehat{d}z$ $\widehat{d}z$ $\widehat{d}z$ $\widehat{d}r$ z ʒ ʒ ɣ	voiceless p p <sup>h</sup> t t <sup>h</sup> k k <sup>h</sup> $\widehat{t}s$ $\widehat{t}s^h$ $\widehat{t}ʃ$ $\widehat{t}ʃ^h$ $\widehat{t}\zeta$ $\widehat{t}\zeta^h$ $\widehat{t}r$ $\widehat{t}r^h$ s s <sup>h</sup> ʃ ʃ <sup>h</sup> $\zeta$ $\zeta^h$ x
prenasalized obstruents	$^m b^f$ $^n g^f$ $^n \widehat{d}z^f$ $^n \widehat{d}z^f$ $^n \widehat{d}z^f$	$^m b$ $^n d$ $^n g$ $^n \widehat{d}z$ $^n \widehat{d}z$ $^n \widehat{d}r$
sonorants (nasals, liquids)	$^m^f$ $^n^f$ $^j^f$ $^r^f$ $^l^f$	m n ɲ r j l w

epiglottalized consonants have a harsh voice quality

# Phonation types

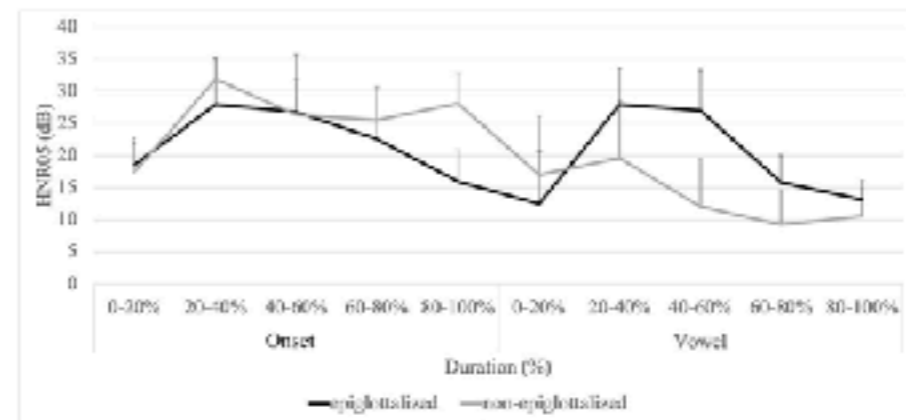
<b>Phonation type</b>	<b>Acoustic correlates</b>	<b>Articulatory correlates</b>
Modal	High HNR	Negligible noise, periodic voicing
Harsh	Low HNR < 500 Hz	Irregular voicing
	Low SoE	Weak voicing
	High-to-low H1*-H2*, drop in F0	Open glottis to glottis constriction
	High F1	Laryngeal raising

Acoustic measures that are important for distinguishing different phonation types (Garellek 2019: 154)

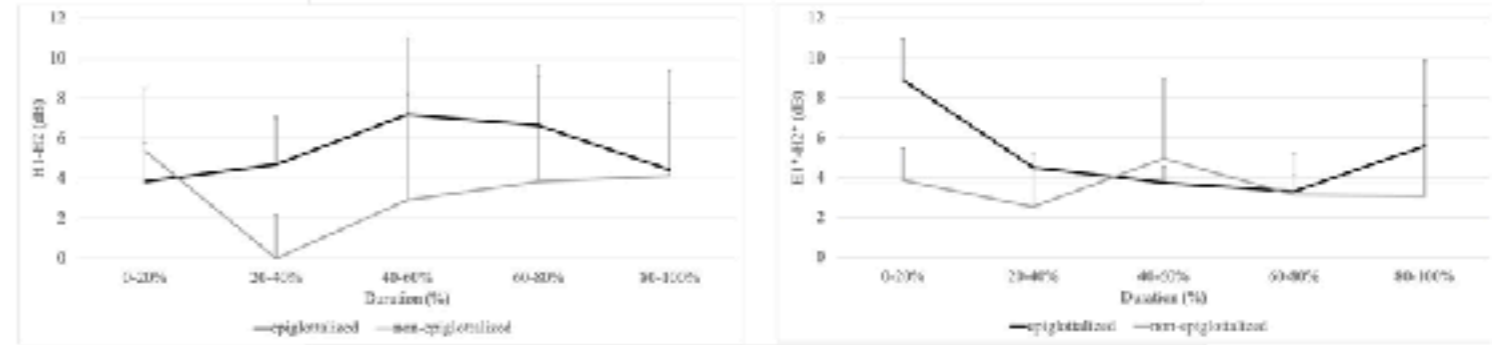
SoE = strength of excitation; lower values index a greater constriction in the larynx or vocal tract and weaker voicing



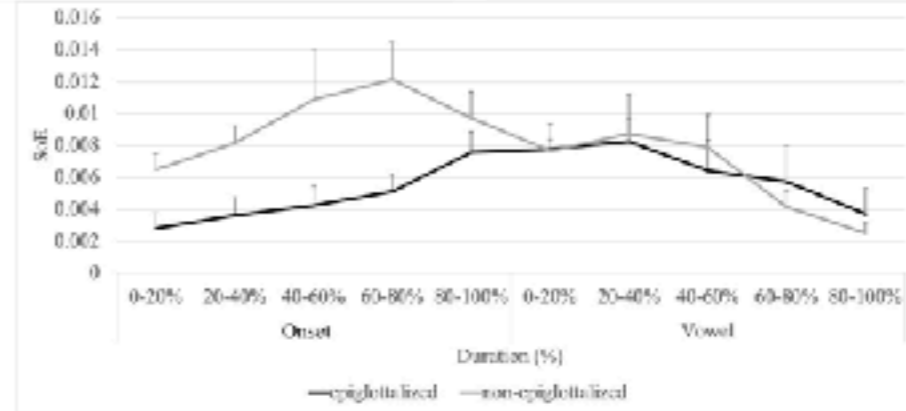
HNR05 (dB)



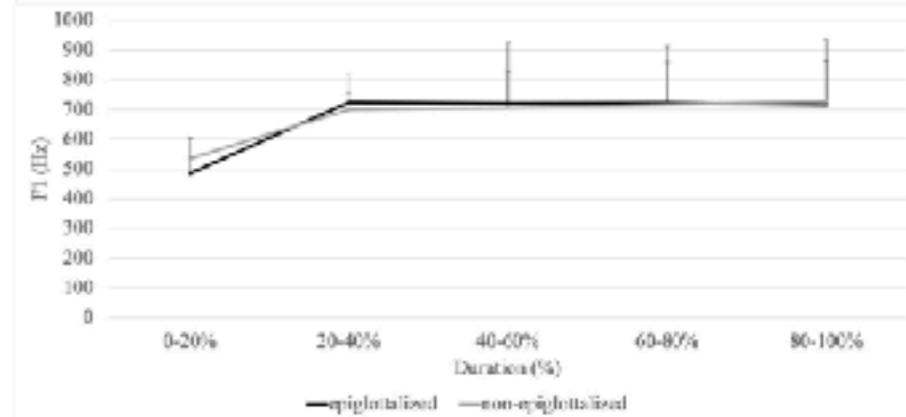
H1-H2, H1\*-H2\* (dB)



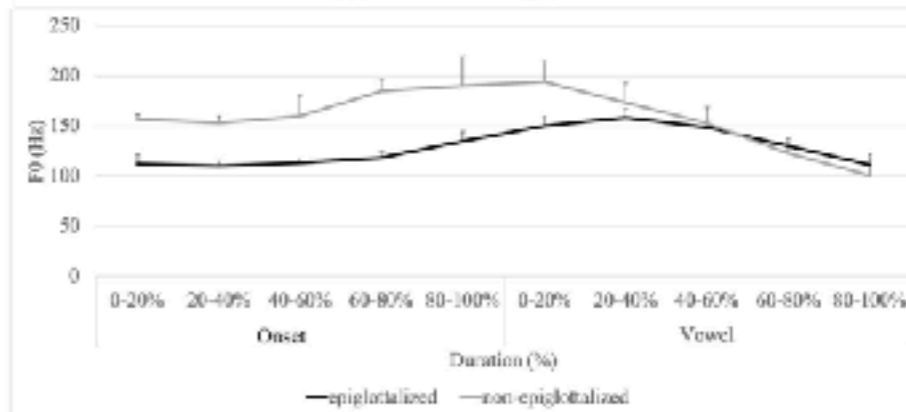
Strength of excitation (SoE)



F1 (Hz) (vowel)



F0 (Hz)



# Pitch contrasts

- our observations are consistent with the data published previously

Initial type

Vowel quality

Tone Initial	High falling		Mid	Low
	non-epiglottalized	epiglottalized		
ɲ	ɲê * <i>mye</i> 'fire'	ɲ <sup>s</sup> ê <i>rnyed</i> 'to find'	ɲē <i>nyal</i> 'to sleep'	ɲè <i>gnyan</i> 'mountain god'
<sup>m</sup> b	<sup>m</sup> bû ' <i>bu</i> 'insect'	<sup>m</sup> b <sup>s</sup> û ' <i>phur</i> 'to fly'	<sup>m</sup> bū 'barn, granary'	<sup>m</sup> bù ? ' <i>phral ba</i> 'partition'
<sup>ŋ</sup> g	<sup>ŋ</sup> guê 'to bark'		<sup>ŋ</sup> guē 'pan'	<sup>ŋ</sup> guè <i>khang 'og</i> 'downstairs'
<sup>n</sup> d͡ʒ		<sup>n</sup> d͡ʒ <sup>s</sup> û <i>mchu</i> 'snout'	<sup>n</sup> d͡ʒū 'thrush'	<sup>n</sup> d͡ʒù <i>mchong</i> 'to jump'

Examples of tone contrasts on words with sonorant and prenasalized stop and affricate onsets

# Adjacent Tibetic varieties

- Chos-rje (Huang 1995; J. Sun 2003): \**r-*, \**l-*, \**s-*, \**g-*, \**d-* before OT voiced obstruents and sonorants > breathy, e.g. *ko<sup>h</sup> sgo* ‘door’ (Baima /g<sup>h</sup>/), *ŋe<sup>h</sup> Inga* ‘five’ (Baima /ŋ<sup>h</sup>/)
- Shibazi / Kun sngon (Songpan County) (Hua Kan & Gazangta 1997): \**r-*, \**l-*, \**s-*, \**g-*, \**d-* before OT voiced obstruents and sonorants > h, e.g. *hdi<sup>31</sup> bdun* ‘seven’ (Baima /d<sup>h</sup>/), *hdo<sup>55</sup> rdo* ‘stone’ (Baima /d<sup>h</sup>/)
- ‘Brug-chu (Suzuki 2015): \**r-*, \**l-*, \**s-*, \**g-*, \**d-* before OT voiced obstruents and sonorants > breathy, e.g. *<sup>h</sup>du rdo* ‘stone’ (Baima /d<sup>h</sup>/), *<sup>h</sup>lo glang* ‘bull’ (Baima /j<sup>h</sup>/)
- bLabrang (Renzeng Wangmu 1987): \**r-*, \**l-*, \**s-*, \**g-*, \**d-* before OT sonorants (\**ŋ*, \**ɲ*, \**n*, \**m*, \**l*, \**r*, \**j*) > *h*, e.g. *hmak dmag* ‘army’ (Baima /m<sup>h</sup>/), *hman sman* ‘medicine’ (Baima /m<sup>h</sup>/)

# Lax / Low / Long

OT	<i>nasal</i> OT <i>-m, -n, -ng, -s, -l;</i> coalesced syllables	<i>long</i>
voiced obstruent + <i>r-, l-, s-, b-, d-, g-</i>	D	Lax
sonorant + <i>r-, l-, s-, b-, d-, g-, m-, '-</i>	S	
aspirated obstruent + <i>m-, '-</i> <i>breathy</i>	$N_D$	
simplex voiceless aspirated obstruent, unprefixd voiceless sonorant	$T^h$ <i>aspirated</i>	

<b>Initial</b>	<b>Gloss</b>	<b>OT</b>	<b>Baima</b>	<b>SHK</b>	<b>H&amp;Z</b>
T <sup>h</sup>	nest	<i>tshang</i>	ts <sup>h</sup> ò	ts <sup>h</sup> ɔ <sup>35</sup>	ts <sup>h</sup> ɔ <sup>35</sup>
	go (PFV)	<i>chas</i>	tɕ <sup>h</sup> è	tɕ <sup>h</sup> ɛ <sup>35</sup>	tɕ <sup>h</sup> æ <sup>35</sup>
	tree	<i>shing</i>	ʃ <sup>h</sup> è	ʃ <sup>h</sup> e <sup>13</sup>	ʃ <sup>h</sup> ɛ <sup>35</sup>
	ashes	<i>thal ba</i>	t <sup>h</sup> iè	t <sup>h</sup> iɛ <sup>35</sup>	t <sup>h</sup> æ <sup>341</sup>
	charcoal	<i>sol ba</i>	s <sup>h</sup> è	s <sup>h</sup> ɛ <sup>35</sup>	s <sup>h</sup> æ <sup>341</sup>
D	seven	<i>bdun</i>	dè	de <sup>13</sup>	de <sup>35</sup>
	bottom part	<i>gdan</i>	dè	de <sup>35</sup>	
	pound	<i>rdung</i>	dù	du <sup>35</sup>	du <sup>35</sup>
	exchange	<i>brjes</i>	ʒè	ʒe <sup>35</sup>	ʒɛ <sup>341</sup>
	roll	<i>sgril</i>	dʒi	dʒɿ <sup>341</sup>	dʒə <sup>35</sup>
	steelyard	<i>rgya ma</i>	dzò	dʒɔ <sup>35</sup>	dʒɔ <sup>35</sup>
<sup>N</sup> D	jump	<i>mchong</i>	<sup>n</sup> dʒù	ndʒɔ <sup>35</sup>	ndʒɔ <sup>42</sup>
	sell	<i>'tshong</i>	<sup>n</sup> dʒù		ndʒu <sup>35</sup>
	drink	<i>'thung</i>	<sup>n</sup> dù	ndu <sup>35</sup>	ndu <sup>35</sup>
S	exist	<i>snang</i>	nò	nɔ <sup>13</sup>	nɦɔ <sup>341</sup>
	mountain god	<i>gnyan</i>	ɲè		
	bull	<i>glang</i>	jò	iɔ <sup>35</sup>	ʒɔ <sup>35</sup>

# Phonetic mechanisms

- breathiness and aspiration
  - on common acoustic measures of phonation, vowels tend to be breathier after aspirated consonants (e.g. Löggqvist & McGowan 1992; Ní Chasaide & Gobl 1993; Gobl & Ní Chasaide 1999; Blankenship 2002; Esposito & Khan 2012; Garellek 2010, 2012; Garrelek & Keating 2011)
- breathiness and nasality
  - nasality and breathiness are acoustically similar: nasalized vowels (caused by velum lowering) and breathy vowels (caused by vocal fold spreading during voicing) both have higher spectral tilt (Klatt and Klatt 1990; Simpson 2012; Garellek, Ritchart & Kuang 2016)
  - the listener can misperceive syllables that are both nasal and breathy as only breathy, and then the listener-turned-speaker produces those syllables with only breathy voice

OT	OT <i>-m, -n, -ng, -s, -l</i> ; coalesced syllables	OT $-\emptyset$ ( $\sim$ -r)	<i>-b, -d, -g</i>
voiced obstruent + <i>r-, l-, s-, b-, d-, g-</i>	D	Lax	$D^f$
sonorant + <i>r-, l-, s-, b-, d-, g-, m-, '-</i>	S		$S^f$
aspirated obstruent + <i>m-, '-</i> <i>breathy</i>	$N_D$		$N_D^f$
simplex voiceless aspirated obstruent, unprefixed voiceless sonorant <i>aspirated</i>	$T^h$		Tense  (High) Falling

- rhymes: phonation type > creaky-like (tense)
  - syllable-final obstruent (*-b, -d, -g*) > syllable-final glottal stop
- initials: cross-linguistically, breathy-creaky and harsh vowels are characterized by high to low  $H1^*$ -  $H2^*$ ; in breathy-creaky vowels, this is due to a transition from an open-glottis configuration to one with a more closed glottis; in harsh vowels, it is a by-product of greater laryngeal constriction (Traill 1985, 1986; Garellek 2020)

OT	OT <i>-m, -n, -ng, -s, -l</i> ; coalesced syllables	OT $-\emptyset$ ( $\sim r$ ), <i>-b, -d, -g</i>		
voiced obstruent + <i>r-, l-, s-, b-, d-, g-</i>	D	Lax Low	D <sup>s</sup>	Tense High falling
sonorant + <i>r-, l-, s-, b-, d-, g-, m-, '-</i>	S		S <sup>s</sup>	
aspirated obstruent + <i>m-, '-</i> <b>breathy</b>	<sup>N</sup> D		<sup>N</sup> D <sup>s</sup>	
simplex voiceless aspirated obstruent, unprefixed voiceless fricative <b>aspirated</b>	T <sup>h</sup>		T <sup>h</sup>	
simplex voiced stop, affricate, voiced fricative	T	Tense Modal High Falling Level	Tense High falling	
voiceless unaspirated stop, affricate + <i>r-, l-, s-, b-, d-, g-</i>				
fricative + <i>b-, d-, g-</i>				
simplex sonorant	S			
voiced obstruent + <i>m-, '-</i>	<sup>N</sup> D			

non-breathy, non-aspirated

Gloss	WT	Baima	Gloss	WT	Baima
year	<i>lo</i>	jê	road	<i>lam</i>	jô
dog	<i>rko</i>	kê	be full	<i>gang</i>	kô

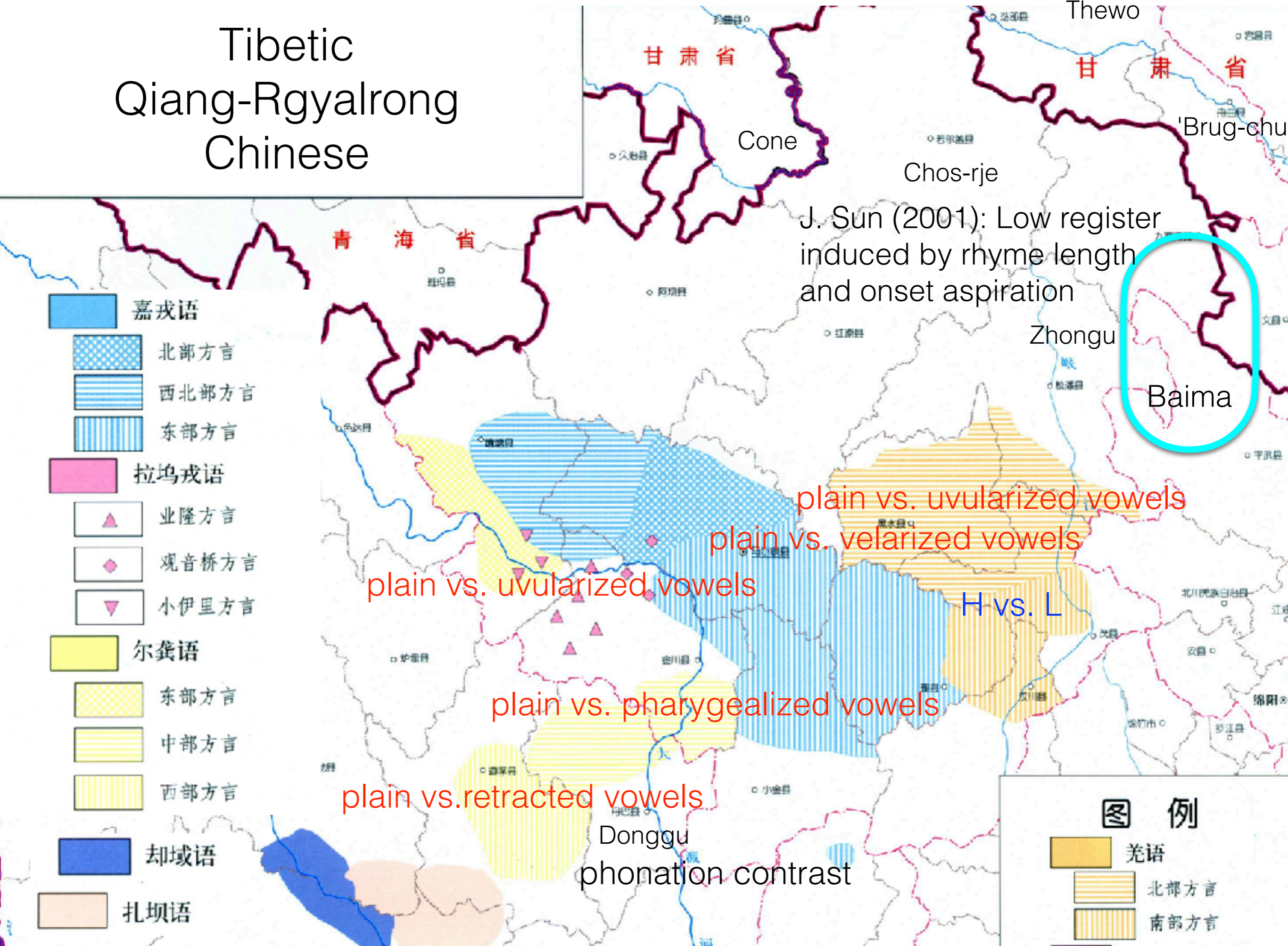


# Summary

	Rhyme	
Initial	long > OT <i>-m, -n, -ng, -s, -l</i> ; coalesced syllables	short > OT $-\emptyset$ ( $\sim -r$ ), <i>-b, -d, -g</i>
breathy / aspirated	[initial + rhyme] > lax	[rhyme] > tense initial > epiglottalized
non-breathy / non-aspirated	[rhyme] > tense / modal	

1. Low lax (breathy-like) register: breathiness, nasality, length
2. Non-low (high), non-breathy (tense) register
3. Split of the non-low register by rhyme type

# Tibetic Qiang-Rgyalrong Chinese



J. Sun (2001): Low register induced by rhyme length and onset aspiration



plain vs. uvularized vowels

plain vs. velarized vowels

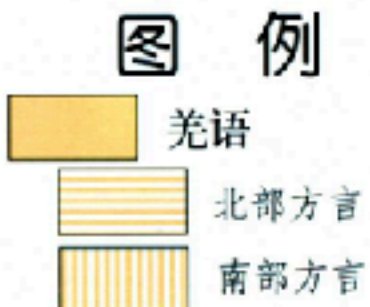
plain vs. uvularized vowels

H vs. L

plain vs. pharygealized vowels

plain vs. retracted vowels

Donggu  
phonation contrast



# Outlook

- register contrast
  - Thurgood (1999: 213): “the external contact provide[s] both the impetus and the directionality for the changes, while the language internal structures [provide] constraints on the potential paths for the changes”
  - pathway of change: breathiness / aspiration, nasality / length < lax/low
- contrastive phonation categories
  - realized with multiple covarying cues (including tone and vowel quality differences) (e.g. Keating et al. 2010; Garellek 2010; Kuang & Cui 2018)

# Outlook

- phonological analysis
  - Yuen Ren Chao (1934) “The non-uniqueness of phonemic solutions of phonetic systems”
  - there are usually more than one possible way of reducing [the sounds of a language] to a system of phonemes, and that these different systems or solutions are not simply correct or incorrect, but may be regarded only as being good or bad for various purposes (p. 363)
  - because phonemic solutions are not unique, it is necessary, before arriving at solutions, to have recourse to considerations of descriptive phonetics and the use of phonetic transcriptions (p. 396)
  - sound files

Thank you for your attention!

Sound files available at:

<https://pangloss.cnrs.fr>