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Vowel Quality in Hongyan Qiang*

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Northern Qiang vowel systems have been described with eight to nine monophthongs, which may be lengthened, rhotacized, or (non-phonemically) nasalized. This paper presents (morpho-)phonological evidence for adding the category of pharyngealization for one variety of Qiang. In addition, an acoustic analysis of vowels is given, which shows how one speaker maintains systematic acoustic distances among plain, pharyngealized, and rhotacized vowels, and vowels with a combination of coarticulatory effects. The implication of proposing the coarticulatory category of pharyngealization is that the Hongyan system may be described with just four plain monophthongs, half as many as have been proposed for other dialects.

Key words: Tibeto-Burman, Qiang, pharyngealization, acoustic properties

1. Introduction

Qiang (羌 Sino-Tibetan: Tibeto-Burman: Qiangic) is spoken by about 110,000 people in Sichuan Province, China. There have been a number of phonological overviews of different varieties of this language, including those in the reference section of this paper. However, no descriptions of Hongyan, a variety of Northern Qiang, have been published heretofore. Northern Qiang (NQ) has a rich phonological system, with numerous consonants, clusters, and a large syllable canon; e.g., Ronghong Yadu has 37 initial consonant phonemes, and 34 initial consonant clusters (LaPolla 2003:24). During the summer of 2005, I began investigating the phonology of the Qiang variety that is spoken by the ethnic Tibetans of Yunlinsi Village, Hongyan Township, Heishui County, Sichuan Province, China. Yunlinsi Village lies on the west side of Yakexia mountain

* This paper would not have been possible without the insightful suggestions and phonetic acumen of David Bradley, John Ohala, and Jackson T.-S. Sun, two anonymous reviewers, and without the publications of the Qiang scholars cited in the text; I stand on the shoulders of giants. All Qiang data from varieties other than Hongyan are taken from the authors cited in the introduction. Any errors herein are my original contribution. The fieldwork was supported by my home institution, and by a grant from the National Science Council of Taiwan (NSC 94-2411-H-001-071).

(/ja χtɕa 'ɕpiˤ/), which is bordered on the east by Mawo Village and Township, whose dialect has been discussed by Liu (1998), H. Sun (1962, 1981), and J. Sun (2003). Mawo and Hongyan are similar, but not identical varieties of NQ. My consultant for this research was Mr. Kejin Nan, a retired official from the Education Bureau, living in the city of Ma'erkang, Sichuan. He speaks the Hongyan dialect in his home with his wife and family. Mr. Nan was very precise about accuracy of pronunciation, which made this research most enjoyable.

This analysis of Hongyan is notable for its radical departure from earlier analyses of NQ vowel systems. Previous publications have given the following inventories of monophthongs in Northern Qiang:

(1) Mawo monophthongs (Liu 1998:38):[1]

plain:			long:			rhotacized:			rhotacized long:		
i, y		u	iː		uː	iʴ		uʴ			uːʴ
e	ə	ɤ			ɤː	eʴ	əʴ		eːʴ	əːʴ	
a		ɑ	aː		ɑː	aʴ		ɑʴ	aːʴ		ɑːʴ

(2) Ekou Yadu monophthongs (B. Huang 1992a:583):

plain:			long:			rhotacized:			rhotacized long:		
i, y		u			uː	iʴ		uʴ			uːʴ
ɪ	ə	o					əʴ				
ɛ			ɛː			ɛʴ					
æ		ɑ	æː		ɑː	æʴ		ɑʴ	æːʴ		ɑːʴ

LaPolla specifies that the following monophthongs occur monomorphemically, which accounts for an inventory that shows fewer rhotacized vowels than the above varieties. In his analysis of Yadu, only three height levels need to be distinguished, in contrast to B. Huang's (1992a) four levels.

(3) Ronghong Yadu monophthongs (LaPolla 2003:25, 27-28):

plain:			long:			rhotacized:			rhotacized long:		
i, y		u	iː, yː		uː	iʴ					
e	ə	o	eː		oː	eʴ	əʴ		eːʴ	əːʴ	
a		ɑ	aː		ɑː	aʴ					

In the present analysis, Hongyan (HY) has four plain vowel phonemes: /i, u, ə, a/. Vowels can be lengthened (/aː/), pharyngealized (/aˤ/), or retroflexed (/aʴ/). More than

[1] H. Sun (1981:30) adds /yʴ, ɤʴ/, but lacks /eːʴ/.

one coarticulatory effect may occur on a single vowel: /pa^{ʕɹ}/ ‘sole of foot’. The total set of monophthongs is as follows:

(4) Hongyan monophthongs:

short:

plain:	rhotacized:	pharyngealized:	rhotacized phar'd:
i u	u^{ɹ}	i^{ʕ} u^{ʕ}	i^{ʕɹ} u^{ʕɹ}
ə	ə^{ɹ}	ə^{ʕ}	
a	a^{ɹ}	a^{ʕ}	a^{ʕɹ}

----

long:

plain:	rhotacized:	pharyngealized:	rhotacized phar'd:
uː		i^{ʕ}ː u^{ʕ}ː	i^{ʕɹ}ː u^{ʕɹ}ː
əː	əː^{ɹ}		
aː	a ː^{ɹ}	a^{ʕ}ː	

Impressionistically, vowel quality is not affected by initial consonants, although some vowels are very restricted in their occurrence; e.g., /i^{ʕɹ}, u^{ʕɹ}/ do not follow labials.

The following consonant initial phonemes have been observed in HY:

(5) Consonant initials of Hongyan:

Bilabial	Dental	Retroflex	Palatal	Velar	Uvular	Glottal
p	t			k	q	
p^{h}	t^{h}			k^{h}	q^{h}	
b	d			g		
	ts	tʂ	tɕ			
	ts^{h}	tʂ^{h}	tɕ^{h}			
	dz	dʐ	dʑ			
	s	ʂ	ɕ	x	χ	h
	z	ʐ	ʑ		ʁ	ɦ
m	n		ȵ	ŋ		
	l, ɬ					
w			j			

Qugu and Yadu are described with the same three-way distinction among affricates as is given above for Hongyan. In addition to the above series, H. Sun (1981) and Liu (1998) also include an alveopalatal series of affricates /tʃ, tʃh, dʒ/ in their descriptions of Mawo; a four-way distinction of affricates in Mawo is questioned by J. Sun (2003).

An obvious difference between the HY vowel inventory and the other descriptions of NQ dialects is the lack of /y/. In Mawo, the phonemic status of /y/ is questionable, as pointed out by J. Sun (2003). He observes that in the description of Mawo, it is claimed that "…when the vowel /y/ occurs alone as a rhyme, it tends to be pronounced /iu/ (H. Sun 1981:31)." Nevertheless, some forms are transcribed differently in different locations in the text: (/ɣliu/, /ɣly/ 'younger sister' (H. Sun 1981:202, 28 cited in J. Sun 2003). Most forms that have been transcribed in Mawo with /y/ have /u/ in HY; one form has /i/. The following list appears to be exhaustive of cognates with Mawo /y/:

(6) Hongyan correspondences to Mawo /y/:

Mawo	Hongyan	gloss
ly	lu	come
syt	sut	day after tomorrow
ɹy ɹy	ɹu ɹu	divide
tshy	tshu	drop/fall
də ɬyn	tu-tɕu-'lu-n	fast (adv.)
tɕyn	tɕin	we two

Mawo	Hongyan	gloss
sy	su	learn, teach
ɣly	ʑdʑu	sister (younger)
ɹy ɹy	su	soul/spirit
dy	du	strike (iron)
sysy	su	tell

In Ronghong Yadu, /y/ is a marginal phoneme with very few occurrences, most of which follow palatal initials, where it contrasts with /i, u/: /tɕi/ 'house', /tɕy/ 'take', /u-tɕu/ 'see' (Evans and C. Huang, submitted). The Southern Qiang (SQ) variety Shuitang also lacks /y/; to the extent that Proto-Qiang *y can be reconstructed, it corresponds to /u/ in Shuitang: Mawo /ly/, Yadu /liu/, Taoping /ly^{33}/, Mianchi /n̥ù/, Shuitang /lu/ 'cat'.[2]

The essential systematic difference between this analysis and those given for other dialects is the addition of pharyngealization, which reduces by half the number of plain vowels needed to describe the data. Evidence in support for the four-monophthong analysis comes from phonology (minimal pairs), morphology (vowel harmony and alternations), and acoustics (measurements of formants). The following sections present the evidence for this analysis.

2. Hongyan vowel length and coarticulations

Hongyan plain vowels may be lengthened and/or bear secondary articulations—rhotacization, pharyngealization, or nasalization. Nasalization is rare, and clearly of

[2] Shuitang data from author's fieldwork.

secondary origin: /hũ/ ‘hair’; cf. Taoping /χmə^{33}/ (H. Sun 1981), Proto-Tibeto-Burman (PTB) *s-mul. It is so infrequent that it is not discussed below.

2.1 Vowel quantity

All NQ varieties have quantity distinctions on vowels, although this feature has not been observed among SQ varieties. Three of the four plain HY monophthongs may occur as long vowels:

(7) Length distinctions in Hongyan:

/bu/	‘board’	/χə/	‘needle’	/pa/	‘bloom’
/buː/	‘sugar’	/χəː/	‘rib’	/paː/	‘give birth (animal)’

Similar sets occur throughout NQ:

(8) Length distinctions in Mawo:

/dzi/	‘heavy’	/bu/	‘board’	/χe/	‘satiated’	/ʁuaʴ/	‘left’
/dziː βi/	‘lunch’	/buː/	‘sugar’	/χeː/	‘physique’	/ʁuaːʴ/	‘city wall’

Hongyan lacks monomorphemic /iː/, although [iː] occurs bimorphemically:

(9) Hongyan [iː]:

thaː tɕhi i-i.
s/he wine pour-ASP:3
‘S/he is pouring wine.’

/iː/ is rare throughout NQ. In Ekou Yadu (B. Huang 1992b), /iː/ only occurs in borrowings from Mandarin Chinese: /jiː liŋ/ ‘collar’. In Mawo, all but one instance of /iː/ occur before a sonorant, a natural environment for allophonic lengthening. The lone exception, /tiːq/ ‘top’, has the Hongyan cognate /tji-'qa/ ‘roof’, which suggests that the lengthened Mawo form may come from a glide-vowel sequence. In Ronghong Yadu, the only instance of /iː/ is /miː/ ‘eye’ (cf. Ronghong /mi/ ‘person’); here, as in Mawo, vowel length comes from a glide-vowel sequence: PTB *myak. There are no correspondence sets of /iː/ among Qiang varieties. Thus, it is not possible to reconstruct *iː for an earlier stage of the language.

A similar gap occurs in the series of rhotacized vowels, where /-iʴ/ is not found, as shown below.

2.2 Rhotacization

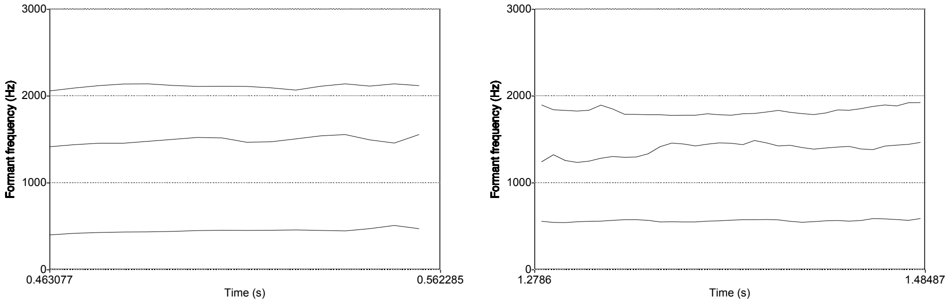
R-coloring, or rhotacization of vowels is found throughout NQ. In Ronghong Yadu, it is disappearing in the speech of younger people (LaPolla 2003:28). In Hongyan, retroflexion of the speaker's tongue is visible, especially on /aʴ/.

(10) Rhotacization pairs in Hongyan:

/gu/	'back basket'	/bə/	'bee'	/ɕi 'ta/	'count'
/guʴ 'guʴ/	'dove, pigeon'	/bəʴ/	'testicles'	/taʴ/	'saliva'

The following formant tracings show the vowels of 'bee' and 'testicle', in which F3 is lowered below 2000 Hz:[3]

(11) Formant tracings (F1 – F3) for Hongyan /bə/ 'bee', /bəʴ/ 'testicle':



/ə/ /əʴ/

As in Hongyan, /-iʴ/ is absent in Ekou and Ronghong Yadu, although it is recorded in Mawo (/khiʴ/ 'hundred', et al.). J. Sun (2003) notes that an underlying /iʴː/ in Mawo surfaces as [eʴː], due to a "universal phonetic tendency for vowels to lower before rhotics (Lindau 1985)." Rhotacization is found throughout NQ, as in these cognate sets:

(12) NQ /-Vʴ/ cognate sets:

Ekou Yadu	Mawo	Hongyan	gloss
/guʴ 'guʴ/	/guʴ guʴ/	/guʴ 'guʴ/	'dove, pigeon'
/phu khʂ̩u qhuʴ/	/qhuʴ kə/	/qhuˤʴ/	'hunt'
/pɑ χə̥ʴ/	/paʴ xəʴ/	/pa 'qhaʴ wa/	'claw, talon'
/qhuɑʴ/	/qhuɑʴ/	/qhaˤʴ/	'cut (potato)'

---

3 Hongyan data was recorded directly onto a Macintosh G3 iBook, at a sampling rate of 44.1 khz. Sound files were analyzed using Praat v4.3.2.6 (www.praat.org).

2.3 Pharyngealization

Jackson T.-S. Sun (2003) has observed that some instances of the vowel transcribed /e/ in Mawo sources (H. Sun 1981, Liu 1998) were pronounced by his Mawo consultant as a glide-vowel sequence; e.g., [bwi] 'plate' (H. Sun /be/). In fact, it was Jackson who, during my fieldwork, pointed out to me that within the vowels of my consultant's speech there appeared to be a pairwise opposition between plain and velarized or pharyngealized vowels. Without his astute observation, the analysis in this paper would have been impossible. To our knowledge, this paper is the first account of pharyngealization in Tibeto-Burman, although it is a typical feature of Caucasian and Athabaskan languages.

I have chosen the label "pharyngealization" for this coarticulatory effect for several reasons. First, visual observations suggest that the tongue body is bunched in the back, and perhaps lowered for this effect. Second, sounds with this effect are impressionistically "darker" than their plain counterparts. In general, they are acoustically retracted (lower F2), with some interesting exceptions, discussed below (thanks to John Ohala for discussing the acoustics with me). Further analysis may require that the labeling of this effect be changed to tongue retraction, or RTR. Recent research on Ronghong Yadu shows that the Ronghong vowels /i, y, ə, u/ are [+ATR], while /e, a, o, ɑ/ are [-ATR] (Evans and C. Huang, submitted). All HY plain vowels have pharyngealized counterparts:

(13) Hongyan pharyngealization pairs:

/bi/	'urine'	/ɹu/	'chest'	/bə/	'bee'	/ba/	'short, low'
/biˤ/	'plate'	/ɹuˤ/	'horse'	/bəˤ/	'be poor'	/baˤ/	'place to rest'

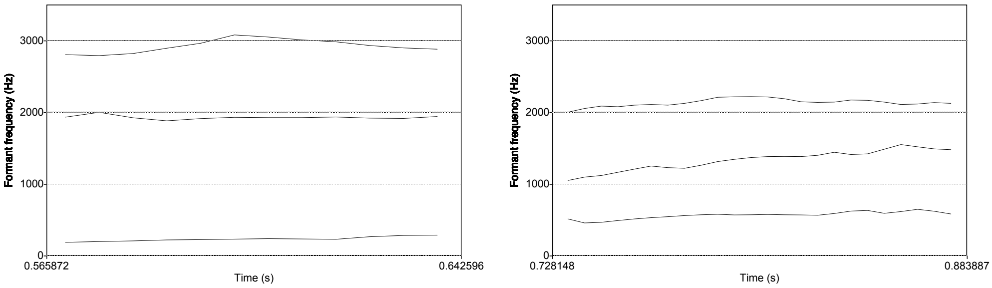
Of the coarticulatory effects discussed in this paper, pharyngealization has the most striking acoustic effect, making plain vowels sound like an entirely different set of plain monophthongs. Plain and pharyngealized vowels in Hongyan correspond to what is described in Mawo as /i, u, ə, a/ vs. /e, u, ɤ, ɑ/; there is not an opposition reported for Mawo that corresponds to /u, uˤ/ in Hongyan:

(14) Mawo vowel pairs:

/bi/	'urine'	/ɹu qhuɑ /	'chest'	/bə/	'bee'	/ba/	'short, low'
/be/	'plate'	/ɹu/	'horse'	/bɤ/	'be poor'	/bɑ/	'place to rest'

There are at least three advantages to the [±pharyngealization] analysis of the HY data. First, it is phonetically accurate. Pharyngealization is often an audible "dark" effect not found on plain vowels. The pharyngealized high front vowel sounds like a diphthong [ɯiˤ], as the tongue moves from a more pharyngealized position (F2~1000 Hz) to a more front position (F2~1500), whereas F2 for [i] stays near 2000 Hz for the duration of the vowel. The first three formants of these two vowels are shown below, from initial release to the end of voicing (vowels taken from /bi/ 'urine', /biˤ/ 'plate'):[4]

(15) Formant tracings (F1 – F3) for [i, iˤ]:



[i] [iˤ]

Acoustic details of all vowels are given in §3.1, ff. Further phonetic evidence for pharyngealization comes from pharyngealized [aˤ], in which the back of the tongue is visibly bunched in the speaker's mouth, while plain [a] does not show this effect.

The second advantage to this analysis is that the resulting four vowel system is much more economical than other proposed NQ vowel systems, with the addition of a single coarticulation replacing four monophthongs in the vowel inventory. This difference is demonstrated in the previous two sets of minimal pairs.

Third, the elusive nature of this coarticulation probably accounts for the fact that in at least some NQ varieties, the distinctions /i/ vs. /e/ (/i/ vs. /iˤ/ in our system) and /u/ vs. /o/ (/u/ vs. /uˤ/) is not always stable:

> "The functional loads of the /u/-/o/ contrast and the /i/-/e/ contrast are not very great: in many cases /o/ and /u/ are interchangeable, and /i/ and /e/ are interchangeable." (LaPolla 2003:25)

Heretofore there has been no explanation of why these vowel distinctions should be so unstable. However, if they are (or previously were) distinguished by a secondary articulation, then variability in pronunciation of this gesture would affect vowel quality in just the way described above by LaPolla.

[4] One reviewer asked whether this gesture, along with the transition into [əˤ] (34) constitute evidence for a pharyngeal glide before the nucleus. As it turns out, this transition of F2 does not occur in all contexts; e.g., F2 is quite steady in [iˤ]/z_ (30) and [uˤ]/qh_ (33).

The evidence offered thus far has been phonological and impressionistic; the following sections offer morphophonological and acoustic evidence.

2.3.1 Morphophonemic evidence for pharyngealization

Vowel harmony is a pervasive trait among NQ varieties, although it is scarcely observed in SQ. Evans and Huang (submitted) demonstrate that in the Ronghong variety of NQ (as well as in Puxi SQ), vowel harmony occurs when an underspecified vowel acquires a feature specification from a vowel in a neighboring (stressed) syllable (cf. LaPolla 2003:35-36). In Ronghong, which lacks pharyngealization, the features Front, High, and ATR all harmonize according to this principle.

Our present analysis of HY pharyngealization is that it is privative, and that non-pharyngealized vowels are not specified for the feature. The prediction of privativity is that non-pharyngealized vowels do not trigger de-pharyngealization, a prediction which accords with the data that have been collected. The following compounds show that the 'hand, foot' morpheme pharyngealizes to harmonize with a subsequent syllable:

(16) Pharyngealization harmony in Hongyan 'hand' and 'foot' compounds:
/dʐa̱ ʁwa 'si/ 'elbow' /dʐa̱ˤ 'quˤ/ 'leg' /dʐa̱ˤ 'suˤ/ 'finger'

Pharyngealization harmony is also observed in the numeral system, in which the numbers 'two' through 'eight' harmonize with the round number morpheme /suˤ/.

(17) Pharyngealization harmony in the numeral system:

ha'nə	two	ɦaˤ-'nəˤ-suˤ	twenty
ksi	three	'ksiˤ-suˤ	thirty
gʐə	four	'gʐəˤ-suˤ	forty
ʁwə	five	'ʁuˤ-suˤ	fifty
χtʂə	six	'χtʂəˤ-suˤ	sixty
stə	seven	'stəˤ-suˤ	seventy
khaʴ	eight	'khaˤʴ-suˤ	eighty

For additional evidence that pharyngealization in HY plays the role ascribed in other analyses to separate vowels, we look for instances of /u/ pharyngealizing under the influence of /aˤ/. If Hongyan were described without pharyngealization, and thus had eight plain vowels, this harmony would be expressed as a lowering:

(18) Competing analysis of /u/ vowel harmony:

/u/ → [o] /_ . '(C) ɑ
[u] / elsewhere.

The elsewhere case includes preceding the vowel /a/. In other words, such a system would claim that /u/ lowers to [o] before the low back vowel [ɑ], but not at all before the low front vowel [a]. In our analysis, this same phenomenon is expressed as harmony of pharyngealization:

(19) Pharyngealization harmony in this analysis:

V [-stress] → [pharyngealized] / _ . (C) V[pharyngealized]

That is, an unstressed vowel harmonizes its pharyngealization with the nucleus of the following syllable. Unlike the previous rule, this description of harmony accords with the physics of articulation. Data that support this harmony expression include the following combinations of DIR-verb:

(20) Pharyngealization harmony in Hongyan verbs:

/nu/	+	/la/	>	/nu-'la/
DIR		‘bring’		‘bring (in upstream direction)’
/nu/	+	/staˤ/	>	/nuˤ-'staˤ/
DIR		‘pull out’	>	‘pull out (in upstream direction)’

This pair shows pharyngealization harmony, in which plain /u/ pharyngealizes, and becomes noticeably lower (higher F1, cf. (28)).[5]

Although pharyngealization participates in vowel harmony, rhotacization does not, unlike Ronghong Yadu, in which rhotacization spreads leftward:

(21) Yadu rhotacization harmony (LaPolla 2003:35):

ʁuɑ-'kheʴ	‘five’-‘hundred’	>	ʁuɑʴ-'kheʴ	‘five hundred’
me-'weʴ	‘not’-‘reduce’	>	meʴ-'weʴ	‘unceasingly’

The following data show the absence of rhotacization harmony in Hongyan.

5 One reviewer asked why harmony is treated in this paper as phonological, rather than as a phonetic effect. Vowel harmony is always phonetically motivated. Because its application in HY changes one phoneme into another, it is treated here as a phonological process.

(22) Lack of rhotacization harmony in Hongyan:

ha-khaʴ	'ten'-'eight'	>	ha-ˈkhaʴ	'eighteen'
ziˤʴ-i	'cry'-PERF	>	ˈziˤʴ-i	'cried'
da-qhuˤʴ-sa	DIR-'shoot'-TRANS	>	daˤ-qhuˤʴ-ˈsa	'(It) stung (me).'

The first two examples above show that Hongyan rhotacization does not spread to prefixes or suffixes. The third case shows that even when pharyngealization spreads to a bound morpheme (/daˤ-/), rhotacization does not.

2.3.2 Acoustic evidence for pharyngealization

For acoustic comparisons in this paper, formants of labial-initial open monosyllabic words were measured using LPC, and samples were taken from the centers of the LPC spectrograms that followed the transition from initial consonant to vowel, and preceding the voicing dropoff at the end of the syllable. These values were then averaged.

(23) Plain and pharyngealized vowels compared:

i	/bi/	'urine'
u	/bu/	'board'
ə	/bə/	'bee'
a	/ba/	'low'
iˤ	/biˤ/	'plate'
uˤ	/puˤ/	'dry measure (5 liters)'
əˤ	/pəˤ/	'poor'
aˤ	/baˤ/	'place to rest'

The following diagram roughly plots the averaged F1 and F2 values for the above vowels. F1 is arranged vertically, from high to low, and F2 is arranged horizontally, with lower values on the right, to mirror the articulatory vowel space (e.g., Johnson 1997:105). Pharyngealized vowels are grayed (the asterisk in the chart is explained in the following text):

(24) Acoustic vowel space of plain and pharyngealized vowels after labials:

F1 (Hz)

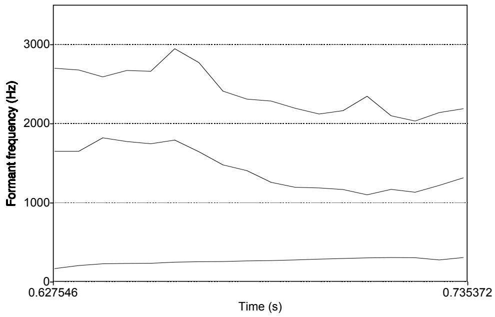
200			i		u	*			
400									
					ə		əˤ	uˤ	
600					iˤ				
				a		aˤ			
800									
	2500		**2000**		**1500**		**1000**		**500**

Second Formant (Hz)

The clearest trend is a rightward shift (lower F2) for the pharyngealized vowels. This trend has been noted for other languages (Shank & Wilson 2000:82, Pickett 1999:42). In addition, the high vowels /i, u/ are lowered (higher F1) when they are pharyngealized. Pharyngealization does not substantially alter acoustic heights for /ə/ vs /əˤ/ and /a/ vs /aˤ/, although pharyngealized vowels occupy a narrower height range than do plain vowels.

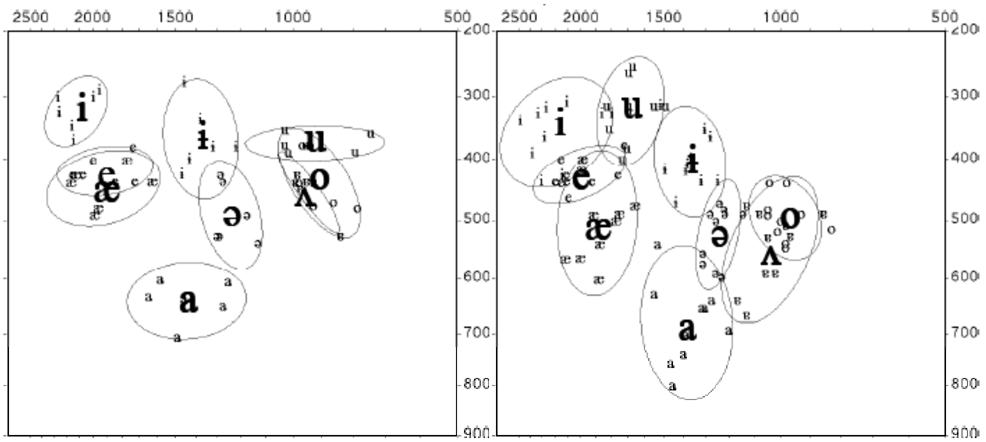
Plain [u] has a more front articulation (higher F2) than in other languages; e.g., average F2 for adult male speakers of American English is 870 Hz (Peterson and Barney 1952); Johnson (1997:105) shows an F2 of about 1000 Hz for Jalapa Mazatec [u]. This leftward shift of plain vowels creates acoustic space that allows the pharyngealized vowels to be more clearly distinguished from their plain counterparts. The following formant trace shows a downward slope of F2 throughout the articulation of [u]. For the samples of [u] recorded, F2 sloped downward from an average high of 1680 Hz to an average low of 1208 Hz, represented by an asterisk in the above table. This lower value more closely fits the acoustic properties of [u] in other languages:

(25) Formant tracks of [u] in ‘board’:



A literature search has turned up no published acoustic descriptions of eight vowel systems (e.g., Assamese, Turkish). However, the following charts plot the formants of vowels in a seven- and a nine-vowel system for comparison (Cho et al. 2001):

(26) Vowels occurring in the context /t_/ for urban and rural Cheju Korean speakers:



The chart on the left labels nine vowels, but /e, æ/ and /o, ʌ/ have merged, so that the urban speakers may be said to have a seven-vowel system, while the rural speakers (right) have a nine-vowel system.

Plots of all Hongyan vowels are given in the following section.

3. Hongyan total vowel space

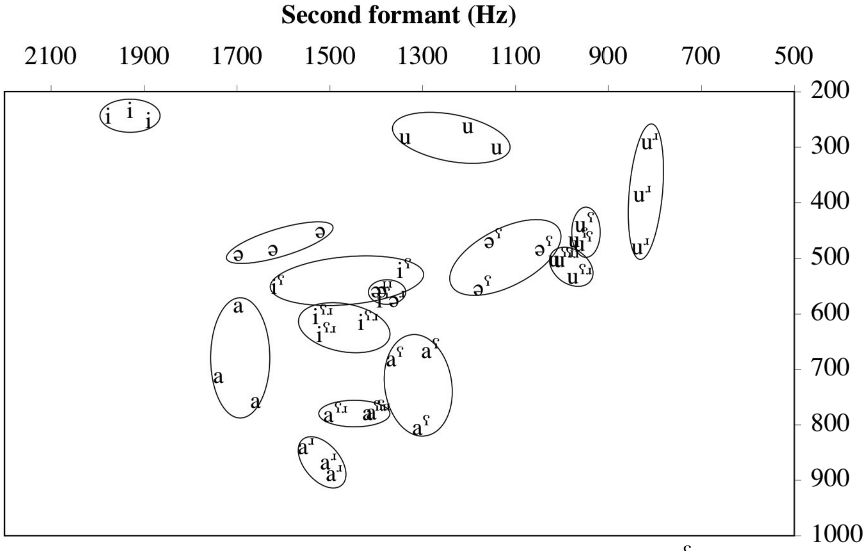
As we have seen, monophthongs that have coarticulatory effects such as pharyngealization function as separate phonemes in Hongyan. Thus, all fourteen of the vowels described above must be perceptibly different. This section discusses the acoustic information needed to keep these vowels distinct. In order to plot the distribution of vowels, samples were taken of three utterances of each vowel, as described for (24). Two of the vowels did not occur in a labial environment; the words are as follows:

(27) Hongyan monophthongs compared:

/bi/	‘urine’	----		/biˁ/	‘plate’	/ziˁʴ/	‘cry’
/bu/	‘board’	/guʴ 'guʴ/	‘dove’	/puˁ/	‘dry meas. (5 l.)’	/qhuˁʴ/	‘shoot’
/bə/	‘bee’	/bəʴ/	‘testicles’	/bəˁ/	‘poor’	---	
/ba/	‘low’	/maʴ/	‘bad’	/baˁ/	‘place to rest’	/paˁʴ/	‘sole’

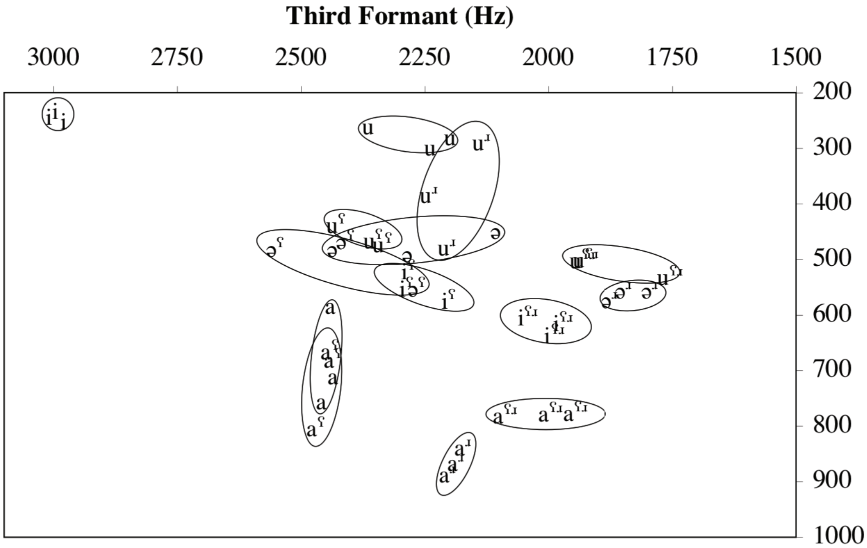
Most, but not all, of these vowels can be kept distinct with information from just the first two formants, as seen below:

(28) Hongyan vowel space (first two formants):



As the figure above shows, F1 and F2 values overlap for /əʴ, iˤ/, and are very close for /əˤ, uˤ, uˤʴ/. If F3 and F1 are compared against each other, these vowels are kept distinct, although other vowels overlap:

(29) Hongyan vowel space (first and third formants):



We observe that /əˤ, uˤ/ are close in both charts, although their distributions do not overlap when F2 and F1 are compared.

From these charts we may observe that pharyngealization and rhotacization do not affect all vowels in the same manner. For example, in rhotacizing /ə/ to form /əʴ/, average F3 drops 2277 – 1841 = 436 Hz, a salient degree of rhotacization. However, F3 values for /u/ and /uʴ/ overlap: the lowest /u/ F3 value is 2198 Hz, while the highest /uʴ/ F3 is 2242 Hz. Thus, F3 differences cannot signal rhotacization of /uʴ/; on the other hand, the difference in averaged F2 for /u/, /uʴ/ is 404 Hz, while internal F2 differences for these vowels are only 198 Hz and 20 Hz respectively, suggesting that F2 is an important indicator of rhotacization for this vowel, which has the lowest F2 values for any vowel. All other rhotacized vowels differ from their non-rhotacized counterparts by significant F3 depression. In addition, non-high plain vowels lower in height (higher F1), and all plain vowels retract (lower F2) when rhotacized. Rhotacization is also accompanied by an audibly tighter voice quality.[5]

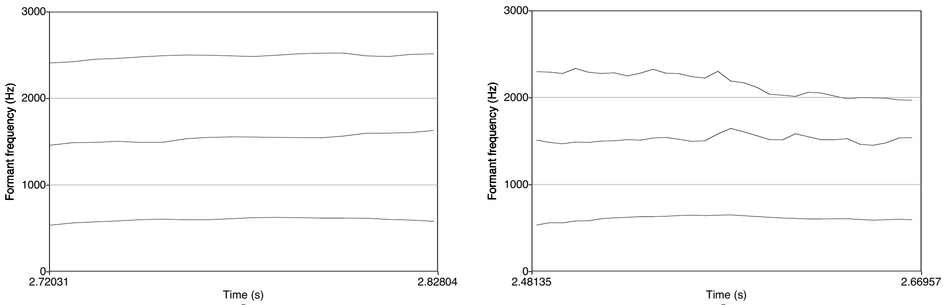
The acoustic trends for pharyngealization are clear. High vowels lower (higher F1), non-rhotacized vowels retract (lower F2), and rhotacized vowels depress F3 when pharyngealized.

The following discussion presents the acoustic properties that keep related (and nearby) vowels distinct.

3.1 Acoustic features of /i/ – like vowels

The vowel /i/ is widely separated from all other vowels by F1 (except /u/), F2, and F3. The pharyngealized vowels /iˤ/ and /iˤʴ/ are close to one another in F1 and F2. Impressionistically they resemble [ɛ, ɛɹ]. The following plots show F1 – F3 traces for a minimal pair of these two vowels (from /ziˤ/ 'ladle', /ziˤʴ/ 'cry'):

(30) Formant tracks for [iˤ, iˤʴ].

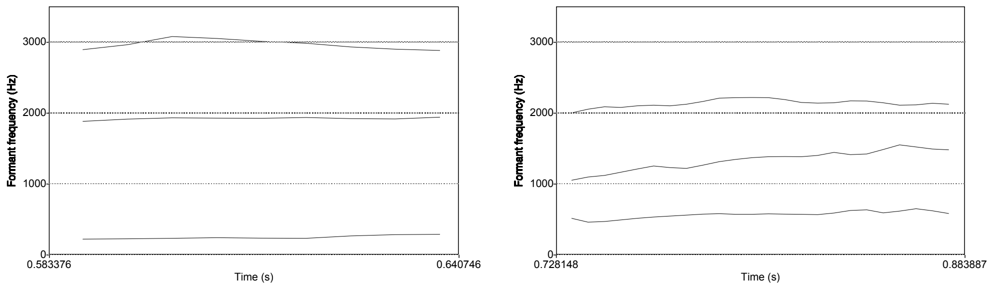


[iˤ] [iˤʴ]

[5] Thanks to David Bradley for making this observation.

F3 values of /iˤʴ/ drift downward during the articulation of the vowel, as shown above. On average, F3 for [iˤʴ] starts at 2300 Hz and ends at 1965 Hz, a change of 335 Hz. F3 plateaus slightly above the ending point, at an average value of 1989 Hz; the vowel reaches its plateau 93 ms after F3 initial peak. As the above figures show, initial F3 values for [iˤ] (avg. 2375 Hz.) and [iˤʴ] (avg. 2300 Hz) are about the same; this suggests that rhotacization of the vowel is only lightly anticipated, no doubt due to the coronal articulation of the initial. /iˤʴ/ does not appear to occur with any other initials. In comparing /i/ and /iˤ/ formant tracks, we note that near the end of the vowel, F2 of /iˤ/ drifts upward, as the retracted tongue root begins to return to a neutral position.

(31) Formant tracks for [i, iˤ] /b_.



[i] [iˤ]

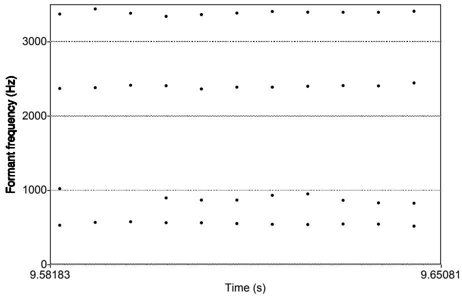
As shown in (28), one instance of [iˤ] has a higher overall F2, which is in the same range as the ending F2 values for the other two instances.

3.2 Acoustic features of /u/ – like vowels

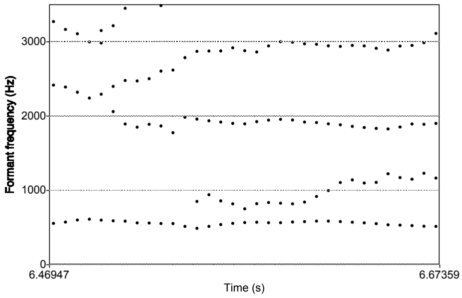
To measure the effects of rhotacization on u-like sounds, the vowels /uˤ, uˤʴ/ (impressionistically [o, oɹ]) were compared; F3 is lower for the rhotacized vowel, as expected. For pharyngealized /tsuˤ/ 'meet' and /tsuˤːʴ/ 'ridge', F2 begins very low, indistinguishable from F1 in most recordings.[7] F2 then rises and falls, as though the tongue bounces forward and back; the steady-state F2 portions of the vowel are similar for /uˤ, uˤːʴ/.

[7] For this reason, the software that produces smooth tracings of formants was not able to properly interpret the data in (26), and the formants are presented as dots. F1, F2 start as the lowest series of dots, and then separate after about 1/3 of the vowel duration. F3 is near 2000 Hz for both sounds.

(32) /uˁ, uˁːʴ/ /ts_.



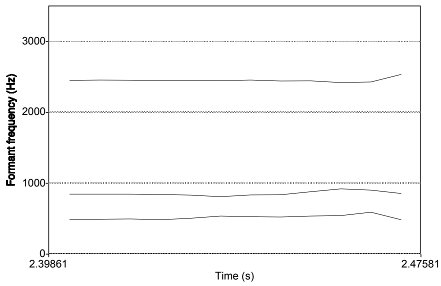
/uˁ/ /ts_



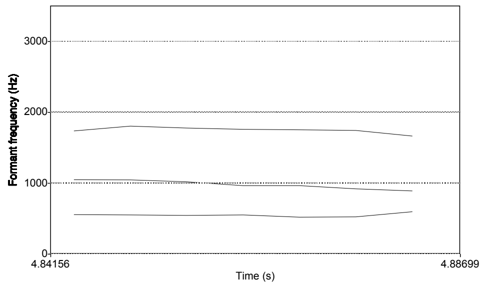
/uˁʴ/ /ts_

This bounce is not observed after uvular initials; cf. /qhuˁ/ 'lose', /qhuˁʴ/ 'shoot', probably due to the raising and backing of the dorsal portion of the tongue, necessary for articulating a uvular consonant:

(33) /uˁ, uˁːʴ/ /qh_.



[uˁ] /qh_



[uˁʴ] /qh_

Note that in both environments, F2 drops slightly at the end of [uˁ, uˁʴ], indicating tongue retraction.

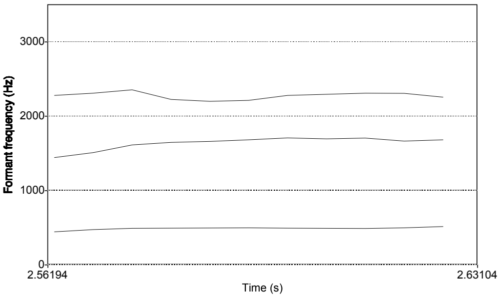
3.3 Acoustic features of /ə/ – like vowels

As shown below, /ə, əʴ, əˁ/[8] are primarily distinguished by F2, /əʴ/ also has a lowered F3. Below are formant traces for [ə] (/bə/ 'bee'), [əʴ] (/bəʴ/ 'testicles'), [əˁ] (/bəˁ/ 'poor'):

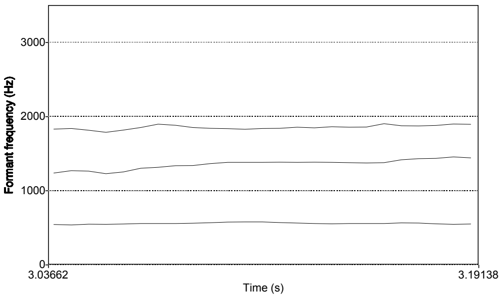
---

[8] The first two vowels sound as one might expect them to sound. The pharyngealized schwa sounds similar to [ɯ].

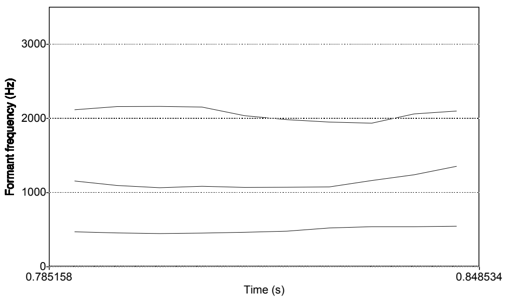
(34) Formant tracks for /ə, əᴵ, əˤ/ /b_.



/ə/



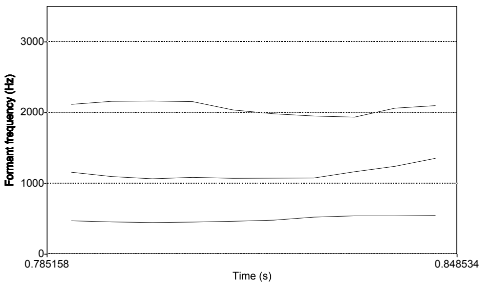
/əᴵ/



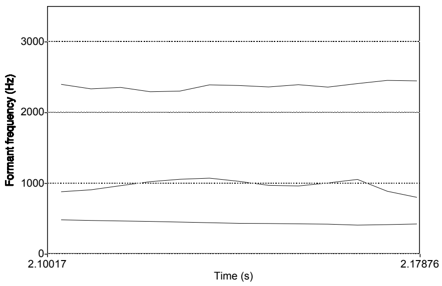
/əˤ/

The rise in F2 at the end of /əˤ/ marks the end of pharyngealization, and the tongue body moving toward its default position. As shown in the vowel space charts, /əˤ, uˤ/ are the most similar vowel phonemes — F1 and F3 values overlap, and F2 values are close. Below are post-labial formant traces for /əˤ, uˤ/ (/bəˤ/ ‘poor’, /buˤ/ ‘5 liter measure’):

(35) F1, F2, F3 for [əˤ, uˤ]/b_.



[əˤ]



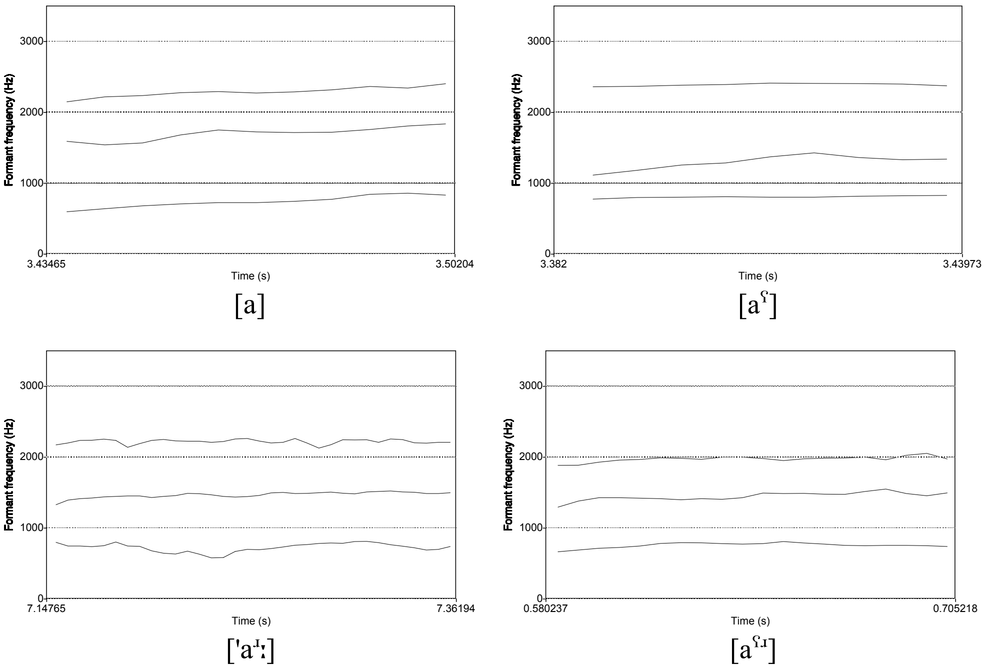
[uˤ]

In addition to a difference in rounding, [əˤ] ‘de-pharyngealizes’ earlier—all samples show rising F2 during the last third of the vowel; [uˤ] F2 values are steady, or fall at the end, an acoustic indication of retraction.

3.4 Acoustic features of /a/ – like vowels

The following formant traces highlight the acoustic differences between /a/-like vowels in the labial-initial words /pa/ ‘bloom’, /paˤ/ ‘husband’, /maʴː/ ‘bad’, /paˤʴ/ ‘sole of foot’ (impressionistically [æ, ɑ, æɹ, ɑɹ]):

(36) Post-labial [a, aˤ, aʴ, aˤʴ].



The vowels /aʴ, aˤʴ/ are the most acoustically similar pair in the set. For all tokens, F3 values of /aˤʴ/ are lower than those of /aʴ/.

4. Conclusions

Phonological, morphophonological, and acoustic data support an analysis of three basic tongue postures in Hongyan, which are not absolute, but are influenced by vowel position:

- *Modal*, unmarked vowels, which are shifted slightly to the front, relative to other languages; e.g., the differences between the plots of F1 and F2 values for HY /u, ə, a/ and the corresponding plots in Cheju. The F1 values of HY /u/ corresponds to the F1 values of Cheju /ɨ, ə/.
- *Pharyngealization* retracts modal vowels and lowers high vowels.
- *Rhotacized* vowels are marked by retroflexion (lower F3) for all vowels. This posture is often accompanied by tight vocal quality.

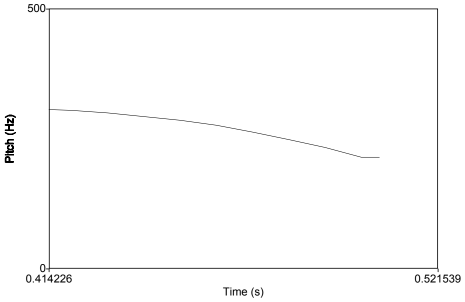
Pharyngealization and rhotacization may combine, but the retraction effects of these postures are not additive. That is, doubly affected vowels have the same or higher F2 values than corresponding singly affected vowels.

The data and analysis in this paper support a greatly reduced plain vowel inventory, with several possible coarticulatory effects, for one dialect of Northern Qiang. Research conducted by J. Sun (2000, p.c.) shows the existence of velarization or pharyngealization in rGyalrongic languages, which lie to the northwest of the Qiang-speaking area, suggesting that this pattern may be an areal feature of some languages of Northern Sichuan. For more on possible connections between Qiang and rGyalrong (post-)velarization, cf. Evans (in press).

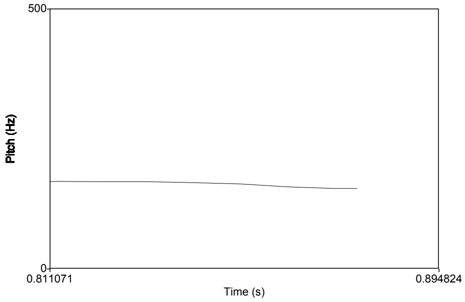
Appendix: Some thoughts on tone

Publications of the past forty years claim that Northern Qiang has stress and lacks tone (H. Sun 1962, 1981). However, the following HY pair is distinguished solely by pitch:

(37) Pitch on ‘stone tower’, ‘swim’:



/ʁlùˤ/ ‘stone tower’



/ʁlūˤ/ ‘swim’

(38) Other tonal near pairs:

ʁwə̀	‘bowl’	ʁwə̄	‘five’
rbù	‘drum’	bū	‘high’; ‘board’
χ̀ɪˤ	‘needle’	χ̄ɪˤ	‘rib’

The existence of a few intriguing pairs is not enough to fully describe the tonal properties of Hongyan. Nevertheless, the evidence given here indicates that some pitch phenomena are phonemic in the language, which may be taken as the definition of a tonal language, according to Hyman (2001): “A language with tone is one in which an indication of pitch enters into the lexical realization of at least some morphemes.”

Abbreviations

F1, F2, F3	first (etc.) formant
HY	Hongyan Qiang
NQ	Northern Qiang
PERF	perfective
PTB	Proto-Tibeto-Burman
SQ	Southern Qiang
TRANS	transitive marker (cf. Evans 2004)

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北羌紅岩方言的母音**

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一般認爲北部羌語有八到九個單純母音，而這些母音可以拉長、兒化，或是鼻化。本文提出構詞和音韻證據，主張北羌紅岩方言的母音還可以咽頭化。同時，我們也對紅岩方言的母音進行聲學分析，結果顯示基本母音、咽頭化母音和兒化母音都保持系統性的距離，並且出現共同發音的效應。這些證據顯示紅岩方言只有四個基本單純母音，數量上爲其他北羌方言一般所認定的一半。

關鍵詞：藏緬語，羌語，咽頭化，聲學性質

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