

Xumi (part 2): Upper Xumi, the variety of the upper reaches of the Shuiluo river

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This Illustration focuses on the variety of the Xumi language (旭米, /^{LP}ʂu ketɕɜ/ or /^{EP}ʂu-hĩ ketɕɜ/) that is spoken in the upper reaches of the Shuiluo river (水洛河) in Shuiluo Township (水洛乡) (hereafter Upper Xumi).¹ The township is located in Muli Tibetan Autonomous County (木里藏族自治县, *smi li rang skyong rdzong* in Written Tibetan, hereafter, WT), in the South-West of Sichuan Province (四川省) in the People's Republic of China.

Upper Xumi is one of the two dialects of the Xumi language, the other one being Lower Xumi. That dialect is spoken in the lower and middle reaches of the Shuiluo river, as we discussed in our phonetic and phonological sketch of Lower Xumi (Chirkova & Chen 2013b). The present overview of Upper Xumi complements our overview of Lower Xumi.

The two dialects of Xumi are closely related to each other, but they are distinctly different, due to their contact with different languages. Upper Xumi is essentially influenced by the local dialect of Tibetan (Gami Tibetan), as well as, to a lesser extent, by Pumi. By contrast, Lower Xumi is mostly influenced by the local dialects of the Pumi, Mosuo, and Naxi languages. The observed diversity is highly remarkable given:

- (a) the small geographical area occupied by the group (there is a mere 15.25 km beeline between the northernmost village of Lanman (兰满村) in the upper reaches of Shuiluo river and the southernmost village of Mianbang (免邦村) in the lower reaches of Shuiluo river);
- (b) the small number of speakers (less than 2,000 people);
- (c) the continuing contact and exchange between villages in the upper, middle, and lower reaches of Shuiluo river.

¹ In transcriptions of Xumi words ‘-’ stands for morpheme boundary, and ‘=’ stands for clitic boundary. In WT etymologies ‘?’ stands for a morpheme whose meaning is unclear. When attached to a word, it signals that the etymon represented by this word is tentative. When standing on its own (between spaces), it indicates an uncertain origin of a morpheme in a disyllabic word. See section ‘Prosodic organisation’ for the adopted system of tone notation (the superscript letters and numbers in transcriptions).

The comparative data on the two varieties are of interest for studies on language change in progress, and they may provide insight into the mechanisms at work in the implementation of language change and the diffusion of linguistic innovations.

The present sketch provides an overview of Upper Xumi with an emphasis on those features that distinguish it from Lower Xumi. It also contains an instrumental study of the voiceless–voiced contrast in nasals and laterals (nasal and oral airflow and electroglottographic measures), made possible by the fact that we could work with our principal Upper Xumi language consultant in a phonetics laboratory.

The description is based on the first author’s fieldwork. The word list and the recorded passage provided with this paper were recited by a fifty-nine year old male native speaker of Xumi, who was born and raised in Lanman village. To facilitate comparison with Lower Xumi, the present description uses (whenever available) cognates in both varieties as illustrative examples. (In the sound archive, sound files with Lower Xumi forms are marked with ‘LX’.)

Consonants

The consonant inventory of Upper Xumi comprises of 44 consonants, as listed below. (Low frequency phonemes are given in parentheses. See section ‘Prosodic organization’ for tonal variation on monosyllabic words.) The appendix provides the distributional patterns of consonants and vowels that include permissible sequences in syllables as attested in our corpus of c. 2,800 words. Upper Xumi is characterized by a reduced segmental inventory (44 consonants compared with 50 in Lower Xumi), different phonotactic constraints, and the presence of prenasalized clusters.

	Bilabial	Alveolar	Retroflex	Alveolo-palatal	Velar	Uvular	Glottal
Plosive	p p ^h b	t t ^h d			k k ^h g	q q ^h	
Affricate		ts ts ^h dz	tʂ tʂ ^h dz	tɕ tɕ ^h dz			
Nasal	(m̩) m	(n̩) n		ɲ	ŋ		
Fricative		s z	ʂ ʐ	ç ʝ	x	(χ) ʁ	h (fi)
Approximant	w	ɹ		j			
Lateral approximant		l̥ l		ɭ ʎ			

p	^H pɜ	‘to speak’	ʂ	^H ʂɹ	‘fishing net’
p ^h	^H p ^h ɜ	‘price’	ʐ	^{RP} lɛ-zɹ	‘to sleep’
b	^H bɜ	‘(house) beam’	tɕ	^H tɕɜ	‘star’
m	^R mɜ	‘sky’	tɕ ^h	^R tɕ ^h ɜ	‘muntjac’
m̩	^H m̩ɛ̃	‘medicine’	dʐ	^H dʐɜ	‘water’
w	^H wɜ	‘tooth’	ɲ	^R ɲɜ	‘fire’
t	^H tjɛ	‘cutting board’	ç	^{RP} dzi-çɜ	‘one hundred’
t ^h	^H t ^h jɛ	‘to wear (a hat)’	ʐ	^H ʐɜ	‘beer, wine’
d	^H djɛ	‘fox’	j	^H jɜ	‘tent’
ts	^{RP} tɕɛ-tsɜ	‘to bundle’	ɭ	^H ɭɛ	‘correct, right’
ts ^h	^H ts ^h ɜ	‘salt’	ʎ	^H ʎɛ	‘flavorless’
dz	^R dzɜ	‘to eat’	k	^H ku	‘to be able’
n	^R nɜ	‘whole; complete’	k ^h	^R k ^h u	‘want’
ɲ	^R ɲɔ̃	‘fur, animal hair’	g	^H gu	‘clothes’
ɹ	^R ɹɛ	‘chicken’	ŋ	^H ŋɜ	‘I’
s	^H sɜ	‘to know’	x	^R xu	‘to go (IMP)’
z	^R zɜ	‘to wash’	q	^H qu	‘hearth’
l	^H lɛ	‘tiger’	q ^h	^H q ^h u	‘year’

l	^{EP} bu-l̥ɐ [^{EP} bə-l̥ɐ]	‘to open a lock’ ²	χ	^{RP} lɐ-χ̥ɛ	‘to cause to break’
tʂ	^{RP} dzi-tʂu	‘unit of length’ ³	ɣ	^{RP} lɐ-ɣ̥ɛ	‘to break, to be broken’
tʂ ^h	^{LP} tʂ ^h u-tʂ ^h u	‘to suck’	h	^h h̥ɔ	‘vegetable’
dʒ	^{RP} lɐ-dʒu	‘to be tired’	fi	^h fi̥ɔ	‘to dare’

There is a general three-way contrast in stops and affricates: voiceless aspirated, voiceless unaspirated, and voiced. Velars and uvular stops are in near complementary distribution. Uvular stops are found before non-high vowels, and velar stops are found elsewhere. The two series contrast before /e ɜ u ɔ/, e.g. /^Rk^he/ ‘tax’ (WT *khral?*) vs. /^Rq^he/ ‘lime’, /^hk^hɜ/ ‘foot’ vs. /^hq^hɜ/ ‘feces’, /^hku/ ‘to be able’ vs. /^hqu/ ‘hearth’, /^{RP}ɲɜ-kɔ/ ‘to warm oneself’ vs. /^hqɔ/ ‘fate, life’. Unlike Lower Xumi, Upper Xumi does not have a voiced uvular stop. Words with the voiced uvular stop in Lower Xumi correspond to words with the cluster /Ng/ in Upper Xumi (see section on prenasalized clusters below).

Fricatives are pronounced at six different places of articulation: alveolar, retroflex, alveopalatal, velar, uvular, and glottal. Voiceless velar and glottal fricatives are in complementary distribution, the former only occur with oral vowels, whereas the latter only occur with nasal vowels, e.g. /^hxɔ/ ‘cooked rice, food’, /^hh̥ɔ/ ‘to stretch’. /fi/ has the most restricted distribution of all fricatives. It co-occurs only with the nasal vowels /ɔ̃/ and /ɛ̃/; examples include: /^hfi̥ɔ/ ‘to dare’ (compare with /^hɔ̃/ [ʰɔ̃] ‘self (first person subject)’), /^Rfi̥ɛ/ ‘self (third person subject)’ (compare with /^hɛ̃/ [ʰɛ̃] ‘sheep’). Also unlike Lower Xumi, Upper Xumi does not have a voiced velar fricative, but it has the voiceless uvular fricative /χ/ as an independent phoneme, which can occur word-initially, e.g. /^{LP}χɜ-χ̥ɐ/ ‘to itch’ (compare Lower Xumi /^{LP}q^hɐ-χ̥ɐ/), /^hχɐ/ ‘difficulty’ (WT *dka*).

Xumi nasals and laterals contrast (i) alveolar and alveopalatal places of articulation and (ii) voiced and voiceless counterparts.

Alveolar and alveopalatal laterals and nasals are minimally distinguished before /u/; in addition, alveolar and alveopalatal nasals are also distinguished before /ɐ/. Examples include: /^{LP}ɲu-ɲu/ ‘breast’ vs. /^{LP}nu-tʂ^hu/ ‘bean curd’, /^Rlu/ ‘again’ vs. /^Rɬu/ ‘come (IMP)’, /^{RP}nɐɐ/ ‘twenty’ vs. /^{LP}ɲɐɐ/ ‘shadow’. For nasals, the contrast is not found before the vowels /i e ɜ/, and for laterals, before /ɛ/. In the above cases, we use the symbols for the alveopalatal nasals and laterals, respectively. Example include: /^hɲi/ ‘you, thou’, /^hɲe/ ‘snivel, snot’, /^hɲɐ/ ‘milk’, /^hɲɜ/ ‘to have a craving (for something), to be hungry’; /^Rɬɛ/ ‘predestined affinity’.

Bilabial and alveolar nasals show a clear voiced vs. voiceless contrast as confirmed with our electroglottography (EGG) data (see Figures 1 and 2). Voiceless nasals are infrequent. They mostly occur in loanwords from Tibetan, but they are also attested in the native vocabulary, e.g. /^{RP}ɲjɛts̥u/ [ʰɲjɛts̥u] ‘tail’, /^Rɲɔ̃/ ‘fur, animal hair’.⁴ Upper Xumi has two voiceless nasals (/ɲ̥, ɲ̥/), which is two voiceless nasals less than in Lower Xumi (/ɲ̥, ɲ̥, ɲ̥/). This is surprising, given that Upper Xumi is in closer contact with a local Tibetan dialect than Lower Xumi and that that local Tibetan dialect has four voiceless nasals (/ɲ̥, ɲ̥, ɲ̥, ɲ̥/, Chirkova, in press). Moreover, /^{EP}l̥ɐɲmu/ (WT *lha rnga mo*), the word for ‘camel’, is distinct in Upper Xumi not only from the corresponding form in Lower Xumi (/^{EP}ɲ̥amɔ̃/ ‘camel’), but also from that in Gami Tibetan, /^hɲ̥amɔ̃/ (WT *rnga mong*), suggesting distinct donor languages for this form.

² In prefixes (which are prosodically unstressed), such as the directional prefix /bu-/ ‘outward’, /u/ is reduced to a schwa, e.g. /^{RP}bu-ɕe/ [ʰbə-ɕe] ‘to stick, to glue’, /^{RP}bu-ge/ [ʰbə-ge] ‘to pull outward’, /^{RP}bu-ɲɔ̃/ [ʰbə-ɲɔ̃] ‘to push (outward)’.

³ This is a traditional unit of length, equal to the distance between the thumb and out-stretched middle finger.

⁴ The combination /jɛ/ is realized as [jæ] for some speakers, see also below, section on vowels.

Table 1 Measured values of nasal airflow (NAF) and oral airflow (OAF) (in liter/second) for the (near) minimal pairs /^Hmjɛ/ ‘bamboo’ vs. /^Hm̥ɛ̃/ ‘medicine’ (WT *sman*), /^{RP}nɛkɛ/ ‘twenty’ vs. /^Hŋɛ/ ‘incantation, curse’ (WT *sngags?*), and /^Rnɔ/ ‘whole, complete’ vs. /^{RP}ŋɔ̃/ ‘fur, animal hair’.

Word	NAF min	NAF max	NAF mean	OAF min	OAF max	OAF mean
/ ^H mjɛ/ ‘bamboo’	0.01311	0.04695	0.02849	−0.05225	0.0166	−0.010466
/ ^H m̥ɛ̃/ ‘medicine’	0.24425	0.38435	0.34294	0.10735	1.1086	0.8391
/ ^{RP} nɛkɛ/ ‘twenty’	0.04065	0.1048	0.06417	−0.21485	−0.09365	−0.171984
/ ^H ŋɛ/ ‘incantation’	0.24227	0.43413	0.35542	0.01703	0.75213	0.59644
/ ^R nɔ/ ‘whole, complete’	0.02163	0.0574	0.03928	−0.09573	−0.01457	−0.07147
/ ^{RP} ŋɔ̃/ ‘fur, animal hair’	0.25163	0.4995	0.40140	0.02893	0.67113	0.31034

Table 1 provides the measured values of nasal airflow (NAF) and oral airflow (OAF) for the three (near) minimal pairs: /^Hmjɛ/ ‘bamboo’ vs. /^Hm̥ɛ̃/ ‘medicine’ (WT *sman*), /^{RP}nɛkɛ/ ‘twenty’ vs. /^Hŋɛ/ ‘incantation, curse’ (WT *sngags?*), and /^Rnɔ/ ‘whole, complete’ vs. /^{RP}ŋɔ̃/ ‘fur, animal hair’. In the table, NAFmin = minimum NAF; NAFmax = maximum NAF; NAFmean = mean NAF value; the provided measures represent an average of two to three repetitions and are measured during the nasal closure only. Figure 1 provides waveforms, spectrograms, EGG, NAF, and OAF for the three pairs.

A surprising finding of this pilot investigation is that all values are greater during the articulation of voiceless nasals. More precisely, while in the articulation of voiceless nasals the air escapes both through the nasal and oral cavity, there is almost no airflow through either nasal or oral cavity for the voiced nasals. Piezoelectric data, recorded for the same corpus, confirms that in voiced nasals, there is resonance recorded in the nose but no nasal (and no oral) airflow. A more detailed study (in preparation) will hopefully provide a more accurate description of this potentially new kind of nasals.

All examples of the voiceless laterals include friction and an abrupt release of the front closure that occurs slightly before the onset of voicing for the vowel (see Figure 2). The burst separates the segment into two parts with different spectral structure. The pre-burst part has the greatest energy centered around 3000 Hz and greater amplitude of frequencies above that peak. The post-burst part has the noise present more equally across the frequencies, with minor peaks at the frequencies corresponding to the formant peaks of the following vowel. In addition, the post-burst part resembles the spectral structure of the voiced lateral counterpart. The presence of the burst and the spectral structure of the post-burst part suggest that these segments have developed from clusters.

Syllabic consonant

As a syllabic consonant, /ɹ/ may occur with a zero-initial (e.g. /^{RP}k^hu-ɹ/ ‘to be in debt’), and after alveolar sibilants and retroflexes (attested in our corpus after /ts ts^h dz s z tʂ tʂ^h ʂ z/). We take the position that this syllabic consonant is phonologically the same as the fricative vowel after alveolar sibilants and retroflexes (/s z ts ts^h dz ʃ ʒ tʂ tʂ^h/). In the latter case, /ɹ/ is realized as homorganic to the preceding consonant onset. Consider the following examples: /^Htsɹ/ [tʰtsz] ‘to use’, /^Hts^hɹ/ [tʰts^hz] ‘to cut with scissors’, /^Hdzɹ/ [dʰdz] ‘wheat’, /^{RP}mɛsɹ/ [mɛsz] ‘tomorrow’, /^{RP}mɛzɹ/ [mɛsz] ‘cat’, /^Htʂ^hɹ/ [tʂ^hz] ‘to sell’, /^Hʂɹ/ [ʂz] ‘fishing net’, /^Rzɹ/ [zʂz] ‘to sleep’. Similar to the distribution of the syllabic consonant /ɹ/ in Lower Xumi, /ɹ/ in Upper Xumi contrasts with the high vowels (/i u/), as in /^Htsi/ ‘lock’, /^Htsɹ/ ‘to use’, /^Htsu/ ‘to pluck (facial hair)’. We therefore analyse it as a separate phoneme in this language.

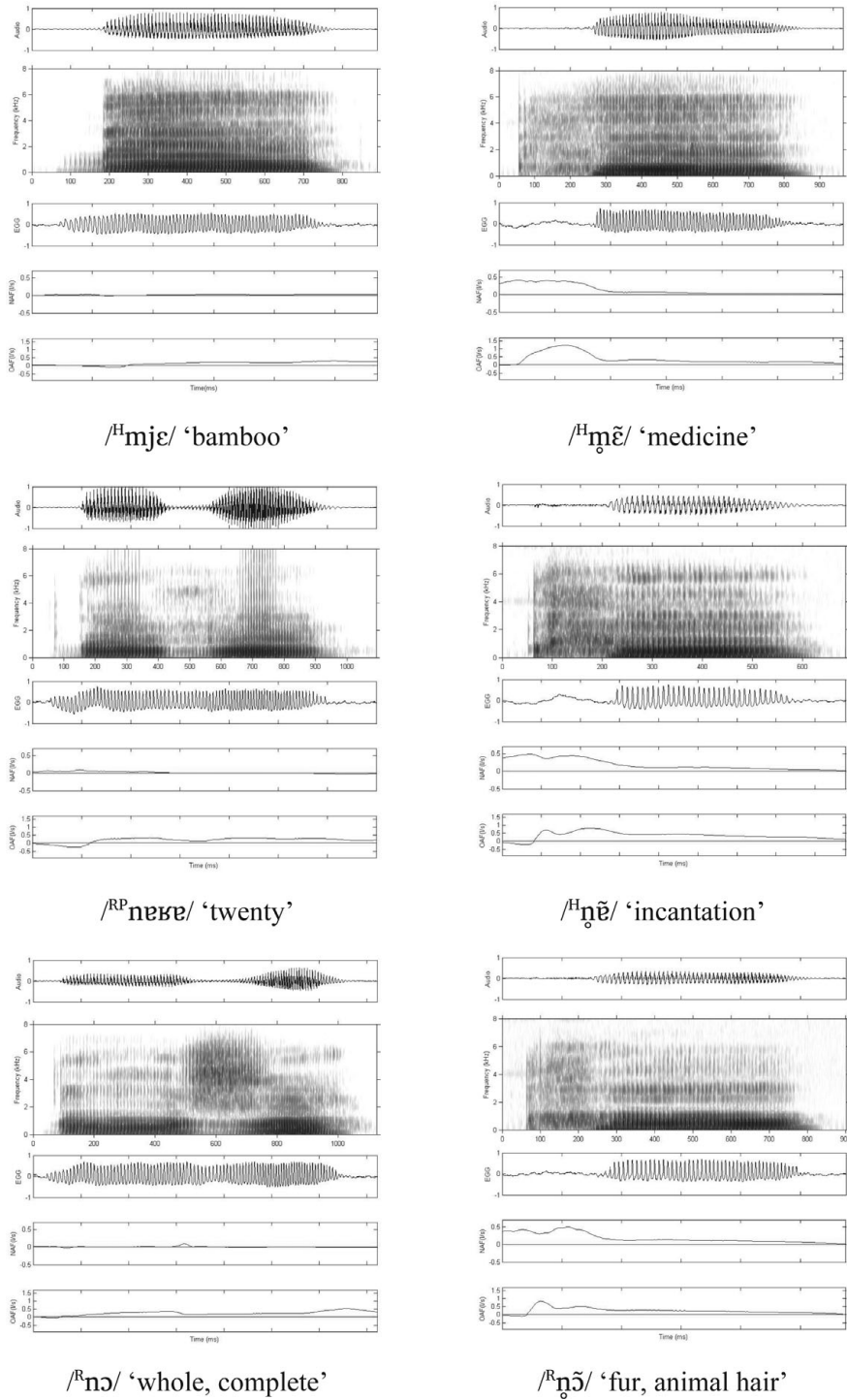


Figure 1 Waveforms, spectrograms, EGG, NAF, and OAF for the pairs /^Hmjε/ 'bamboo' vs. /^Hm̩ε̃/ 'medicine', /^{RP}nεεε/ 'twenty' vs. /^Hŋ̩ε̃/ 'incantation', and /^Rnɔ/ 'whole, complete' vs. /^Rŋ̩ɔ̃/ 'fur, animal hair'.

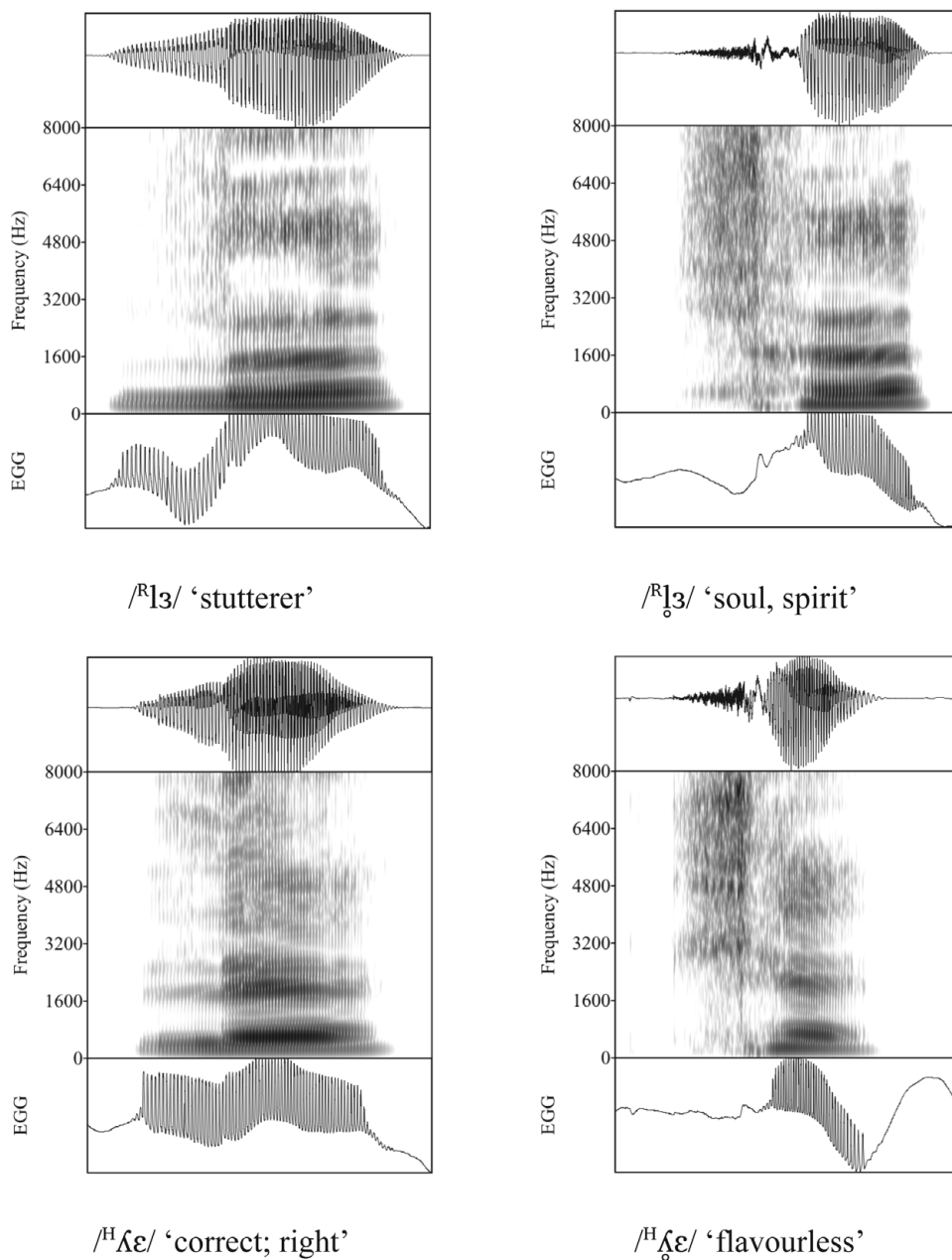


Figure 2 Waveforms, spectrograms, and EGG of the minimal pairs /ʀlɜ/ 'stutterer' vs. /ʀl̥ɜ/ 'soul, spirit', and /ʰl̥ɛ/ 'correct; right' vs. /ʰl̥̥ɛ/ 'flavourless'

Consonant clusters

Clusters with /w/

The approximant /w/ occurs in the second position in consonant clusters, where it may be realized as secondary labialization of the first position consonant. /w/ occurs after alveolars, alveopalatals, retroflexes, velars, uvulars, as well as after /ŋ/ and /ɹ/. It may be followed

by /i e ε ɜ ɐ ẽ/ as well as, marginally, also by /ĩ/. If preceded by an alveolopalatal onset or followed by the front vowels /i e ε ã/, /w/ is realized as [ɥ], e.g. /^Hgwi/ [ʰgɥi] ‘bundle wrapped in cloth’, /^Rdwe/ [ʳdɥe] ‘to ask’, /^Rdʒwε/ [ʳdʒɥε] ‘bird’, /^Rdʒwɜ/ [ʳdʒɥɜ] ‘honey, sugar’, /^{EP}gwe-wɜ/ [ʰɛp gɥe-wɜ] ‘to hunt’, /^{EP}lɛ-gwɜ/ [ʰɛp lɛ-gɥɜ] ‘to hide something’, /^R.ɪwɜ/ ‘copper’, /^R.ɪwɛ/ ‘heavy’, /^Hqwɛ/ ‘to cry, to weep’.

Prenasalized clusters

Similar to its linguistic neighbour, Gami Tibetan (Chirkova, in press), Upper Xumi has prenasalized voiced stops and affricates clusters (/Nb Nd Ndʒ Ndʒ Ng/). The stop component of the cluster may only be voiced, and a sequence of a nasal and a stop must be homorganic.⁵ Prenasalization in Upper Xumi is contrastive, as evidenced by the (near) minimal pairs below:

/ ^{LP} bemi/ ‘axe’	/ ^H Nbe/ ‘saddle pad’ (WT ¹ bol ‘cushion’)
/ ^R dze/ ‘to exist (at a fixed location)’	/ ^R Ndze/ ‘board for pressing things together’
/ ^H dʒɔ/ ‘enemy’ (WT <i>dgra</i>)	/ ^R Ndʒɔ-Ndʒɔ/ ‘to be similar’ (WT ¹ dra) ⁶
/ ^{RP} lɛ-gɛ/ ‘to obstruct, to block’	/ ^{RP} lɛ-Ngɛ/ ‘to be scorched’

Prenasalized clusters mostly occur in Tibetan loanwords (corresponding Gami sound files have been provided whenever available), and they are likely to be borrowed due to widespread Xumi–Gami Tibetan bilingualism in the upper reaches of the Shuiluo river. Examples include: /^{RP}Ndiwu/ ‘bullet’ (WT *mde*¹u, Gami /^HNdi/), /^RNdʒɔ-Ndʒɔ/ ‘to be similar’ (WT ¹dra, Gami /^HNdʒɔ/). (Compare the corresponding words in Lower Xumi: /^{RP}diwu/ ‘bullet’, /^{EP}dʒe-hĩ/ ‘similar’, with the nominalizing marker /hĩ/.) Prenasalized clusters are also attested in Xumi native vocabulary. We note that such words (invariably with the cluster /Ng/) are cognates with Lower Xumi forms with the voiced uvular stop, as in ‘to stew’: Upper Xumi /^RNgu/, Lower Xumi /^RGo/. As suggested by the external reviewer of this paper, the presence of Tibetan loanwords containing the cluster /Ng/ has possibly paved the way for the reinterpretation of the voiced uvular stop as a /Ng/ cluster in Upper Xumi. We note that such a development would be consistent with the correlation between stops and voicing, as discussed in Ohala (1983: 194–201). Given that the farther forward in the vocal tract a stop is articulated, the better able it is to accommodate voicing, /g/ is the most difficult stop to voice. The prenasalized stop /Ng/ avoids the problems associated with maintaining voicing, while maintaining the original phonemic contrast between /g/ and /G/.

Consonant lenition

Similar to Lower Xumi, Upper Xumi has a set of productive lenition rules, which transform some intervocalic voiced and voiceless aspirated stops and affricates into spirants. However, compared to the lenition rules in Lower Xumi, those in Upper Xumi are reduced in number and solely yield independent full-fledged phonemes that can occur word-initially. The attested lenition rules are summarized as follows:

⁵ Homorganic nasal-consonant onsets can be described as unit phonemes or as consonant clusters (clusters carrying secondary articulatory gestures). Our analysis of such segments as consonant clusters in Xumi follows that of similar segments in Kham Tibetan dialects (e.g. Gesang & Gesang 2002), which, in most cases, appear to be the donors of words with homorganic nasal-consonant onsets in Upper Xumi.

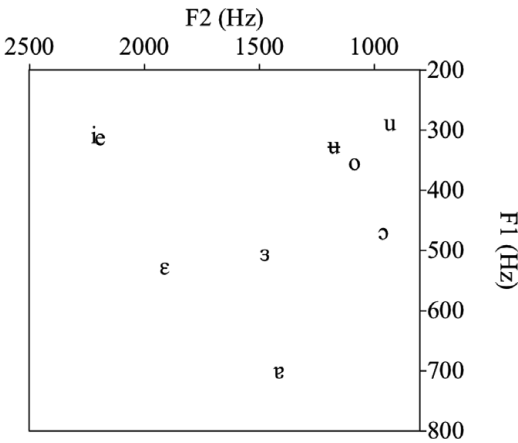
⁶ This word is realized with a rising contour on the first syllable. This is an unusual pattern for disyllabic words, not further attested in other words in the corpus.

CHANGE	EXAMPLE
b > w	^{/R} bjɛ/ ‘leaf’ > ^{/LP} sĩ-wjɛ/ [^{/LP} sĩ-ɥɛ] ‘tree leaves’
p > hw	^{/H} p ^h i/ ‘to weave’ > ^{/EP} mjɛ hwi/ [hɥi] ‘to weave a bamboo basket’
dz > z	^{/H} dzjɛ/ ‘to ride’ > ^{/RP} rõ zjɛ/ ‘to ride a horse’
tɕ ^h > ɕ	^{/R} tɕ ^h i/ ‘to drink’ > ^{/EP} tɕwe ɕĩ/ ‘drink tea’
dẓ > ẓ	^{/R} dẓwɐ/ ‘to hit’ > ^{/LP} hĩ ẓwɐ/ ‘to hit a man’
k ^h > x	^{/H} k ^h u/ ‘to want’ > ^{/EP} mu = xu/ ‘not want’
q ^h > χ	^{/H} q ^h ɔ/ ‘to slaughter, kill’ > ^{/RP} be χɔ/ ‘to kill a pig’

The noted changes are not only less numerous, but are also less regular than the lenition rules in Lower Xumi, and for some initials, also sporadic and marginal. This is the case for ^{/R}dẓɔ̃/ ‘to have’, where the initial /dẓ/ irregularly lenites to /ẓ/, as in [^{/RP}mu = ẓɔ̃] ‘not have’.

Vowels

The Xumi vowel system comprises nine oral vowels and six nasal vowels (i.e. one oral vowel more than in Lower Xumi). Vowels exhibit a wide range of surface realizations (also among the language consultants that we worked with) with most vowels occurring in a rather narrow range of contexts. The number of hypothesized underlying vowels and the relation between the surface vowel realizations and the phonemic vowel categories have been established on the basis of cognates in both varieties. See also the vowel chart plotted on the relative F1/F2 formant values below. (F1 and F2 were measured at one quarter of the vowel duration (25%), at mid point (50%), and at three quarters of the vowel duration (75%); the mean formant value of a vowel was calculated by averaging over the three measurements).



i	^R bi	‘flour’	^H tsi	‘lock’	^{RP} lɐ-ts ^h i	‘to abstain’
e	^R be	‘pig’	^{EP} tsezi	‘to trample’	^H ts ^h e	‘to like’
ε	^R bjɛ	‘leaf’	^{EP} ɐ-tsɟɛ	‘hot’	^{EP} ɲets ^h jɛ	‘earring’ ⁷
ɜ	^R bɜ	‘pot, pan’	^{RP} tsɐ-tsɜ	‘to bundle’	^H ts ^h ɜ	‘salt’
u	^R bu	‘crops’	^H tsu	‘to pluck’	^R ts ^h u	‘ghost’
ʊ	^R bʊ	‘to rub with hands’				

⁷ This word is likely to be a loan from Tibetan, WT *rna* ? ‘ear ?’.

- o ^{LP}boxu ‘gourd’ ^Htso [ʰtsɤ] ‘crown of a head’ ^Htsʰo ‘lungs’
 ɔ ^Hbɔ ‘mask’⁸
 ɐ ^{RP}bezɛ̃ ‘cicada’ ^Htsɐ ‘sinew’ ^{EP}nɛtsʰɐ ‘ink’⁹

Upper Xumi nasal vowels include /ɪ ɛ̃ ʊ̃ ɔ̃ ɛ̃/, as in /^Hhĩ/ ‘man, person’, /^Hhɛ̃/ ‘to cut, to slice (meat)’, /^Hhũ/ ‘to blow’, /^Hhɔ̃/ ‘vegetable’, /^{RP}lɐ-hɛ̃/ ‘have disappeared’. Marginally, Upper Xumi also has the vowel /ɔ̃/, which is only attested in one word in our corpus, namely /^{LP}mɔ̃dɐ/ ‘on the roof, upstairs’ (compare /^{LP}mĩdɐ/ ‘pitiful’).

Vowel realization

/i/ and /e/ overlap with some initials (see below for discussion).

Front mid vowels contrast two degrees of vowel height: /e/ vs. /ɛ/, as in the following examples (where these vowels are also contrasted with /i/): /^Rji/ ‘to exist (of animate beings)’, /^Rje/ ‘to lick’, /^Rjɛ/ ‘vegetable oil’; /^{RP}ɛdʒi/ ‘alcohol, spirits’, /^Hdʒɛ/ ‘happy’, /^Hdʒɛ/ ‘rich’.

The front vowel /ɛ/ seems to be limited to occur only with [j], e.g. /^Hbjɛ/ ‘hoof’, /^Hdjɛ/ ‘fox’, /^Rgje/ ‘eggplant’, /^Hmjɛ/ ‘bamboo’. The combination /jɛ/ is realized as [jæ] for some speakers, e.g. /^{LP}mjɛ-tsʰu/ [ʰLPmjæ-tsʰu] ‘downstairs’.

/ʌ/ has a restricted distribution. It only occurs after bilabials (e.g. /^Rbʌ/ ‘to rub (with hands), to twist’), and velars, where it is realized as [u] (e.g. /^Hkʌ/ [ʰku] ‘to bake, to roast, to toast’).

/o/ has many different realizations, for it represents a change in progress, that is, raising to /u/ (see below). After alveolars, it is realized as [o] or [ø] (e.g. /^Htʰo/ ‘manner, way (to do things)’, /^Hto/ [ʰtø] ‘to build’). After alveopalatals, it is realized as [əu] (e.g. /^Htɕʰo/ [ʰtɕʰəu] ‘to insert, to stick in’, /^Hɕo/ [ʰɕəu] ‘meat’). Occasionally, it can also be realized as [ɤ] (e.g. /^Htso/ [ʰtsɤ] ‘crown of a head’).

/ɔ/ frequently appears in Tibetan loanwords (where it corresponds to WT *a*), e.g. /^{EP}tʰuɔ/ ‘hammer’ (WT *tho ba*), /^Hbɔ/ ‘mask’ (WT *ba*), /^Hdʒɔ/ ‘enemy’ (WT *dgra*), /^{RP}lɛtɕʰɔ/ ‘instrument, utensil’ (WT *lag cha*), /^{EP}mɛzɔ/ ‘peacock’ (WT *rma bya*). In the native vocabulary, /ɔ/ contrasts with /ɐ/, e.g. /^Hqɔ/ ‘mountain range’ vs. /^Hqɐ/ ‘to move’, /^Hɕɔ/ ‘strength’ vs. /^{RP}nɛɐ/ ‘twenty’.

Comparison with Lower Xumi

The main differences between the vowel systems of Lower and Upper Xumi can be summarized as follows. Compared to their counterparts in the vowel system of Lower Xumi, the vowels of Upper Xumi evidence a chain shift that consists of the raising of most vowels. The chain shift is possibly triggered by the addition to the system of the phoneme /ɔ/. Hence, Lower Xumi /e o ɐ a ɛ̃ ɔ̃ ɛ̃ ɔ̃/ generally correspond to Upper Xumi /e u ɜ ɔ ɪ ʊ̃ ɛ̃ ɔ̃/, respectively. For the oral mid vowels /e o/, the change is in progress, yielding a number of intermediate forms (see above on the realization of these vowels) and resulting in near merger for some words, as discussed below.

The Lower Xumi /ʌ/ generally merges with /u/ in Upper Xumi, except after bilabial and velar initials, where it continues to be contrastive with /u/, e.g. /^Hbʌ/ ‘bowels, intestines’ vs. /^Hbu/ ‘Pumi people’, /^Rbʌ/ ‘to rub (with hands), to twist’ vs. /^Rbu/ ‘crops’, /^Hkʌ/ to bake, to roast, to toast’ vs. /^Hku/ ‘to be able’. In all other cases, we observe merger with /u/. For example, the words ‘to count’ and ‘to wipe’, which are contrastive in Lower Xumi (/^Hsu/ and /^Hsʌ/, respectively), are homophonous in Upper Xumi, /^Hsu/ ‘to count’ and /^Hsu/ ‘to wipe’.

The clearest examples of vowel raising involve the (Lower Xumi) low vowels /ɐ a ɛ̃ ɔ̃/, which rise into the empty mid vowel space. Thus, Lower Xumi /ɐ/ generally corresponds to Upper Xumi /ɜ/, Lower Xumi /a/ generally corresponds to Upper Xumi /ɔ/, Lower Xumi

⁸ This word is a loan from Tibetan, WT *ba* ‘mask’.

⁹ This word is a loan from Tibetan, WT *snag tsha* ‘ink’.

/ẽ/ generally corresponds to Upper Xumi /ẽ/, and Lower Xumi /ã/ generally corresponds to Upper Xumi /ɔ̃/; this is illustrated by the following examples:

GLOSS	LOWER XUMI	UPPER XUMI
‘to speak’	/ ^H pɐ/	/ ^H pɜ/
‘to arrive’	/ ^H pɑ/	/ ^H pɔ/
‘sheep’	/ ^H ẽ/	/ ^H ẽ/
‘self’	/ ^H ã/	/ ^H ɔ̃/

The situation is more complex for the (Lower Xumi) oral mid open vowels /e o/, which by raising towards (Upper Xumi) /e u/ cause the overcrowding of the high vowel space, leading in some cases to merger or near merger. The minimal pair ‘now’ and ‘cloth’ (Lower Xumi /^Hi/ ‘now’, /^Hɛ/ ‘cloth’) is a case in point. A minimal pair test investigating speakers’ intuitions about their pronunciation of these words (see Labov 1994: 353–354) suggests complete merger for most Upper Xumi speakers that we consulted: they judged the two words to be homophonous (compare the realization of these words by the speaker DDTR, /^Hi/ ‘now’ and /^Hi/ ‘cloth’). A more careful pronunciation of these words, as in word elicitation and discussion with our principal consultant, yielded a distinction, which our main consultant claimed to be that of tone. He pronounces the word for ‘now’ with a continued fall after the abrupt f0 rise in the initial part of the syllable, which gives the perception of a falling tone (i.e. [i⁴⁵¹] ‘now’). Conversely, he pronounces the word for ‘cloth’ with a high-level pitch contour after the abrupt rise, which gives the perception of a high level tone (i.e. [i⁴⁵⁵] ‘cloth’). We note, however, that our principal language consultant was inconsistent in his judgements, and that this type of variation in the realization of the high tone is non-contrastive in this variety (see below on tone).

Consider another example, involving the back vowels /u/ and /o/, as in the minimal pair /^Hq^hu/ ‘year’ and /^Hq^ho/ ‘bowl’, Lower Xumi /^Hq^hɯ/ and /^Hq^ho/, respectively. While our principal language consultant maintains a distinction, the difference is acoustically very minor. Video recording reveals a difference in the relative degree of lip rounding (see the video clips ‘Year’ and ‘Bowl’ in supplementary materials). Clearly, broader surveys and commutation tests (Labov 1994: 356–357) are needed to provide a complete account of this merger in progress.

Syllable structure

The canonical syllable of Upper Xumi may contain up to two optional elements in the following two types of linear structures: (i) (C1)(C2)V, and (ii) (C2)(C3)V, where C1 stands for nasal (before voiced stops and affricates), C2 can be any consonant, and C3 can only be -w-; V stands for vowel (or the syllable consonant /ɹ/), and parentheses indicate optional constituents. A non-phonemic glottal stop can be inserted at the left edge of a vowel-initial stressed syllable (e.g. /^Hẽ/ [ʰʔẽ] ‘sheep’, /^Hũ/ [ʰʔũ] ‘collar’), and at the left edge of a vowel-initial root (e.g. /^{RP}lɐ-ẽ/ [ʰ^{RP}lɐ-ʔẽ] ‘to be drunk’, /^{EP}mje-ũ/ [ʰ^{EP}mjæ-ʔũ] ‘to swallow down’).

- (1) V /^{RP}ɐ = z̃/ ‘do you have?’
- (2) CV /^Hdzɔ/ ‘enemy’ (WT *dgra*), /^Hsɜ/ ‘to know’
- (3) CCV /^RNdzɔ-Ndzɔ/ ‘to be similar’ (WT ^l*dra*), /^Hswɜ/ ‘to whet (a knife)’

Xumi is phonologically monosyllabic with a strong tendency towards disyllabicity in its lexicon. Trisyllabic and quadrisyllabic words are mostly composite, e.g. /^{LP}t^hɔ̃-sĩpɔ̃/ ‘pine tree’ (WT *thang*) (from the word /^{LP}sĩpɔ̃/ ‘tree’), /^{RP}l̩ɜwu-dzɜwɜ/ ‘peach’ (from the bound root /dzɜwɜ/ ‘fruit’, as in the word /^{LP}dzɜwɜ-dzɜwɜ/ ‘fruit’), /^{LP}ɲɜmi buxu/ ‘sunflower’ (from /^{LP}ɲɜmi/ ‘sun’, /^{RP}buxu/ ‘flower’). At the same time, Upper Xumi also has a handful

monomorphemic trisyllabic words (both native and loanwords), e.g. /^{LP}bɜzɪki/ ‘pillar’, /^{EP}lõmutɕ^{hi}/ ‘elephant’ (WT *glang po che*).

Prosodic organization

Similar to Lower Xumi, Upper Xumi has a two-way tonal contrast on monosyllabic words and a three-way contrast of tonal melodies on polysyllabic words.

Tone and tonal melodies on lexical words

On monosyllabic roots, we observe a two-way tonal contrast: (i) rising (R) (e.g. /^Rjɛ/ ‘to lick’, /^Rjɛ/ ‘vegetable oil’, /^Rlɐ/ ‘suspension bridge’, /^Rwɐ/ ‘cow’), and (ii) high (H) (e.g. /^Hjɛ/ ‘tobacco’, /^Hjɛ/ ‘to buy’, /^Hlɐ/ ‘tiger’, /^Hwɐ/ ‘tooth’). The pitch contours of the two tones differ slightly from the corresponding tones in Lower Xumi, as in Figure 3. Similar to Lower Xumi, non-contrastive variation abounds in the actual realization of the two lexical tones in Upper Xumi. In particular, the high tone may be realized as a falling tone. For example, the word /^Hjɜ/ ‘tent’ may be realized as [jɜ⁴⁵⁵] or as [jɜ⁴⁵¹].

In polysyllabic monomorphemic words, we observe a three-way contrast of tonal melodies. Here, again, we adopt the prosodic system developed for Lizu (Chirkova & Chen 2013a) but it is important to note that just like Lower Xumi, Upper Xumi does not show a consistent correlation between duration and melody as observed in Lizu. Rather, the three patterns are more consistently signaled via their melodic difference. These tonal melodies are:

- (i) Equally-Prominent Contour (EP). There is no salient rise or fall over any of the syllables. Rather, it seems to be high-level pitch contours throughout the two syllables. This pattern is mostly attested in monomorphemic words and in loanwords, e.g. /^{EP}mɛmi/ ‘soldier’ (WT *dmag mi*), /^{EP}tɕɛzɐ/ ‘airplane’ (WT *lchags bya*).
- (ii) Left-Prominent Contour (LP). The high f₀ peak is realized before the end of the first syllable, where the pitch starts to fall already and continues to fall in the second syllable, e.g. /^{LP}mɛɲɛ/ ‘fire tongs’, /^{LP}dzɜɕi/ ‘chopsticks’, /^{LP}bɛmi/ ‘axe’.
- (iii) Right-Prominent Contour (RP). The high f₀ peak is realized over the last syllable of the word, e.g. /^{RP}mɛɲi/ ‘mani pile’ (WT *ma ni*, pile of stones with the Mani Mantra of Avalokiteshvara), /^{RP}tɕɛzɐ/ ‘weeding hoe’ (WT *lcags gzar*), /^{RP}dzɜɕi/ ‘to stand’, /^{RP}bɛ-mi/ ‘sow’.

Tone patterns in compounds

If the tone of the leftmost monosyllabic root is high, the resulting compound has the left-prominent pattern, as illustrated with the following sequence:

/^Hsĩ/ ‘wood, tree’ + /^Hq^ho/ ‘bowl’ = /^{LP}sĩ-χo/ ‘wooden bowl’
 /^Hsĩ/ ‘wood, tree’ + /^Rk^hɰ/ ‘root’ = /^{LP}sĩ k^hɰ/ ‘root of a tree’
 /^Hsĩ/ ‘wood’ + /^{RP}dzɔ̃hɔ̃/ ‘house’ = /^{LP}sĩ dzɔ̃hɔ̃/ ‘wooden house’

Conversely, if the tone of the leftmost monosyllabic root is rising, the resulting tonal melody is right prominent, as the following illustrate:

/^Rʂɔ̃/ ‘iron’ + /^Hq^ho/ ‘bowl’ = /^{RP}ʂɔ̃-χo/ ‘iron bowl’
 /^Rɪɔ̃/ ‘horse’ + /^Rk^hwɜ/ ‘shed’ = /^{RP}ɪɔ̃ k^hwɜ/ ‘stable, horse shed’
 /^Rɪɔ̃/ ‘horse’ + /^{RP}m̥jɛtsũ/ ‘tail’ = /^{RP}ɪɔ̃ m̥jɛtsũ/ ‘horse tail’

Transcription of the recorded passage

Our principal language consultant was recorded at the Laboratoire de Phonétique et Phonologie (LPP) of the Centre National de la Recherche Scientifique (CNRS). The original recording (made with a Digidesign 003 Rack soundcard, Sound Studio 3.6 software for iMac, and an AKG C520L microphone) has been made available to the *JIPA* along with this

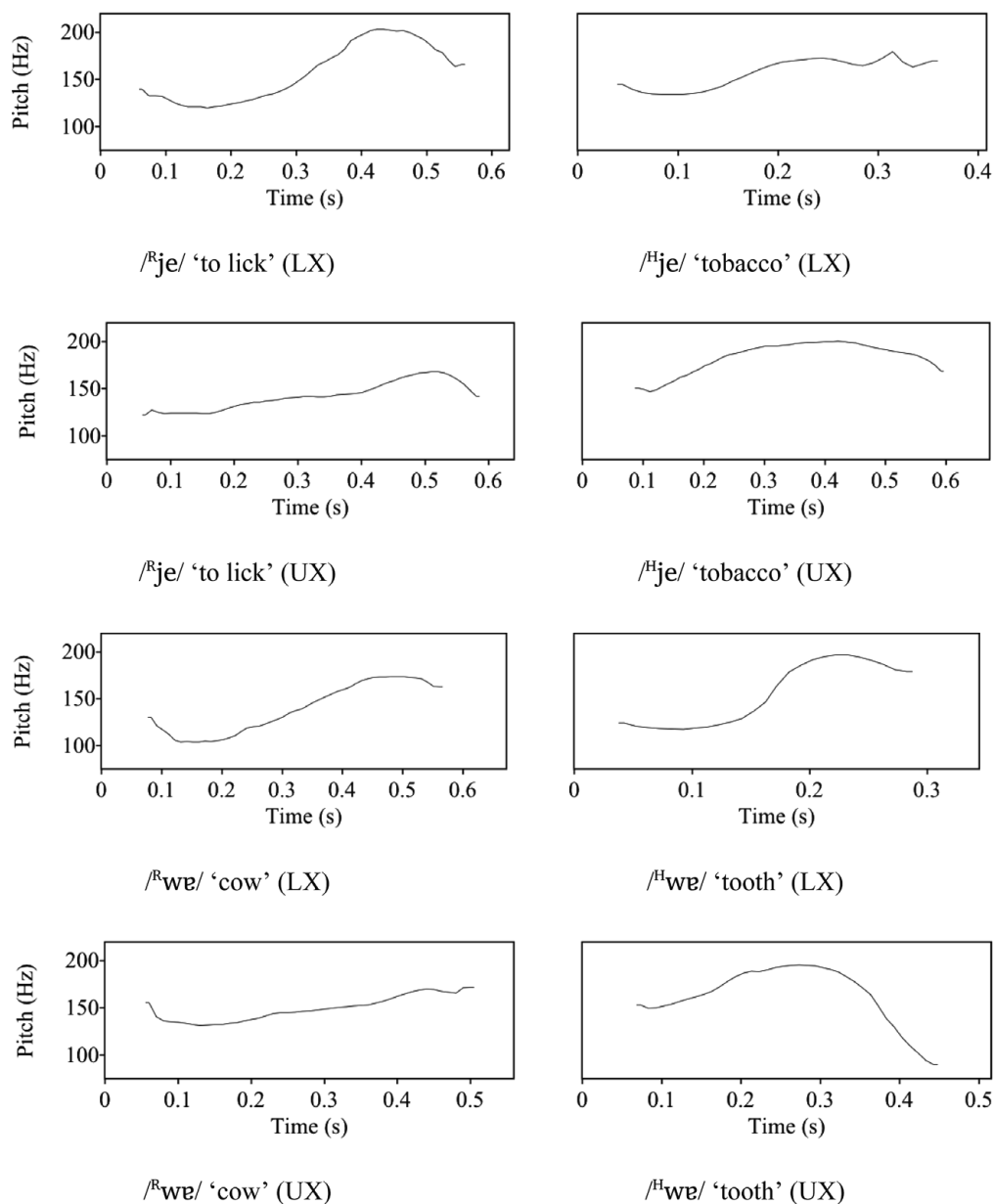


Figure 3 Pitch contours for the pairs /ʀje/ 'to lick' vs. /ʰje/ 'tobacco', and /ʀwɐ/ 'cow' vs. /ʰwɐ/ 'tooth' in Lower and Upper Xumi.

analysis. In the transcription, only lexical items are marked for tone, whereas function words are not. Xumi function words and discourse particles (e.g. the genitive particle /ji/, the topic marker /z_v/ in the appended text) are never pronounced in isolation. Their surface tone realization depends on the tone of the preceding (host) lexical word (similar to tone sandhi in compounds).

Semi-narrow phonetic transcription

North Wind and the Sun

^{RP}dzi-bu | ^{EP}dʒɜ-bu = ji ^Hlɔ̌ ni | ^{LP}nɜmi ^{RP}nɜ-ku | ^Hni χe | ^{EP}eɔ̌ λe = ji |
^{RP}tɕ^heɭe li nɔ̌ || ^{RP}tɕ^heɭe dʒɜ lɜ | ^{EP}.umi nɔ̌ ^{RP}ts^h-ɣ p^hɜlɔ̌ ^Hgu ^Hhĩ ^Hhĩ ^Rdʒĩ | ^Htɜ
^Hpɔ̌ ^Rtɕ^hũ li nɔ̌ || ^{RP}t^he-λe ^{LP}t^hi-dʒɣ ^{RP}nɜ-ku | ^{RP}le-k^hɔ̌dɛ se | ^Ht^hi ^Rbɜ λu | ^Hpɜ
li nɔ̌ || ^Hni = iẽ ^{EP}ɕeɜe nɔ̌ | ^Hhĩ ^{RP}t^hi = sɣ | ^{RP}ts^h-ɣ p^hɜlɔ̌ | ^Rfĩ = iẽ ^{RP}le-p^hɜ dɔ̌
xi zu | ^{RP}t^hi = zɣ | ^{EP}eɔ̌ nɔ̌ ^Hsu λu ^Hpɜ li nɔ̌ || ^{RP}t^he-λe | ^{EP}dʒɜ-bu = ji ^Hlɔ̌ =
iẽ | ^{EP}ɕɜ mu gi ^Rbɜ se | ^Hlɔ̌ ^Hɕũ ^Rxi li nɔ̌ || ^Hlɔ̌ ^{RP}sɜkɔ̌ ^{EP}duɜ nɔ̌ ni | ^Hhĩ ^{t^h}i ^Rdʒĩ
se | ^{EP}p^hɜlɔ̌ ^{RP}lisɣpu = kɔ̌ | ^{RP}sɜkɔ̌ ^{RP}le-lu-lu li nɔ̌ || ^{EP}dʒɜ-bu = ji ^Hlɔ̌ | ^Ht^ho
^{RP}mu = zɔ̌ se | ^Htɜ ^Htɕ^hu ^Rtɕi li nɔ̌ || ^{EP}dʒe-χe λe λe | ^{LP}nɜmi = iẽ | ^{RP}bɔ̌-tse li
se | ^{RP}mje-qĩ ^Hpu ^Rxɛ li nɔ̌ || ^Hhĩ ^{t^h}i | ^{EP}e-tsje ^Hpu li se | ^{EP}p^hɜlɔ̌ | ^{EP}dʒe-χɔ̌
^{RP}dzi-wu | ^{RP}le-p^hɜ ^Rtɕi li nɔ̌ || ^{RP}t^he-λe | ^{EP}dʒɜ-bu = ji ^Hlɔ̌ = iẽ | ^Hmɔ̌ nɔ̌ ^Hpɜ
lɜ | ^Hpɜ mɔ̌ hẽ | ^{LP}nɜmi ^Hχe ^{EP}eɔ̌ ^Rwẽ nɔ̌ | ^Hpɜ li nɔ̌ ||

Interlinear morphemic glossing

Abbreviations used in the gloss below follow the Leipzig Glossing Rules (LGR, <http://www.eva.mpg.de/lingua/resources/glossing-rules.php>). Non-standard abbreviations (those not included in the LGR) are: AGT = agentive, ANM = animate, ITSF = intensifying.

^{RP}dzi-bu | ^{EP}dʒɜ-bu = ji ^Hlɔ̌ ni | ^{LP}nɜmi ^{LP}nɜ-ku | ^Hni χe |
one-time water-head = GEN wind and sun two-item who only
^{EP}eɔ̌ λe = ji | ^{RP}tɕ^heɭe li nɔ̌ || ^{RP}tɕ^heɭe
ruthless become = GEN discuss NMLZ.PST COP discuss
dʒɜ lɜ | ^{EP}.umi nɔ̌ ^{RP}ts^h-ɣ p^hɜlɔ̌ ^Hgu ^Hhĩ
EXP come road on ship-skin coat clothes man
^Hhĩ ^Rdʒĩ | ^Htɜ ^Hpɔ̌ ^Rtɕ^hũ li nɔ̌ || ^{RP}t^he-λe | ^{LP}t^hi-dʒɣ
man one there arrive come NMLZ.PST COP that-become that-DU
nɜ-ku | ^{RP}le-k^hɔ̌dɛ se | ^Ht^hi ^Rbɜ λu | ^Hpɜ li
two-item PFV-talk.over then that do come.IMP speak NMLZ.PST
nɔ̌ || ^Hni = iẽ ^{EP}ɕeɜe nɔ̌ | ^Hhĩ ^{RP}t^hi = sɣ | ^{RP}ts^h-ɣ
COP who = AGT first inside man that = ANM.PNT goat-skin
p^hɜlɔ̌ | ^Rfĩ = iẽ ^{RP}le-p^hɜ dɔ̌ ^Rxi zu | ^{RP}t^hi = zɣ |
coat self = AGT PFV-take.off can CAUS if that = TOP
^{EP}eɔ̌ nɔ̌ ^Hsu λu | ^Hpɜ li nɔ̌ || ^{LP}t^he-λe |
ruthless inside count come.IMP speak NMLZ.PST COP that-become

^{EP}dʒɜ-ku = ji H₁ɔ = ɿẽ | ^{EP}ɕɜ mu gi R_bɜ se | H₁ɔ H_ɕũ
 water-head = GEN wind = AGT die NEG care do then wind blow
 R_xi li ɲɔ || H₁ɔ R^Psɛɜɔ ^{EP}duɜ nɔ ɲi |
 CAUS NMLZ.PST COP wind more big inside and
 H_hĩ t^hi | R^Pdʒɔ se | ^{EP}p^hɜlɔ | R^Pliɜɲpu = ɜɔ | R^Psɛɜɔ |
 man that cold then coat body = on more
 R^Plɛ-lu-lu li ɲɔ || ^{EP}dʒɜ-ku = ji H₁ɔ |
 PFV-wrap-wrap NMLZ.PST COP water-head = GEN wind
 H_t^ho L^Pmu = ɜɔ se | H_tɜ H_tɕ^hu R_tɕi li ɲɔ ||
 manner NEG = have then there abandon do NMLZ.PST COP
^{EP}dʒɛ-ɕɛ λɛ λɛ | L^Pɲɜmi = ɿẽ | R^Pbə-tɕɛ li
 one-instant become become sun = AGT outward-jump NMLZ.PST
 se | R^Pmjɛ-qɛ H_{pu} R_xɛ li ɲɔ || H_hĩ t^hi |
 then downward-roast carry go.PST NMLZ.PST COP man that
^{EP}ɛ-tɕjɛ H_{pu} li se | ^{EP}p^hɜlɔ ^{EP}dʒɛ-ɕɔ R^Pdʒi-wu |
 ITSF-hot carry NMLZ.PST then coat one-instant one-return
 R^Plɛ-p^hɕ R_tɕi li ɲɔ || R^Pt^he-λɛ | ^{EP}dʒɜ-ku = ji
 PFV-take.off do NMLZ.PST COP that-become water-head = GEN
 H₁ɔ = ɿẽ | H_mɔ ɲɔ H_pɜ lɜ | H_pɜ mɔ hɛ |
 wind = AGT NEG.COP COP speak come speak NEG.COP have
 L^Pɲɜmi H_ɕɛ ^{EP}e₁ɔ R_wɛ ɲɔ | H_pɜ li ɲɔ ||
 sun only ruthless COP.EMPH COP speak NMLZ.PST COP

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Appendix. C-V and CC-V combinations in Upper Xumi

C-V combinations

The table is based on a vocabulary list of *c.* 2,800 words. Marginal phonemes are restricted to two or less occurrences. Chinese loanwords and place names (such as Lanman) are in grey.

	i	e	ɛ	ɪ	ɜ	ʈ	u	o	ɔ	ɐ	ĩ	ẽ	ũ	õ	ẽ̃
∅	✓	✓		✓			✓	✓		✓		✓	✓	✓	
p	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
p ^h	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
b	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Nb		✓					✓		✓						
t	✓	✓	✓		✓		✓	✓		✓	✓	✓	✓	✓	✓
t ^h	✓	✓	✓				✓	✓		✓		✓		✓	
d		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Nd	✓						✓								
k	✓	✓	✓			✓	✓			✓		✓		✓	
k ^h	✓	✓			✓	✓	✓			✓				✓	✓
g	✓	✓	✓		✓		✓			✓	✓	✓		✓	
Ng							✓	✓		✓					
q					✓		✓	✓	✓			✓	✓	✓	
q ^h		✓			✓		✓	✓	✓				✓	✓	
ts	✓	✓	✓	✓	✓		✓	✓		✓		✓	✓	✓	✓
ts ^h	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓
dz		✓	✓	✓	✓		✓			✓		✓	✓	✓	
Ndz	✓	✓			✓				✓						
tʂ	✓			✓			✓			✓		✓		✓	
tʂ ^h	✓	✓		✓			✓			✓		✓		✓	
dz _v	✓			✓			✓	✓	✓	✓					
Ndz _v									✓						
tɕ	✓	✓	✓		✓		✓	✓		✓	✓	✓	✓		
tɕ ^h	✓	✓	✓		✓		✓	✓		✓	✓	✓	✓	✓	
dz	✓	✓	✓		✓		✓	✓		✓	✓	✓	✓	✓	
Ndz		✓													
ɱ			✓									✓			
m	✓	✓	✓		✓		✓	✓		✓	✓		✓	✓	✓
ɱ̃										✓				✓	✓
n							✓		✓	✓				✓	✓
ɲ	✓	✓	✓		✓		✓			✓				✓	
ŋ					✓		✓			✓				✓	
s	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
z	✓	✓		✓	✓		✓			✓	✓	✓	✓	✓	✓
ʂ				✓			✓			✓		✓	✓	✓	
z _v				✓	✓		✓							✓	
ɕ	✓		✓		✓		✓	✓		✓	✓	✓	✓		
z	✓	✓	✓		✓		✓			✓	✓				
x			✓			✓		✓	✓	✓					
ɣ					✓		✓	✓		✓					
ʁ			✓				✓	✓	✓	✓		✓	✓	✓	
h											✓	✓	✓	✓	✓

Appendix. Continued

	i	e	ɛ	ɪ	ɚ	ʌ	u	o	ɔ	ɐ	ĩ	ẽ	ũ	õ	ẽ̃
ɦ												✓		✓	
w	✓	✓			✓		✓	✓	✓	✓		✓			✓
ɹ	✓	✓			✓		✓			✓		✓	✓	✓	✓
ɹ̥	✓	✓	✓		✓		✓			✓	✓	✓	✓	✓	✓
ɹ̥̄	✓	✓			✓				✓	✓					
ɹ̥̄̄	✓	✓			✓		✓		✓	✓				✓	✓
ɹ̥̄̄̄			✓				✓			✓					
ɹ̥̄̄̄̄			✓												

CC-V combinations

	i	e	ɛ	ɚ	ɐ	ĩ	ẽ
tw	✓			✓			
t ^h w				✓			
dw	✓	✓		✓			
kw	✓	✓		✓			
k ^h w				✓			
gw	✓		✓	✓	✓		
qw				✓	✓		
q ^h w				✓	✓		
tsw	✓			✓			
t ^h sw	✓		✓	✓			
dzw				✓			
tʃw					✓		✓
tʃ ^h w				✓			✓
dzw					✓		
tɕw	✓	✓	✓	✓			
tɕ ^h w	✓			✓			
dzw	✓	✓	✓	✓			
ŋw							✓
sw	✓			✓			✓
zw				✓			
ɕw	✓		✓	✓		✓	✓
zw			✓	✓			
zw				✓			
xw	✓	✓					
hw						✓	
ɸw					✓		
ɹw				✓	✓		
ɹ̥w	✓	✓		✓			

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