Central Lisu

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Lisu (ISO 639-2 lis) is spoken by just over a million members of the group of this name in south-western China, north-eastern Burma, northern Thailand and north-eastern India. It formerly also had other names used by outsiders, including Yeren (Chinese *yeren* 'wild people'), and Yawyin in Burma and Yobin in India (both derived from the Chinese term). Other names included Lisaw from the Shan and Thai name for the group, also seen in the former Burmese name Lishaw. About two-thirds of the speakers live in China, especially in north-western Yunnan Province, but also scattered elsewhere in Yunnan and Sichuan. About a quarter live in the Kachin State and the northern Shan State in Burma, with a substantial number in Chiangmai, Chiangrai and other provinces of Thailand, and a few thousand in Arunachal Pradesh in India. It is also spoken as a second language by many speakers of Nusu, Anung, Rawang and others in north-western Yunnan and northern Burma. Lisu has almost completely replaced Anung in China and is replacing Lemei in China. The Lisu are one of the 55 national minorities recognised in China, one of 135 ethnic groups recognised in Burma, a scheduled (officially listed and recognised) tribe in India, and one of the recognised hill tribe groups of Thailand. Figure 1 shows a map of the area where Lisu is spoken.

Lisu has four main dialects: Northern, as described in Bradley (1994), and spoken in northwestern Yunnan in China, far northern Burma and India; Central, as described in Fraser (1922), Bradley (2016, 2017) and Yu (2007), and spoken in west central Yunnan in China and in north-eastern Burma; Southern, as described in Hope (1974) and Bradley et al. (2006), and spoken in Thailand and nearby in eastern Burma; and Eastern, as spoken in south-western Sichuan in China and nearby in Yunnan, and described in Yu (2007). The standard literary variety is based on the Central dialect, with some elements of the Northern dialect (Bradley 1997, Bradley & Bradley 1999). The data here is from the literary dialect as spoken by author

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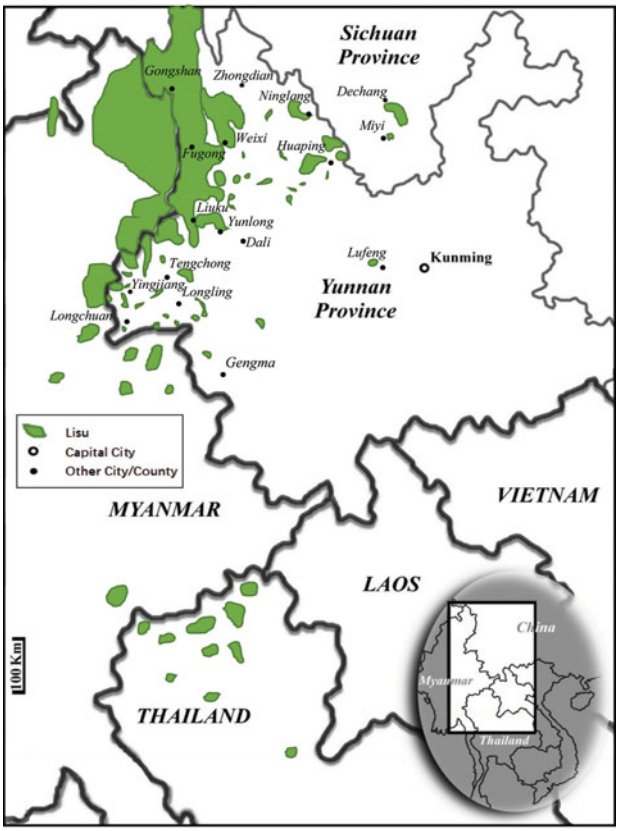

Figure 1 (Colour online) Map of Lisu language area.

DY, whose own dialect is a subdialect of Central Lisu. Many words, such as 'sun' and 'knee' in the data provided below, have alternative traditional and innovative forms used in literary Lisu.

Lisu has three main orthographies: one devised in 1914 by a group of Christian missionaries led by James O. Fraser (the author of Fraser 1922) and now universally used by all Lisu Christians in China, Burma, Thailand and India (i.e. over half of the total Lisu population); one devised in the 1920s in China by an indigenous Lisu leader, Huang Renbo, but no longer in use; and one devised between 1956 and 1958 based on the principles of Chinese *pinyin* ('phonetic writing') and used in China since then, especially by non-Christians (Bradley 1994, 1997, 2006). In 1983 the so-called Fraser script was made the standard for government use in the two Lisu autonomous areas in China, but the *pinyin* script also continues in limited use there. The Fraser script has a Unicode standard, and is used in this presentation. This is a Romanisation which uses 25 upper case letters upright and 15 inverted to represent segments, and uses punctuation to indicate tones (see Table 1). The use of punctuation to indicate tones is derived and expanded from the traditional Burmese writing system, as is the use of the hyphen for comma and an equals sign for full stop. In Lisu, the comma indicates a rising tone and the full stop indicates a high level tone; other punctuation is used for the other four contrasting tones. Note that there are no syllable-final consonants in the native Lisu vocabulary, although /n/ and /ŋ/ occur syllable-finally in a few loanwords.

The speaker in this Illustration is the author DY, a female born in Shibacha village in Yingjiang county of Yunnan in 1964. She spoke Central Lisu and Yunnan Mandarin with her

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Table 1 Fraser orthography for Lisu. Note that the vowel /ɑ/ is 'inherent' in any consonant, e.g. **ʙ** is /bɑ/, **ᴢ** is /dzɑ/, etc. Note also that there are two graphemes for /h/ – one for the relatively common /h/ which may be pronounced [ɦ], and which induces nasalization on the following vowel; and one for the marginal /h/, which is written in one imperative particle and which may be pronounced as [h] or as [x].

Alphabetical order

ʙ ᴘ ᵭ ᴅ ᴛ ⊥ ɢ ᴋ ʞ ᴊ ᴄ ↄ ᴢ ꜰ ꟻ ᴍ ɴ ʟ ꜱ ʀ ʁ ʌ ᴠ ʜ ɢ ᴶ ᴡ ᴊ ʏ ᴀ ∀ ᴇ ∃ ɪ ᴏ ᴜ ᑎ ᒣ ᗺ ., ..., : ;

Consonants

	Bilabial	Alveolar	Retroflex	Alveo-palatal	Velar	Glottal
Voiceless unaspirated plosive	p **ᴘ**	t **ᴛ**			k **ᴋ**	ʔ **ᴀ**
Voiceless aspirated plosive	pʰ **ᵭ**	tʰ **⊥**			kʰ **ʞ**	
Voiced plosive	b **ʙ**	d **ᴅ**			g **ɢ**	
Voiceless unaspirated affricate		ts **ꜰ**	tʂ **ᴄ**	tɕ **ᴄʏ**		
Voiceless aspirated affricate		tsʰ **ꟻ**	tʂʰ **ↄ**	tɕʰ **ↄʏ**		
Voiced affricate		dz **ᴢ**	dʐ **ᴊ**	dʑ **ᴊʏ**		
Voiceless fricative	f **ꟻ**	s **ꜱ**	ʂ **ˣ**	ɕ **ˣʏ**	x **ʜ**	
Voiced fricative		z **ʁ**	ʐ **ʀ**		ɣ **ʁ**	
Nasal	m **ᴍ**	n **ɴ**		ɲ **ɴʏ**	ŋ **ʌ**	
Approximant	w **ᴡ**			j **ʏ**		h **ɢ** h (ṽ) **ᴠ**
Lateral		l **ʟ**				

Vowels

	Front		Back	
	Unrounded	Rounded	Unrounded	Rounded
High	i **ɪ**	y **ᑎ**	ɯ **ᒣ**	u **ᑌ**
Mid	e **∃**	ø **∃**	ɤ **ᗡ**	o **ᴏ**
Low/lower mid	ɛ **∀**		ɑ (Ø)	

Tones

.	,	..	.,	:	;
55	35	44	33	21	21ʔ

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parents, and was schooled in standard Mandarin.[1] She completed a Ph.D. on the Lisu language at La Trobe University, under the supervision of author DB (Yu 2007), and is currently an associate professor of Lisu language at Yunnan Minzu University. The recordings for this Illustration took place in March 2014 using a Zoom H4 solid state recorder.[2] Some follow-up recordings of examples were made in July 2016.

Consonants

	Bilabial	Labio-dental	Alveolar	Retroflex	(Alveo-) palatal	Velar	Glottal
Plosive	p pʰ b		t tʰ d			k kʰ g	ʔ
Affricate			ts tsʰ dz	tʂ tʂʰ dʐ	tɕ tɕʰ dʑ		
Nasal	m		n		ɲ	ŋ	
Fricative		[f]	s z	ʂ ʐ	ɕ	x ɣ	
Approximant					j	w	h
Lateral			l				

As can be seen in the table above, Central Lisu has three places of articulation in the plosives (bilabial, alveolar and velar), with a three-way voicing contrast at each place (voiceless unaspirated, voiceless aspirated, and voiced). In most cases, we give examples in both initial and in medial position. Note that all transcriptions are phonemic, unless explicitly noted otherwise.

[1] The speaker in this Illustration uses both standard Central Lisu (as represented here) in work, public, religious and other domains, as well as her own local subdialect in the family domain with older relatives. The local subdialect and the standard dialect are in the process of converging; the local subdialect is being replaced by the standard dialect among younger people. Differences between the standard dialect, as represented here, and the local subdialect are primarily lexical and morpho-syntactic. This is discussed in detail in Yu (2007).

There is no effect of local south-western Mandarin on the standard dialect of Lisu. In the village and with other Lisu people, Lisu is spoken; with outsiders, either south-western Mandarin or standard Mandarin is spoken, depending on the formality of the situation, the variety of Mandarin spoken by the Han Chinese or other interlocutors, and whether the Lisu person has enough formal education to use standard Mandarin. Mandarin is not normally spoken in the village, except when Han Chinese outsiders are present.

[2] The words were elicited with a modified Swadesh list augmented by extra examples for the tones. As a result, the number of tokens for each consonant, vowel and tone are not balanced across the dataset.

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	IPA	Orthography	English
p	pɑ^{44} dzạ^{21}	P.. J:	to hear
	ts^{h}o^{33} pɑ^{55} zɑ^{21}	ƎO., P. Я:	husband/man
p^{h}	p^{h}ɑ^{33} t^{h}i^{55}	Ԁ., ⊥I.	near
	lɛ^{21ʔ} p^{h}ɛ^{35}	LA; ԀA,	hand
b	bɑ^{21}	B:	thin
	ʔɑ^{21} bɑ^{21}	A: B:	father
t	tø^{35}	TƎ,	straight
	tɯ^{35} leo^{44}	Tㄱ, LEO	to freeze
	ji^{21ʔ} tɑ^{55}	YI; T.	to lie down
t^{h}	t^{h}ɑ^{33}	⊥.,	here
	ʔɑ^{55} t^{h}ɛ^{21}	A. ⊥A:	when
d	do^{33}	DO.,	to drink
	dɯ^{21}	Dㄱ:	to hit
	bɯ^{21} di^{33}	Bㄱ: DI.,	worm
k	kɑ^{55}	K.	to stab
	tɕ^{h}i^{44} nɑ^{44} kɑ^{44}	ƆI.. N.. K..	knee
k^{h}	k^{h}ɑ^{21ʔ} be^{21}	Ж; BE:	mouth
	nɑ^{44} k^{h}u^{44}	N.. ЖU..	nose
g	gɑ^{21ʔ}	G;	to hunt (game)
	dzạ^{33} gu^{44}	J., GU..	road

Table 2 shows mean Voice Onset Time (VOT) values for the voiceless plosive bursts. It can be seen that VOT ranges between about 10 ms and 25 ms for the voiceless un-aspirated plosives, depending on place. By contrast, for the voiceless aspirated plosives, VOT ranges between about 55 ms and 90 ms, depending on place.

Table 2 Voice Onset Time (in milliseconds) for Lisu voiceless plosives based on 214 tokens. Note that tokens without a visible stop burst on the spectrogram are not included in this count – this mainly concerns velar plosives which were realized as fricatives.

	p	t	k	p^{h}	t^{h}	k^{h}
Number	22	36	42	47	31	36
Mean	11	20	24	54	69	88
S.D.	5.4	8.9	9.3	26.4	19.5	29.1

An examination of voicing probability values sampled at 35 ms prior to the offset of the plosive confirmed that the probability of voicing was much higher at this time-point for voiced plosives than for voiceless plosives, with mean values tending around 90% for the voiced plosives (range: 88–92%) and around 20–30% for the voiceless plosives (range: 11–44%).[3]

There are also four nasal consonants, three of which correspond to the plosive places of articulation (bilabial, alveolar, velar), with the other nasal consonant being palatal.

[3] Voicing probability was tracked using the ESPS pitch tool in EMU – these values exclude tokens which are preceded by a glottal stop, but include both initial and medial tokens. Note that medial tokens are more likely to show voicing than initial tokens.

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m	mɑ^{21} ŋɑ^{33}	M: Λ.,	not
	ʔɑ^{44} mɑ^{44}	A.. M..	mother
n	nɛ^{44}	NƎ..	dirty-black
	nɑ^{55} po^{44}	N. PO..	ear
	ʔɑ^{55} nɑ^{21}	A. N:	dog
ɲ	ɲi^{44}	NYI..	day (not night)
	ɲɑ^{35}	NY,	bird
	bɛ^{44} ɲɑ^{33}	BƎ.. NY.,	if
ŋ	ŋɑ^{33}	Λ.,	yes
	ʔɑ^{44} li^{44} ŋɑ^{33}	A.. LI.. Λ.,	how

Lisu is particularly rich in fricative and affricate places of articulation. There are four phonemic voiceless fricatives /s ʂ ɕ x/, respectively alveolar, retroflex, alveo-palatal and velar, plus [f] which can be treated as an allophone of the glottal stop before /u/. There are also two phonemic voiced fricatives: retroflex /ʐ̩/ and velar /ɣ/. However, retroflex /ʐ̩/ is often produced without friction, rendering it much more similar to the rhotic [ɻ̩], as can be heard in the example word /ʐ̩o^{21}/ 'we (inclusive)' – the first two repetitions here have some friction, whereas the last repetition does not (on another recording we have of the speaker saying the same word, the first repetition has friction, and the second and third don't). We class the sound as a fricative phonologically in Lisu because languages in the Ngwi sub-group of Tibeto-Burman (to which Lisu belongs) do not have a rhotic phoneme: cognate words instead have a clear fricative phoneme. (Note that in the Lisu orthography, the grapheme for this sound is like the Latin capital 'R'.) Note also that the voiced velar fricative /ɣ/ can likewise be very lenited, as in the example word /ɣɯ^{21}/ 'far' below.

[f]	ji^{55} fu^{44}	YI. ᒥU..	egg
s	sɑ^{44}	S..	three
	ji^{33} dʑɑ^{44} sɑ^{55}	YI., JY.. S.	to swim
ʂ	ʂʐ̩^{33}	XՈ.,	die
	ji^{55} ʂʐ̩^{44} ʂʐ̩^{44}	YI. XՈ.. XՈ..	yellow
ɕ	ɕɑ^{35}	XY,	make
	ɕø^{21}	XƎ:	to walk
	lɛ^{21ʔ} ɕø^{21}	LƎ; XƎ:	fingernail
x	lo^{21} xɯ^{21}	LO.. Hᒣ:	sand
z	zɑ^{21} nø^{44}	Я: NƎ..	child
	ts^{h}o^{33} pɑ^{55} zɑ^{21}	ᎭO., P. Я:	husband-man[4]
ʐ̩	ʐ̩o^{21}	RO:	we (inclusive)
ɣ	ɣɯ^{21}	ᒣ:	far

Figure 2 gives spectra for the six voiceless fricatives of Lisu. It can be seen that /s/ has more spectral energy above 6 kHz than any other fricative, as is typical for this sibilant sound. The grave fricatives [f] and /x/ have the least energy of all the fricatives, though in this dataset [f] has more energy than /x/ in the frequency range above 6 kHz. The retroflex and the alveo-palatal have the most energy of all the fricatives in the 2–5 kHz range, with the retroflex having more energy than the alveo-palatal in this range. The retroflex also seems to have more energy in the frequency range above 8 kHz than does the alveo-palatal. Note that it is not clear whether the retroflex of Central Lisu is typically produced with an apical or a sub-apical articulation, or at the post-alveolar or pre-palatal place of articulation (this also applies to the affricates below). We leave this question open for further instrumental investigation.

[4] A reviewer notes that the /z/ is particularly weak in some repetitions of this word (note that the same word was used to illustrate /p/ above).

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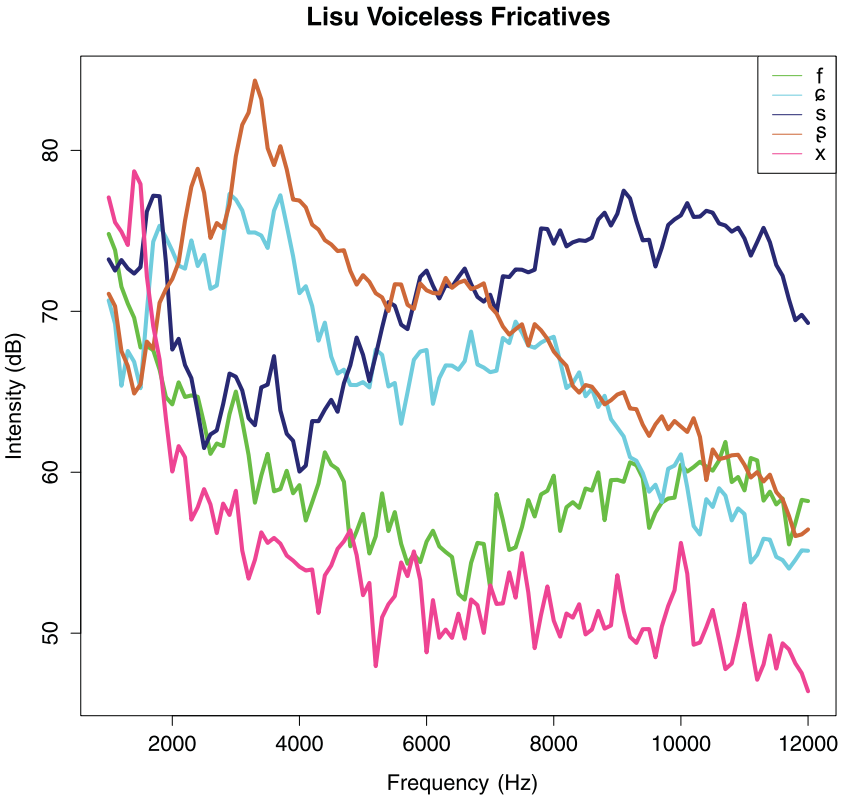

Figure 2 (Colour online) Plot of averaged Fast Fourier Transformed spectra for the five voiceless fricatives of Lisu as produced by speaker DY. Data are sampled at the temporal midpoint of the fricative using a 10 ms Hamming window. Only the spectral range between 1 kHz and 12 kHz is shown. The plot is based on 183 tokens: 16 /f/, 21 /ɕ/, 53 /ʂ/, 63 /s/ and 15 /x/. Note that all [f] are necessarily followed by /u/. Note also that in the dataset presented here, all /x/ tokens are followed by either /ɯ/ or the approximant /w/; /ɕ/ is only followed by /ø/; and /ʂ/ is followed by the fricative vowel. /s/ is followed by a variety of vowel contexts in this dataset, including the fricative vowel.

Lisu also has nine phonemic affricates – the alveolar, retroflex and alveo-palatal affricates can all be voiceless unaspirated, voiceless aspirated, or voiced. Example words are given below. Note that the alveo-palatal affricates occur only before front vowels (rounded or unrounded), and before the vowel /ɑ/, in which case the vowel is produced more forward in the vowel space, towards [a]. A little more information on vowel contexts for the fricatives and affricates is provided further below.

ts	$tɕ^hi^{44}$ $tsz̩^{55}$	ꓒꓲ.. ꓫꓲ.	knee (joint of leg)
ts^h	$ts^hɑ^{21}$ bo^{44}	ꓫ: ꓑꓳ..	salt
	$mɯ^{21}$ $ts^hɑ^{33}$	ꓜꓶ: ꓫ.,	sun
dz	$dzɑ^{21}$	ꓩ:	to eat
	$sɯ^{35}$ $dzz̩^{33}$	ꓢꓶ, ꓒꓲ.,	tree
$tʂ$	ji^{55} $tʂɑ^{44}$	ꓨꓲ. ꓒ..	rope
$tʂ^h$	$tʂ^hz̩ˤ^{21ʔ}$	ꓒꓵ;	to suck
	$sz̩^{21}$ $tʂ^hz̩ˤ^{44}$	ꓢꓲ: ꓒꓵ..	tooth (front)

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dz̻	dz̻a^{21} ŋo^{21}	J: ʌO:	stick (of wood)
	dy^{21} dz̻a^{21}	DՈ: J:	to think
tɕ	tɕa^{55}	CY.	cook
	sɯ^{35} tɕø^{44}	Sꟻ, CƎ..	root
tɕ^{h}	tɕ^{h}a^{33}	ƆY.,	make a mistake
	tɕ^{h}e^{35}	ƆE,	scratch (itch)
	tɕ^{h}i^{44} p^{h}ɛ^{35}	ƆI.. ԀA,	foot-leg
	he^{21ʔ} tɕ^{h}i^{21}	VE; ƆI:	belly
dʑ	dʑa^{44}	JY..	cold
	ji^{3} dʑa^{44}	YI., JY..	water
	dʑø^{21} za^{21}	JƎ: ꓤ:	animal

Note that the voiced alveo-palatal often sounds like a sequence /dj/, as can perhaps be heard in the word for 'water' /ji^{3} dʑa^{44}/ above or 'cold' /dʑa^{44}/.

Figure 3 gives spectra for the three voiceless aspirated affricates of Lisu (the voicing category for which we had the largest number of tokens). The similarities with the fricative phonemes are clear – alveolar /ts^{h}/ has more spectral energy above 8 kHz than the other affricates, while the retroflex /tʂ^{h}/ and the alveo-palatal /tɕ^{h}/ have more energy in the 2–6 kHz range, with the retroflex having more energy than the alveo-palatal in the 2–5 kHz range (although the alveo-palatal seems to have more energy than the retroflex in the 5–8 kHz range, something that we did not observe in the fricative spectra).[5]

Table 3 shows mean Voice Onset Time values for the voiceless affricates. It can be seen that VOT ranges between about 40 ms and 75 ms for the voiceless un-aspirated affricates, depending on place. For the voiceless aspirated affricates, VOT ranges between about 110 ms and 135 ms, depending on place. In both cases, the alveo-palatal has the lowest VOT values, and the retroflex has slightly higher VOT values than the alveolar.

In terms of vowel context distributions, the alveolar fricatives and affricates /s z ts^{h} ts dz/ can occur in all vowel contexts except /y/ and /ɤ/. They can also occur before the fricative vowel [z̻], which the orthography treats as an allophone of the vowel /i/ following precisely these sounds. The alveo-palatal fricative and affricates /ɕ tɕ tɕ^{h} dʑ/ occur before front vowels /i e ø/ and occasionally before /ɛ/. The alveo-palatal fricative and affricates also occur before /ɑ/, in which case, as already mentioned, the vowel is realized as [a]. The retroflex fricatives and affricates /ʂ z̻ tʂ tʂ^{h} dz̻/ occur before the back vowels /u o ɑ ɤ/. They also occur before the sequence /wɑ/, and before the fricative vowel [ʐ̻], which the orthography treats as an allophone of the high front rounded vowel /y/. However, although it is possible to analyse [z̻] as an allophone of /i/ following alveolar fricatives and affricates, and [ʐ̻] as an allophone of /y/ following retroflex fricatives and affricates (based on the orthography, and also given that these particular vowel contexts do not occur for these respective sounds), linguistic tradition for this language instead treats the fricative vowels as allophones of a phoneme /ɨ/ (the vowels are treated further below). Finally, it should be noted that the velar fricative /x/ occurs before /ɑ o ɯ w/ in native words, although other vowel contexts are possible in Chinese loan words.

[5] Our dataset is not well balanced for vowel context, and so it was not possible for us to explore formant trajectories for the fricative and affricate consonants in any meaningful way. However, both examination of the raw spectra, and also preliminary examination of formant trajectories and of spectral moments, suggest that the retroflex vs. alveo-palatal contrast in Lisu is quite different to the nominally same contrast that exists in Polish, which is represented using the same IPA symbols (see Bukmaier & Harrington 2016 for some recent work on Polish fricatives). This is in line with our own auditory impressions, as well as those of Maya Bradley, a native speaker of Polish with experience of Lisu.

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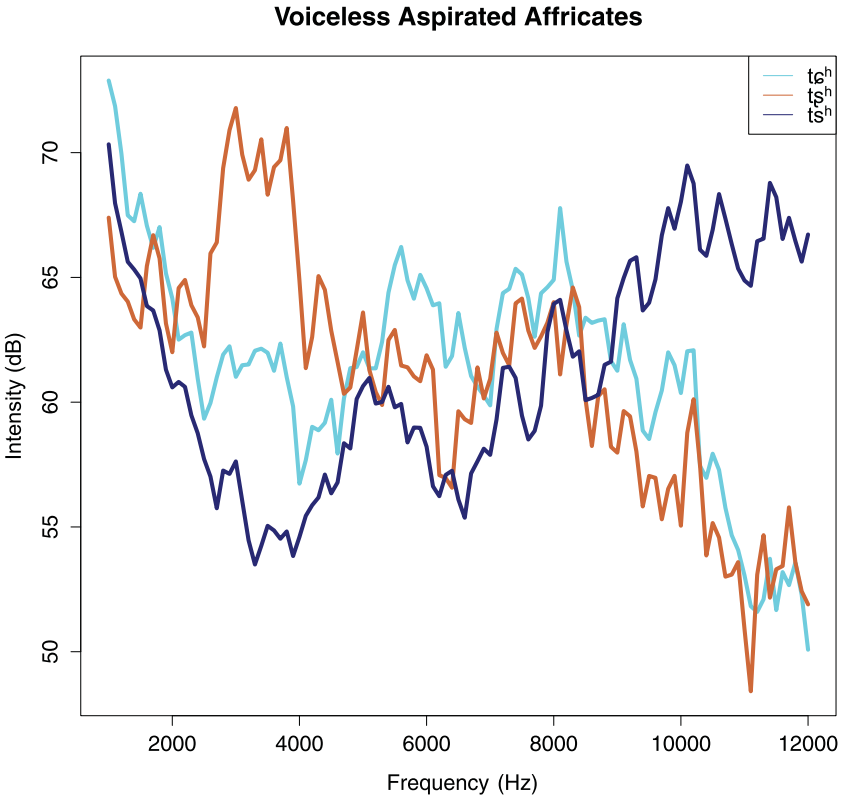

Figure 3 (Colour online) Plot of averaged Fast Fourier Transformed spectra for the three voiceless aspirated affricates of Lisu as produced by speaker DY. Data are sampled at the onset of the burst following the closure, using a 10 ms Hamming window. Only the spectral range between 1 kHz and 12 kHz is shown. The plot is based on 109 tokens: 48 /tsʰ/, 18 /tʂʰ/ and 43 /tɕʰ/. Note that the alveo-palatal is only followed by front vowels, the retroflex is only followed by its fricative vowel in this dataset, and the alveolar is followed by a variety of vowel contexts, including its fricative vowel.

Table 3 Voice Onset Time (in milliseconds) for Lisu voiceless affricates based on 133 tokens.

	ts	tʂ	tɕ	tsʰ	tʂʰ	tɕʰ
Number	3	9	12	48	18	43
Mean	54	74	38	129	135	107
S.D.	6.7	25.6	7.1	45.9	39.8	28.7

Note that we have posited two series for the fricatives and affricates, alveo-palatal and retroflex, in addition to the alveolars. However, it is possible to suggest that the alveo-palatals and retroflexes are in complementary distribution. The alveo-palatals occur before front vowels, and the retroflexes occur before back vowels. However, in this case, we would need to posit an extra vowel phoneme /a/, which occurs only after alveo-palatals, with a separate vowel /ɑ/ occurring after all other consonants, including retroflexes. We choose to adopt the analysis where alveo-palatals and retroflexes are not in complementary distribution, and therefore we only have one low vowel phoneme, with an allophone [a] following alveo-palatals.

In addition to the above-mentioned consonants, Lisu has a palatal approximant, a labio-velar approximant, a lateral (alveolar), a glottal approximant, and a glottal stop. The palatal

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approximant is often realized as the alveo-palatal [ʑ], as in the word /ji^{33}/ 'to flow' below. This is the reason why we have put the sounds traditionally labelled 'palatal' (namely /j/ and /ɲ/) in the same column as the sounds traditionally labelled 'alveo-palatal' (namely the alveo-palatal fricative and affricates). Note however that while the alveo-palatal fricative and affricates occur only before front vowels and /ɑ/, the palatal nasal may additionally occur before /o/, but does not occur before /y/. The palatal approximant has the same distribution as the palatal nasal, with the addition of /u/ as a possible context. Further articulatory study may elucidate more precisely the exact place-of-articulation of these various consonant sounds. Note that there is no phonemic alveo-palatal /ʑ/ in this dialect, representing a gap in the system of fricatives as seen in the table above. In some other dialects there is a phonemic contrast between /j/ and /ʑ/ before /i/, but not in this dialect. Note also the [a] variant of /ɑ/ following /j/.

j	jɑ^{21ʔ}	Y;	weave
	ji^{33}	YI.,	to flow
	ji^{55} ʂʐ̩^{21}	YI. XՈ:	liver
	lɛ^{21ʔ} jɑ^{44}	LƎ; Y..	right (hand)
w	wɑ^{21}	W:	snow
	ji^{55} wɑ^{21}	YI. W:	they
	wu^{21}	WU:	big
	wu^{55} dø^{44}	WU. DƎ..	heard
l	lɑ^{33}	L.,	to come
	du^{33} lɛ^{21ʔ}	DU., LƎ;	wing

The glottal approximant /h/ causes the following vowel to be nasalized, as in the following examples. The glottal consonant itself may be rather breathy, and is perhaps more accurately transcribed as [ɦ]. The tendency for syllables with glottal consonants to be nasalized has been termed rhinoglottophilia (Matisoff 1975), and the question of exactly how nasalization and glottal properties such as breathiness interact and spread across the syllable requires further instrumental examination. Note that a non-nasalized [h] has a marginal phonemic status in Lisu, occurring only in one of the imperative markers (not given here).

h	hɑ^{33} bɑ^{44}	V., B..	moon
	mɯ^{21} hɑ^{33} hɑ^{33}	MT: V., V.,	to rain

The glottal stop /ʔ/ serves as the syllable onset where no other consonant is available. When followed by any vowel other than /ɑ/, the glottal stop causes the following vowel to be nasalized, in the same way as the glottal approximant /h/ causes its following vowel to be nasalized (see example word /ʔo^{44}/ 'to swell' below). Note however that in the context of a following /u/ vowel, the default consonant is [f] rather than /ʔ/, and there is no nasalization of the /u/ vowel (see below for the fricatives).

ʔ	ʔɑ^{21} dzʐ̩^{21}	A: JՈ:	all
	ʔo^{44}	O'..	to swell[6]

The palatal and labio-velar approximants can be used to form clusters with the plosive and nasal consonants at the onset of a syllable. The palatal approximant forms clusters with bilabials and alveolars (plosives, nasals and lateral), and the labio-velar approximant forms clusters with velars and with alveolar affricates. Some examples are given below.

[6] Note that there is a hesitation 'oh' before the second repetition of this word.

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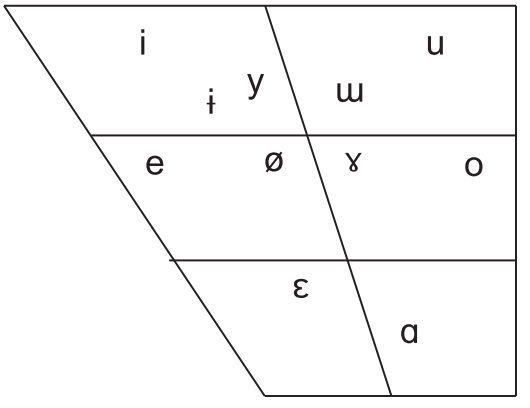
Clusters			
pj	pjɑ^{44}	PY..	flat
p^{h}j	p^{h}jɑ^{21}	ԀY:	leaf
bj	bjɑ^{21}	BY..	bad
mj	mjɑ^{21}	MY:	many
tj	tjɑ^{35}	TY,	(to) live[7]
kw	kwɑ^{44}	KW..	at
	k^{h}u^{21} kwɑ^{44}	ЖU: KW..	in
k^{h}w	k^{h}wɑ^{21}	ЖW:	bitter
gw	gwɑ^{33}	GW.,	there
	mu^{21} gwɑ^{21} gwɑ^{44}	MU: GW: GW..	to sing
ŋw	ŋwɑ^{33}	ΛW.,	I

Vowels



Central Lisu has 11 phonemic vowels: three front unrounded vowels, two front rounded vowels, two back rounded vowels, three back unrounded vowels, and two 'fricative vowels' [z̩] and [z̩̈], which may be collapsed into the single phoneme /ɨ/ as has been done for the above chart. This chart is based on the acoustic measurement of vowel formants for this speaker, which are presented further below.

The example words given here for vowels are mostly monosyllables beginning with /b/, but where such a word did not exist in our recordings for a particular vowel, we chose another consonant context, and then tried to give a similar word for another vowel in order to facilitate comparison.

[7] Note that in this recording, the second repetition has the perfective /o^{44}/ added to the verb. This results in tone sandhi in which /33/ + /44/ becomes /35/. The third repetition has a shortened form which has the /35/ tone showing the same sandhi but without the vowel of the perfective. All three are tokens of the same verb, but with different forms. These would be written TY., TY.,O.. TY,. These are not mistakes, just alternative forms of the same verb without or with different post-verbal markers.

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i	bi^{44}	BI..	full
e	be^{44}	BE..	and, with
ɛ	bɛ^{44}	BƐ..	say
ɑ	bɑ^{21}	B:	thin
	ʔɑ^{21} bɑ^{21}	A: B:	father
o	ts^{h}ɑ^{21} bo^{44}	ㄐ: BO..	salt
	ɻo^{21}	RO:	we
u	bu^{33}	BU.,	to float
y	ji^{35} ly^{21ʔ}	YI, LՈ;	smooth
ø	bø^{33}	BƎ.,	to fly
ɤ	sɤ^{55}	SƆ.	know
ɯ	ɣɯ^{21}	ㄱ:	far
	sɯ^{35} sɯ^{21}	Sㄱ, Sㄱ:	fruit
[ɻ̩]	tɕ^{h}i^{44} tsɻ̩^{55}	ƆI.. ㄐI.	knee (joint of leg)
[ʐ̩]	ji^{55} ni^{35} tʂ^{h}ʐ̩^{21ʔ}	YI. NI, ƆՈ;	green

The vowel /i/ is quite high in the vowel space, and /e/ is produced by this speaker with a noticeable palatal onglide. The vowel /ɛ/ is quite low, and could perhaps even be represented with the /æ/ symbol. The /ɑ/ vowel is a little further back than central, hence our choice of this symbol. /u/ is quite high and back, while the quality of /o/ varies between high-mid and slightly lower, as can be heard on these two example recordings. These are all frequently occurring vowels.

The front rounded vowel /y/ is fairly common, as is /ø/. The back unrounded vowel /ɯ/ is also very common, particularly following a velar fricative, as shown here. We also give this vowel following /s/ in order to provide a minimal pair with the much less common vowel /ɤ/.

Finally, we use the symbol [ɻ̩] to represent the weakly fricative high central vowel which follows the alveolar affricates and fricatives, and we use [ʐ̩] to represent the slightly stronger fricative high central vowel which follows the retroflex affricates and fricatives. Note, however, that Chinese linguistic tradition represents these sounds with the symbols [ɿ] for the fricative vowel which follows alveolar consonants, and [ʅ] for the fricative vowel which follows retroflex consonants (Handel 2016). The fricative vowels are represented in the orthography – the [ɻ̩] is written with 'I' and the [ʐ̩] is written with inverted 'U'. Thus, as already mentioned above, the orthography is suggesting that [ɻ̩]~[ɿ] is an allophone of /i/ and [ʐ̩]~[ʅ] is an allophone of /y/; however, some dialects have alveolar affricates /ts ts^{h} dz/ and fricatives /s z/ before [i] /i/, contrasting with [ɻ̩] /ɨ/ after these same initials.

As can be seen in Figure 4, it is quite possible to track the formants in these fricative vowels. As seen in Figure 4 (top panel), their common phoneme /ɨ/ is then located in the high central region of the vowel space, quite close to /y/. It is possible that the phoneme /ɨ/ is at least partly distinguished from the phoneme /y/ by the presence of the extra noise in the vowel spectrum that follows the various affricates and fricatives, though this is clearly a question for further empirical study. It should be noted that although we have collapsed the fricative vowels for plotting purposes in the top panel of Figure 4 given the analysis that they function as a single phoneme, the two fricative vowels in fact show quite different F2 values (Figure 4, bottom panel). [ʐ̩] (which occurs after retroflexes) has a mean F2 value of 2232 Hz (S.D. = 150 Hz, N = 83), patterning closer to /i/ than /y/; while [ɻ̩] (which occurs after alveolars) has a mean F2 value of 1676 Hz (S.D. = 237, N = 30), patterning closer to /ɯ/ (F1 and F3 values are very similar). There is therefore some evidence in the formant data for [ʐ̩] patterning with /i/, and [ɻ̩] patterning with /y/, in line with the orthography. If these two fricative vowels were part of the same phoneme /ɨ/, it is not clear why the retroflex would induce a higher F2 in the following vowel than would the alveolar.

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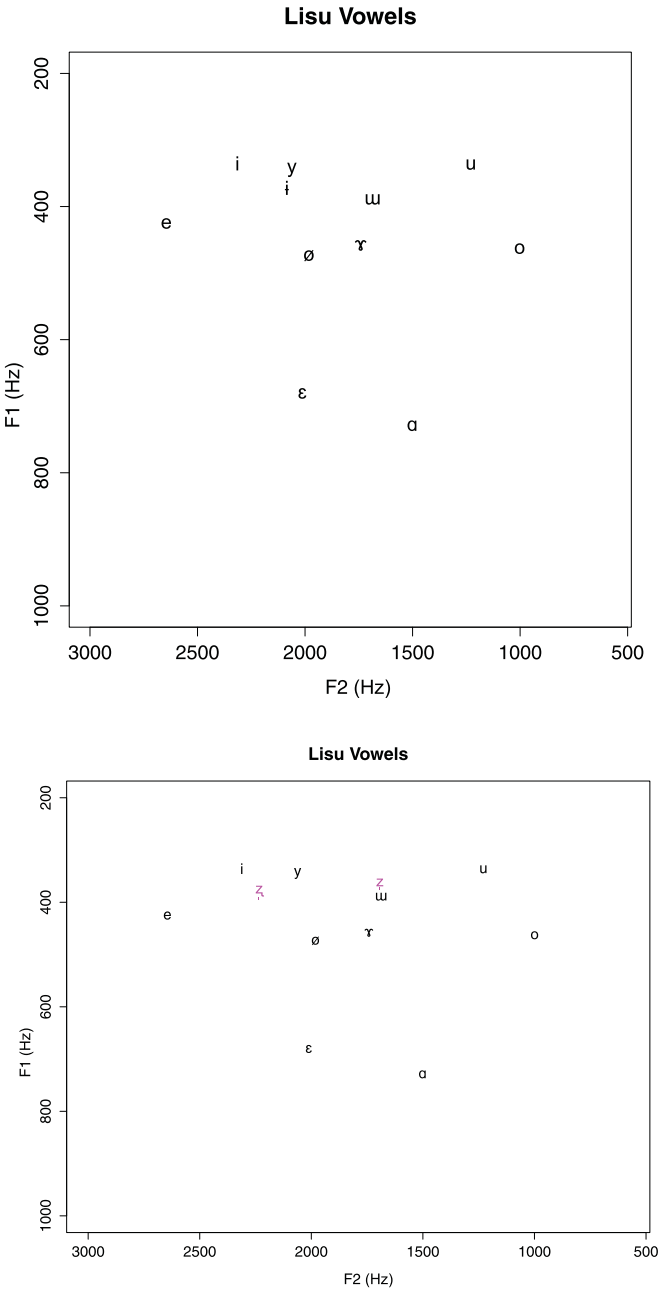

Figure 4 (Colour online) Plot of mean Lisu vowels formants for speaker DY based on 1428 tokens. Top panel: Vowel plot with the fricative vowels combined into a phoneme /ɨ/. Bottom panel: Vowel plot with the fricative vowels plotted separately. Individual vowel token numbers are as follows: /i/ 278, /e/ 70, /ɛ/ 89, /ɑ/ 418, /o/ 127, /u/ 104, /y/ 15, /ø/ 93, /ɤ/ 6, /ɯ/ 115, /ɨ/ 113 (83 [ʐ̩] and 30 [ʐ̩̞]). Note that /u/ and /o/ means exclude tokens where F2 was tracked as greater than 2000 Hz, and /ɑ/ means exclude tokens where F1 was tracked as less than 250 Hz. Note also that the /ɑ/ means do not include any preceding alveo-palatal consonants. Formants were tracked using the ESPS formant tracker in EMU (default settings, with the exception of frame rate set to 5 ms and window set to Hamming).

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Finally, the reader is referred to Bradley et al. (2006) for tables of co-occurrence restrictions between the various vowels and consonants. For instance, /y/ occurs primarily after bilabial and alveolar stops and nasals, and after the lateral /l/. By contrast, /ø/ occurs after all places of articulation, except the velar.

Tones

Lisu has six phonemic tones, as exemplified by the minimal set given below, based on the sequence /lo/. There is one high tone /55/; one rising tone /35/; two mid tones, /44/ and /33/; and two falling tones, /21/ and /21ʔ/. As can be seen, one of the falling tones is represented as being 'checked' by a glottal stop. However, in practice this is realized as some form of laryngealization on the affected syllable, whether this involves a point of complete glottal closure or not. Note the use of punctuation to represent the tones in the orthography.

lo^{55}	**LO.**	watch
lo^{35}	**LO,**	pass over top
lo^{44}	**LO..**	throw/(dog) bark
lo^{33}	**LO.,**	light (weight)
lo^{21}	**LO:**	gather
$lo^{21ʔ}$	**LO;**	enough

An averaged and time-normalized plot of f0 for these tones is presented in Figure 5. It can be seen that /55/ is indeed a high tone, at a little over 200 Hz in this speaker's range. The

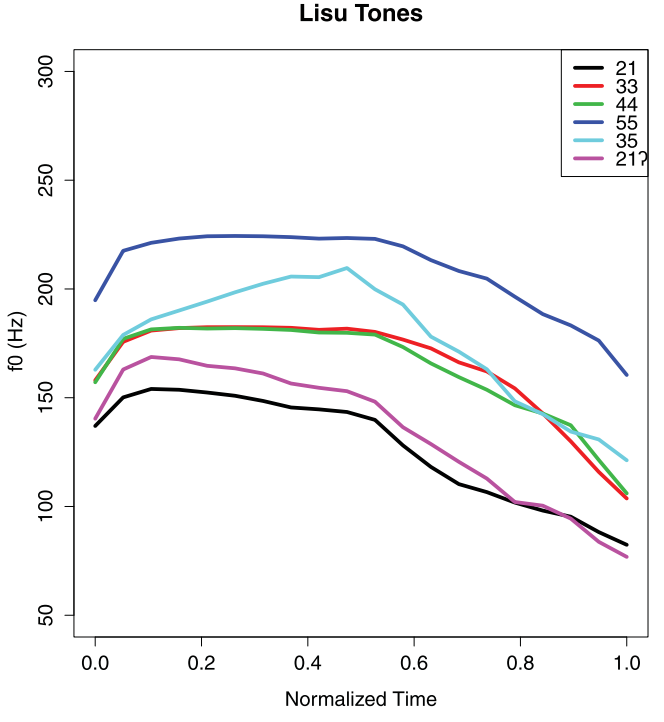

Figure 5 (Colour online) Plot of averaged and time-normalized Lisu f0 trajectories for the six tones of Lisu as produced by speaker DY. The plot is based on 1381 tokens, as sampled across the vowel portion of the tone. Individual tone token numbers are as follows: /21/ 308, /21ʔ/ 101, /33/ 242, /35/ 93, /44/ 399, /55/ 238. Note that tokens where f0 was less than 80 Hz at the midpoint of the vowel were excluded from this plot. f0 was tracked using the ESPS pitch and formant tool in EMU (default settings).

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/35/ tone rises until about the mid-point of the vowel before falling again – further acoustic study is needed in order to determine the precise timing of this tone peak.

The /44/ and /33/ tones are difficult to differentiate for non-native speakers, and indeed it can be seen on the plot that their f0 values largely overlap. Native speakers who are asked to describe the difference between these tones say the /44/ has a constriction in the throat, while the /33/ is more relaxed. The difference could be described as 'tense' vs. 'non-tense' – author DB often hears a slightly tight phonation for /44/, as compared to a very slightly breathy phonation for /33/. However, for this particular speaker, an examination of H1*-H2* (the difference between the first harmonic and the second harmonic, corrected for formant) and of CPP (Cepstral Peak Prominence, a measure of the harmonic energy relative to noise energy) suggested no differences between the /33/ and /44/ tones. Further study may elucidate any differences between these tones across the various dialects of Lisu.

Note that for some other dialects of Lisu (such as Southern Lisu – see Bradley et al. 2006), the /44/ is slightly higher in pitch, which is why it has been transcribed as /44/. In yet other dialects (such as Northern Lisu – see Bradley 1994), the contrast varies and is in the process of being lost, with both tones neutralised to /33/ with modal phonation. Historically these tones derive from different sources, the /44/ from syllables with a final stop, or from a tone category which has creaky phonation in some related languages such as Burmese; and the /33/ derives from syllables with another tone category, no final stop and no creaky phonation (see Bradley 1979).

Finally, the falling tones can be seen to end very low, falling from 150 Hz to below 100 Hz for this female speaker. It can be seen that the 'checked' tone /21ʔ/ has a slightly higher onset than the non-checked /21/. In the standard Chinese tradition (see Chao 1930) this checked tone is described as [42ʔ] – based on this plot, the tone might be described as [31ʔ]. It is possible that the non-checked /21/ tone is in general produced with a slightly more breathy phonation, for greater contrast with the checked tone /21ʔ/ (consider /lo^{21}/ above, and /ŋwɑ^{21}/ in the sentence below). Indeed, for this particular speaker, there were clear differences between the /21/ tone and the /21ʔ/ tone as measured by H2*-H1*. H2*-H1* values tended around 2–3 dB for /21ʔ/, and around 8–9 dB for /21/ (as sampled at the temporal midpoint of the vowel using the VoiceSauce software). By contrast, H2*-H1* values tended around 6–7 dB for both the /33/ tone and the /44/ tone. It could therefore be said that for this particular speaker, the /21ʔ/ tone is more creaky than the /33/ and /44/ mid tones, and the /21/ tone is more breathy than the two mid tones. In addition, CPP values for this speaker tended around 22–23 dB for the mid tones /33/ and /44/, and around 17–18 dB for the low tones /21/ and /21ʔ/, with the checked tone /21ʔ/ having slightly lower CPP values than the non-checked tone /21/. This provides confirmation that the mid tones have a more regular (i.e. modal) phonation than either of the low tones.

Table 4 Duration (in milliseconds) for Lisu tones based on 1514 tokens.

Tones	21	21ʔ	33	35	44	55
Mean (ms)	199	138	235	219	220	162
S.D.	86.6	49.3	89.5	98.4	82.6	77.8
Number of tokens	379	126	251	104	413	241

Table 4 gives the average duration values for the six tones of Lisu. It can be seen that the 'checked' tone /21ʔ/ is considerably shorter than the non-checked /21/ (about 140 ms vs. 200 ms in this speaker's data). The mid tones as well as the rising tone tend around 220–230 ms, while the high tone is much shorter, at around 160 ms.

Most of the tones of Lisu can also be illustrated using the following fun sentence based on the syllables /mɑ/ and /ŋwɑ/:

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ʌw.,	a.. m..	ʌw.	ʌw:	m.,	m:	ʌw.=
ŋwɑ^{33}	ʔɑ^{44} mɑ^{44}	ŋwɑ^{55}	ŋwɑ^{21}	mɑ^{33}	mɑ^{21}	ŋwɑ^{55}
I	mother	fish	five	CLF	NEG	borrow

'My mother doesn't borrow five fish.'

There is little productive tone sandhi, but there is some variation between the /21/ and /21ʔ/ tones in two-syllable words which have a sequence of two low falling tones. Thus, /21ʔ/ + /21/ can come out as [21] + [21], and /21/ + /21ʔ/ can come out as [21ʔ] + [21ʔ] with the first tone in the word assimilating to the second. There are also some dialectal differences in the lexical distribution of the /33/ and /44/ tones. One diachronic sandhi process, no longer absolutely productive, is that the nominal prefix /ʔɑ/ has a tone which mirrors (i.e. inverts) the following main syllable: /55/ before /21/ and /21ʔ/ tones; /21/ before /55/, /35/ and /33/; and /44/ before /44/. However, this pattern does not apply to adverbs, kin terms and loans.

Another sandhi pattern involves three very frequently-occurring clitics which are attached to verbs: declarative /ɑ^{44}/, perfective /o^{44}/ and interrogative /ɑ^{21ʔ}/, which consist of a single vowel with a tone (in some dialects the interrogative instead has the form /lɑ^{21}/). Unlike non-clitic syllables with an initial vowel, these never have an initial glottal stop, and are always tightly fused to the preceding verb syllable. In songs and poetry, these do not count as an additional syllable for the purpose of metre. An example was given in footnote 3 for the word 'to live' with the perfective /o^{44}/. For the clitic /ɑ^{44}/, there is a fairly frequent but not categorical process in which the /ɑ/ vowel of the clitic disappears and the tone of the verb and the tone of the clitic fuse. When the verb has the /33/, /35/, /55/ or /44/ tone, the resulting fused tone is /55/; when the verb has the /21/ or /21ʔ/ tones, the resulting fused tone is /35/. This fusion is particularly frequent in song and poetic style, but also occurs in normal speech.

Transcription of recorded passage

mi: mi.,	be..	lo.,	wu.	mi: vi.,
mi^{21} mi^{33}	be^{44}	lo^{33}	wu^{55}	mi^{21} hi^{33}
sun	and	river	head	wind

'The Sun and the North Wind'

⊥i:	nyi..	jo.,	⊥ʌ:-.	mi: mi.,	be..
t^{h}i^{21}	ɲi^{44}	dzo̤^{33}	t^{h}ɛ^{21},	mi^{21} mi^{33}	be^{44}
one	day	have	TIME	sun	and

lo.,	wu.	mi: vi.,	ny.,
lo^{33}	wu^{55}	mi^{21} hi^{33}	ɲɑ^{33}
river	head	wind	TOP

bʊ., ⊣i:	d: m..	f⅂.	be..	⊥ɜ,	t.	xʊ:
by^{33} ts^{h}z̩^{21}	dɑ^{21} mɑ^{44}	tsɤ^{55}	be^{44}	t^{h}ø^{35}	tɑ^{55}	ʂz̩^{21}
coat	big	tight	ADV	wrap	STAY	NMZR

do., do..	j., xɜ:	su..
do^{33} do^{44}	dzɑ^{33} ɕø^{21}	su^{44}
go.out	travel	NMZR

⊥i:	ro..	zi.,	l∀; ʞo.,	⊥∀:-.
t^{h}i^{21}	ɻo^{44}	dzz̩^{33}	lɛ^{21ʔ} k^{h}o^{33}	t^{h}ɛ^{21}
one	CLF	meet	RECIP	TIME

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YI. W:	NYI:	RO..	A: M.,	MY: NI.,
ji^{55} wɑ^{21}	ɲi^{21}	ɻo^{44}	ʔɑ^{21} mɑ^{33}	mjɑ^{21} ni^{33}
3PL	two	CLF	who	more

D.,	A:	BE..	BƐ..	LƐ; ꓘO.,	TY.	JO:=
dɑ^{33}	ɑ^{21}	be^{44}	bɛ^{44}	lɛ^{21ʔ} k^{h}o^{33}	tjɑ^{55}	dz̩o^{21}
capable	Q	ADV	say	RECIP	DUR	QUOT

'One day, the Sun and the North Wind met a traveller who came along wrapped in an overcoat. They discussed which one of them was stronger.'

YI. W:	NYI:	RO..	NY.,
ji^{55} wɑ^{21}	ɲi^{21}	ɻo^{44}	ɲɑ^{33}
3PL	two	CLF	TOP

A: M.,	DO., DO..	J., XƎ:	SU..	GW:	T.	M.,
ʔɑ^{21} mɑ^{33}	do^{33} do^{44}	dz̩ɑ^{33} ɕø^{21}	su^{44}	gwɑ^{21}	tɑ^{55}	mɑ^{33}
who	go.out	travel	NMZR	wear	STAY	NMZR

YI.	BՈ., ꓲI:	GW.,	LՈ.	KƆ..	FI..
ji^{55}	by^{33} ts^{h}z̩^{21}	gwɑ^{33}	ly^{55}	kɤ^{44}	tsz̩^{44}
3SG	coat	there	take.off	PAST	CAUS

B., L.,	NY.,	A: M.,	MY: NI.,	D.,	M.,
bɑ^{33} lɑ^{33}	ɲɑ^{33}	ʔɑ^{21} mɑ^{33}	mjɑ^{21} ni^{33}	dɑ^{33}	mɑ^{33}
able	TOP	who	more	capable	NMZR

ꓥO.,	BE..	BƐ..	T.	JO:=
ŋo^{33}	be^{44}	bɛ^{44}	tɑ^{55}	dz̩o^{21}
be	ADV	say	STAY	QUOT

'They agreed that the one who could make the traveller take his coat off would be considered stronger than the other one.'

GO.,	⊥Ɛ:	LO.,	WU.	MI: VI.,	NY.,
go^{33}	thɛ^{21}	lo^{33}	wu^{55}	mi^{21} hi^{33}	ɲɑ^{33}
that	TIME	river	head	wind	TOP

YI.	SƐ;	ᒋU..	SI.	JƎ;=
ji^{55}	sɛ^{21ʔ}	fu^{44}	sz̩^{55}	dʑø^{21ʔ}
3SG	breath	free	SEQ	blow

YI.	W.. JO..	JƎ;	NY.,
ji^{55}	wɑ^{44} dz̩o^{44}	dʑø^{21ʔ}	ɲɑ^{33}
3SG	the.more	blow	TOP

DO., DO..	J., XƎ:	SU..	GW.,
do^{33} do^{44}	dz̩ɑ^{33} ɕø^{21}	su^{44}	gwɑ^{33}
go.out	travel	NMZR	there

W.. JO..	YI.	BՈ., ꓲI:	GW.,	FƆ;	BE..
wɑ^{44} dz̩o^{44}	ji^{55}	by^{33} ts^{h}z̩^{21}	gwɑ^{33}	tsɤ^{21ʔ}	be^{44}
the.more	3SG	coat	there	tight	ADV

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CՈ,	⊥Ǝ,	KƆ..	K. NA.-.
tʂʐ^{35}	t^{h}ø^{35}	kɤ^{44}	kɑ^{55} nɛ^{55}
pull	wrap	PAST	after

LO.,	WU.	MI: VI.,	YE..	M:
lo^{33}	wu^{55}	mi^{21} hi^{33}	je^{44}	mɑ^{21}
river	head	wind	do	NEG

B., L.,	O..	BE..
bɑ^{33} lɑ^{33}	o^{44}	be^{44}
able	PERF	ADV

‘Then the North Wind blew as hard as he could. The harder he blew, the tighter the traveller wrapped his coat around himself, and at last the North Wind gave up trying.’

BA..	⊥A:-.	MI: MI.,	⊥I:	HW,
bɛ^{44}	t^{h}ɛ^{21}	mi^{21} hi^{33}	t^{h}i^{21}	xwɑ^{35}
say	TIME	sun	one	time

⨍.,	⨍,	L Ǝ.	KƆ..	⊥A:-.
ts^{h}ɑ^{33}	ts^{h}ɑ^{35}	lø^{55}	kɤ^{44}	thɛ^{21}
hot	hotter	shine	PAST	TIME

DO., DO..	J., XƎ:	SU..	GW.,	NY.,
do^{33} do^{44}	dʐɑ^{33}ɕø^{21}	su^{44}	gwɑ^{33}	ɲɑ^{33}
go.out	travel	NMZR	there	TOP

YI.	BՈ., ⨍I:	⨍:	⨍.
ji^{55}	by^{33} ts^{h}ʐ^{21}	ts^{h}ɑ^{21}	ts^{h}ɑ^{55}
3SG	coat	quick	quicker

LՈ.	LO..	KƆ..	⊥A:-.
ly^{55}	lo^{44}	kɤ^{44}	t^{h}ɛ^{21}
take.off	throw	PAST	TIME

LO.,	WU.	MI: VI.,	NY.,	MI: MI.,	MY: NI..
lo^{33}	wu^{55}	mi^{21} hi^{33}	ɲɑ^{33}	mi^{21} mi^{33}	mjɑ^{21} ni^{33}
river	head	wind	TOP	sun	more

D.,	BE.,	BA..	N.,	KƆ.,	LEO..=
dɑ^{33}	be^{33}	bɛ^{44}	nɑ^{33}	kɤ^{33}	leo^{33}
capable	ADV	say	must	become	CHANGE.PERF

‘Then the Sun began to shine warmly, and right away the traveller took off his coat, and so the North Wind had to admit that the Sun was stronger than he was.’

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References

Bradley, David. 1979. *Proto-Loloish*. London: Curzon Press.

Bradley, David. 1994. *A dictionary of the northern dialect of Lisu (China and Southeast Asia)* (Pacific Linguistics C-126). Canberra: Department of Linguistics, Research School of Pacific and Asian Studies, Australian National University.

Bradley, David. 1997. Onomastic, orthographic, dialectal and dialectical borders: The Lisu and the Lahu. *Asia Pacific Viewpoint* 38(2), 107–117.

Bradley, David. 2006. Lisu orthographies and email. In Anju Saxena & Lars Borin (eds.), *Lesser-known languages of South Asia: Status and policies, case studies and applications of information technology*, 125–135. Berlin: Mouton de Gruyter.

Bradley, David. 2016. Lisu. In Rint Sybesma, Wolfgang Behr, Yueguo Gu, Zev Handel, C.-T. James Huang & James Myers (eds.), *Encyclopedia of Chinese language and linguistics*. Leiden: Brill.

Bradley, David. 2017. Lisu. In Graham Thurgood & Randy LaPolla (eds.), *Sino-Tibetan languages*, 2nd edn., 902–917. London: Routledge.

Bradley, David. 2018. *Grammar of Lisu*. Berlin: Mouton de Gruyter. [Forthcoming]

Bradley, David & Maya Bradley. 1999. Standardisation of transnational minority languages: Lisu and Lahu. *Bulletin Suisse de Linguistique Appliquée* 69(1), 75–93.

Bradley, David, Edward Reginald Hope, James Fish & Maya Bradley. 2006. *Southern Lisu dictionary* (STEDT Monograph Series, No. 4). Berkeley, CA: Sino-Tibetan Etymological Dictionary and Thesaurus Project, University of California, Berkeley.

Bukmaier, Veronique & Jonathan Harrington. 2016. The articulatory and acoustic characteristics of Polish sibilants and their consequences for diachronic change. *Journal of the International Phonetic Association* 46, 311–329.

Chao, Yuan-ren. 1930. ə sɪstəm əv "toun-lɛtəz". *Maître Phonétique*, 24–27.

Fraser, James O. 1922. *Handbook of the Lisu (Yawyin) language*. Rangoon: Government Printer.

Handel, Zev. 2016. Non-IPA symbols in IPA transcriptions in China. In Rint Sybesma (ed.), *Encyclopedia of Chinese language and linguistics*. Consulted online at https://doi.org/10.1163/2210-7363_ecll_COM_00000292 (15 March 2017).

Hope, Edward R. 1974. *The deep syntax of Lisu sentences* (Pacific Linguistics B-34). Canberra: Department of Linguistics, Research School of Pacific Studies, Australian National University.

Matisoff, James A. 1975. Rhinoglottophilia: The mysterious connection between nasality and glottality. In Charles A. Ferguson, Larry M. Hyman & John J. Ohala (eds.), *Nasálfest: Papers from a Symposium on Nasals and Nasalization*, 265–287. Palo Alto, CA: Stanford University.

Yu, Defen. 2007. *Aspects of Lisu phonology and grammar: A language of Southeast Asia* (Pacific Linguistics 588). Canberra: Research School of Pacific and Asian Studies, Australian National University.

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