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ILLUSTRATION OF THE IPA

IPA Illustration of Kua'nsi

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This Illustration focuses on Kua'nsi (*kʰwa*^{33}*ɳ̩*^{21}*si*^{33}, ISO639: ykn), a Central Ngwi (or Yi) language of the Sino-Tibetan family (Bradley 1997; Fan et al., 2017). It is spoken by approximately 5000 people in Liuhe Township (六合乡, *Liùhé Xiāng*), Heqing County (鹤庆县, *Hèqìng Xiàn*), Dali Bai Autonomous Prefecture, Yunnan Province, China (see the map in Figure 1). Kua'nsi people refer to themselves as *Kua'eshi* (夸萼氏 *Kuà'èshì*) in Chinese and other ethnic groups, Bai (白 *Bái*) and Han (汉 *Hàn*) people living in the county, call them as Baiyi people (白依人 *Báiyīrén*) in Chinese because of their white traditional clothes.

In addition to Kua'nsi, Castro, Crook and Flaming (2010) report that there are four other Ngwi groups in Liuhe Township: Kuamasi, Zibusi, Laizisi and Sonaga. All these Ngwi groups in Liuhe Township have been recognised as part of Yi ethnic minority nationality in China. These groups have not been noticed until recently, and their languages have not yet been studied in detail. As reported by Castro et al. (2010), Kua'nsi is most closely related to Kuamasi, which has around 1000 speakers living in Songping village (松坪村 *Sōngpíng Cūn*), Liuhe Township. Kua'nsi and Kuamasi are partially mutually intelligible, as there is around 65% of the lexical similarity between these two languages based on a comparison of the Swadesh 100 wordlists (Castro et al. 2010, p. 28). The map in Figure 2 shows the location of all Ngwi groups found in Heqing County.

Multilingualism is common among Kua'nsi speakers. The major ethnic group in Heqing county is Bai and most people can speak both Bai and the local variety of Southwestern Mandarin at different levels. Many Kua'nsi elders are bilingual in Kua'nsi and Bai. As Mandarin has become the more socially dominant language, young Kua'nsi people are more proficient in Mandarin and some of them may also have limited knowledge of Bai. Kua'nsi children are still learning Kua'nsi as their first language and use it actively in their daily life except for schooling. Education is conducted primarily in Standard Mandarin (普通话 *pǔtōnghuà* 'common speech'). In the early years of primary school, if the teachers are also Kua'nsi, education is sometimes supplemented in Kua'nsi to help children understand Standard Mandarin properly. Afterwards, the schooling is only in Standard Mandarin.

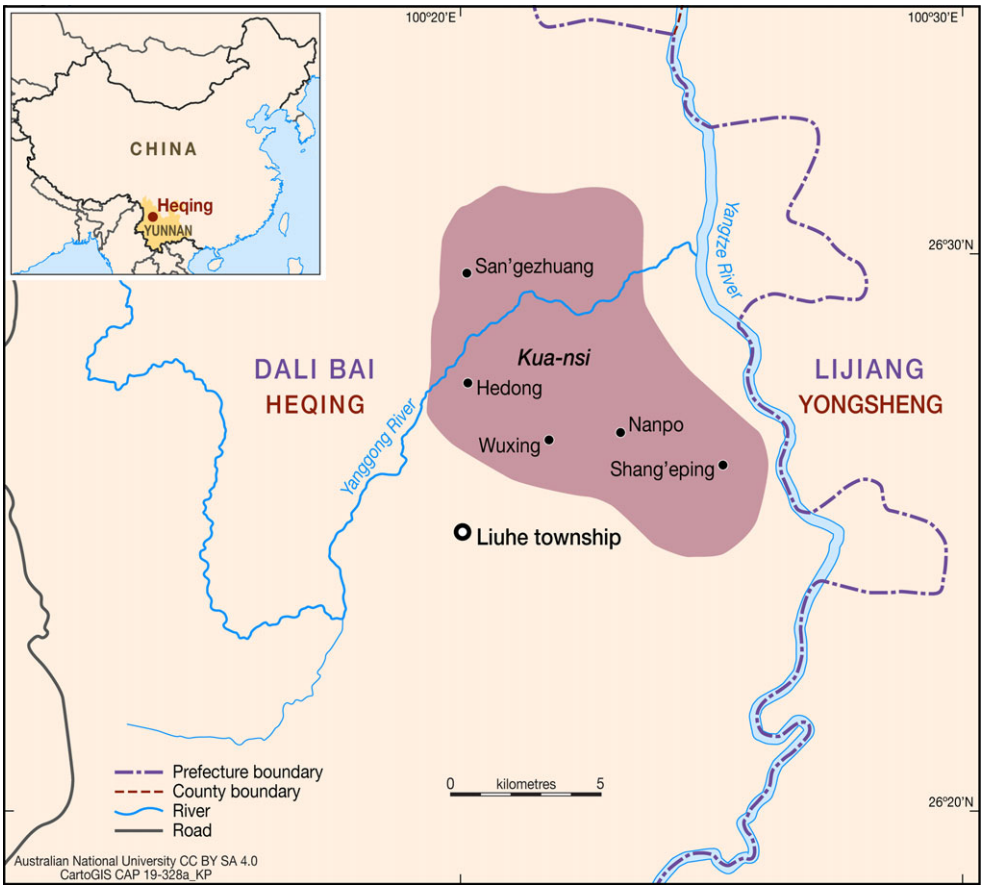

Figure 1. (Colour online) The location of Kua'nsi villages. Map adapted from Castro et al. 2010 by CartoGIS Services, ANU College of Asia and the Pacific, The Australian National University.

As not much work has been done on Kua'nsi except Duan (1998) which provides a sketch of Kua'nsi phonology and morphosyntax, this Illustration aims to provide a detailed description of the phonetic aspects of Kua'nsi. This Illustration is based on both lexical data, containing over 1700 words, and textual data collected during the author's field trips in 2018 and 2019. The lexical data includes the Swadesh 200 wordlist and a long wordlist compiled based on Bradley (1979) and works on other Ngwi languages, especially the most related Ngwi language Talu (Zhou, 2004). Each of the words was repeated three or more times when recorded. The lexical data were recorded mostly with two elder Kua'nsi speakers in Wuxing village (五星村, *wǔxīng cūn*): JIAO Jize (绞基泽, JJZ, male, born in 1962), JIAO Xiangxiu (绞香秀, JXX, female, born in 1964), and the textual data were recorded with them and ten other speakers. The appended text was recorded with JXX. All the participants were born and raised in Kua'nsi villages, and Kua'nsi is their first language. They can also speak Mandarin and Bai at different levels.

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Consonants

	Bilabial	Labio-dental	Labial-palatal	Alveolar	(Alveolo-) Palatal	Velar	Glottal
Plosive	p b p^h			t d t^h		k g k^h	ʔ
Affricate	[pɸ] [bβ] [$pɸ^h$]			ts dz ts^h	tɕ dʑ $tɕ^h$		
Nasal	m ^ʔm			n ^ʔn	ɲ	ŋ $^ʔŋ$	
Fricative		f v		s z	ɕ ʑ	x ɣ	h
Approximant Lateral	w		ɥ	 l	j		
approximant				^ʔl			

As demonstrated in the consonant table, the consonant inventory of Kua'nsi comprises 37 phonemes. The examples below illustrate the phonemic contrast between each phoneme. The bilabial affricates [pɸ, $pɸ^h$, bβ] are in complementary distribution with bilabial plosives /p, p^h, b/. The bilabial affricates only occur before the close central /ɨ/, while the bilabial plosives do not precede /ɨ/ in Kua'nsi. The labio-dental fricatives /f, v/ also occur only before /ɨ/, but they can appear before other vowels in Chinese loanwords where they are in contrast with other consonant phonemes; thus, they are not considered as allophones of other phonemes. The Kua'nsi consonants only occur in the syllable onset position.[1]

p	pi^{55} $ɕu^{21}$	[pi^{55} $ɕu^{21}$]	'make and eat'
p^h	p^hi^{55} xu^{55}	[p^hi^{55} xu^{55}]	'open PFV'
b	$bi^{55}t^hɔ^{55}$	[$bi^{55}t^hɔ^{55}$]	'taro'
t	ta^{55}	[ta^{55}]	'carry'
t^h	t^ha^{33} lwa^{13}	[$t^ha̤^{33}$ lwa^{13}]	'sharp AUG'
d	da^{33} lwa^{13}	[da^{33} lwa^{13}]	'tidy AUG'
k	ku^{55}	[ku^{55}]	'shake'
k^h	k^hu^{21}	[k^hu^{21}]	'CLF:small.round'

[1] The symbol 'a' is used in this Illustration to represent the low central vowel for typographical convenience, and an underlined vowel, e.g. /o̲/ in /$ʔa^{33}to̲^{21}$/ 'fire', is used to indicate tense vowels.

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g	gu^{33}	[gu^{33}]	‘song’
ʔ	ʔa^{33}to̱^{21}	[ʔa^{33}tö̱^{21}]	‘fire’
ts	tsu^{21}	[tsu^{21}]	‘tea’
ts^{h}	u^{33}ts^{h}u^{33}	[u^{33}ts^{h}u^{33}]	‘sun’
dz	dzu^{33}tsa^{21}	[dzu^{33}tsa^{21}]	‘lunch’
tɕ	li^{21}tɕi^{55}	[li^{21}tɕi^{55}]	‘alcohol’
tɕ^{h}	tɕ^{h}i^{55}	[tɕ^{h}i^{55}]	‘money’
dʑ	dʑi^{33}	[dʑi^{33}]	‘pile’
m	mi^{21}ɕi^{55}	[mi^{21}ɕi^{55}]	‘sacrifice ceremony’
ˀm	ˀma^{21}	[ˀma̱^{21}]	‘old’
n	nu^{55}	[nu^{55}]	‘pain, painful’
ˀn	ˀno^{33}	[ˀno^{33}]	‘soybean’
ɲ	ɲu^{33}mu^{21}	[ɲu^{33}mu^{21}]	‘younger sister’
ŋ	ŋu^{55}	[ŋu^{55}]	‘1SG’
ˀŋ	ˀŋu^{21}mo^{33}	[ˀŋu^{21}mo^{33}]	‘May, five months’
f	fɨ^{33}	[^{p}fɨ^{33}]	‘enter’
v	vɨ^{21}	[vɨ̱^{21}]	‘count’
s	ba^{21}sɨ^{33}	[ba^{21}sz̩^{33}]	‘rich person’
z	zɨ^{33}	[zz̩^{33}]	‘boat’
ɕ	ɕu^{55}mu^{55}	[ɕu^{55}mu^{55}]	‘corn’
ʑ	ʔu^{21}ʑu^{21}	[ʔu^{21}ʑu^{21}]	‘fish’
x	xa^{21}pu^{55}	[xa^{21}pu^{55}]	‘Han people’
ɣ	ɣɔ^{21}	[ɣɔ^{21}]	‘needle’
h	ho^{33}	[hõ^{33}]	‘maggot’
j	ja^{55}p^{h}a^{21}	[ja^{55}p^{h}a^{21}]	‘right side’
w	wa^{21}li^{33}	[wa^{21}li^{33}]	‘officials’
l	la^{55}	[la^{55}]	‘light (weight)’
ˀl	ˀlo̱^{21}dzo̱^{33}	[ˀlo̱^{21}dzo̱^{33}]	‘tomb’
ɥ	tɕ^{h}ɥa^{33}	[tɕ^{h}ɥa^{33}]	‘clean’
[pɸ]	m̩^{21}pɨ^{21}	[əm^{21}pɸɨ^{21}]	‘comb’
[pɸ^{h}]	ni^{21}p^{h}i̱^{21}	[ni^{21}pɸ^{h}i̱^{21}]	‘jealous’
[bβ]	bɨ^{55}mwa^{21}	[bβɨ^{55}mwa^{21}]	‘caterpillar’

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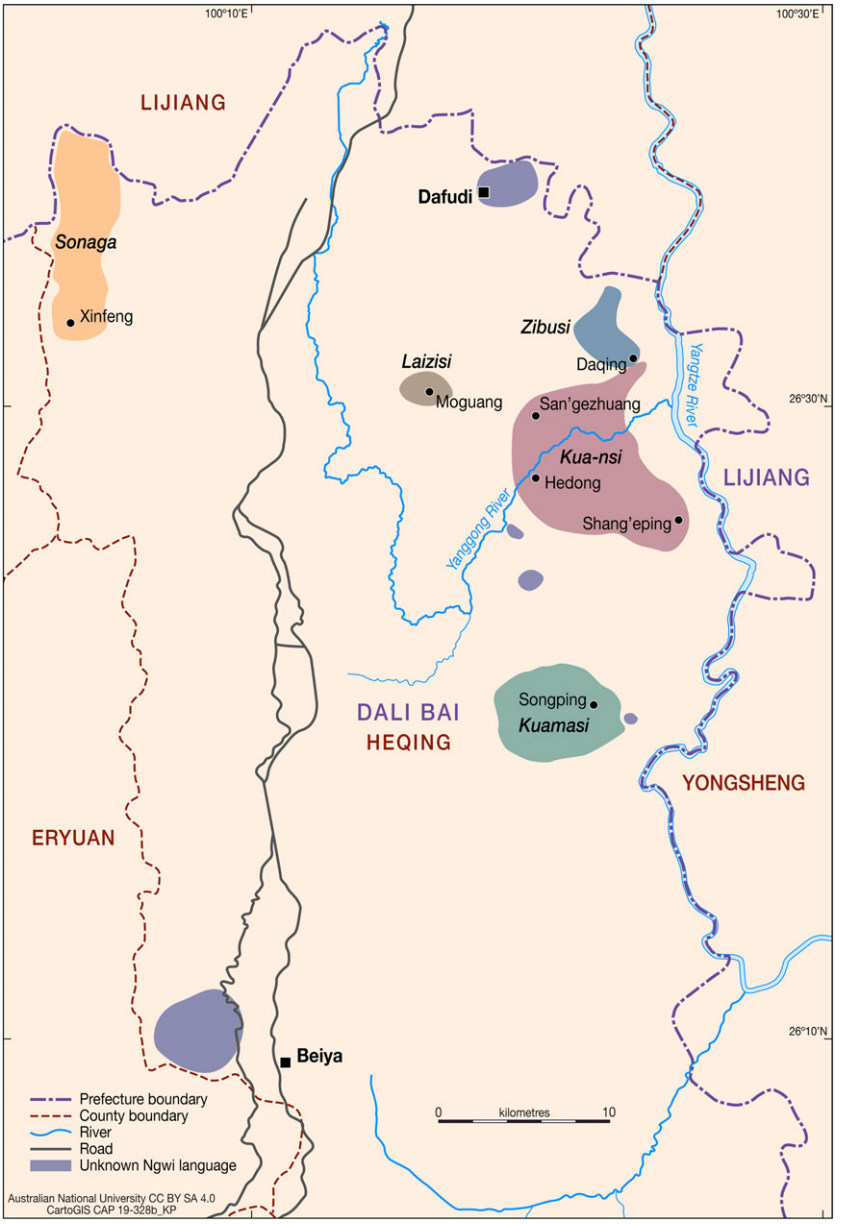

Figure 2. (Colour online) Ngwi groups in Heqing County. Map adapted from Castro et al. 2010 by CartoGIS Services, ANU College of Asia and the Pacific, The Australian National University.

The plosives and affricates, except the glottal stop, show a three-way contrast: voiceless unaspirated, voiceless aspirated and voiced. The plosives show four places of articulation: bilabial, alveolar, velar and glottal. The distribution of velar plosives /k, kʰ, g/ is restricted, and they cannot be followed by the front vowels /i, ɛ/, or the palatal approximant /j/. The distribution of other plosives is not restricted.

The glottal stop /ʔ/ occurs intervocalically in Kua'nsi in addition to the word-initial position, and the realisation of intervocalic /ʔ/ is varied. It can be pronounced with full

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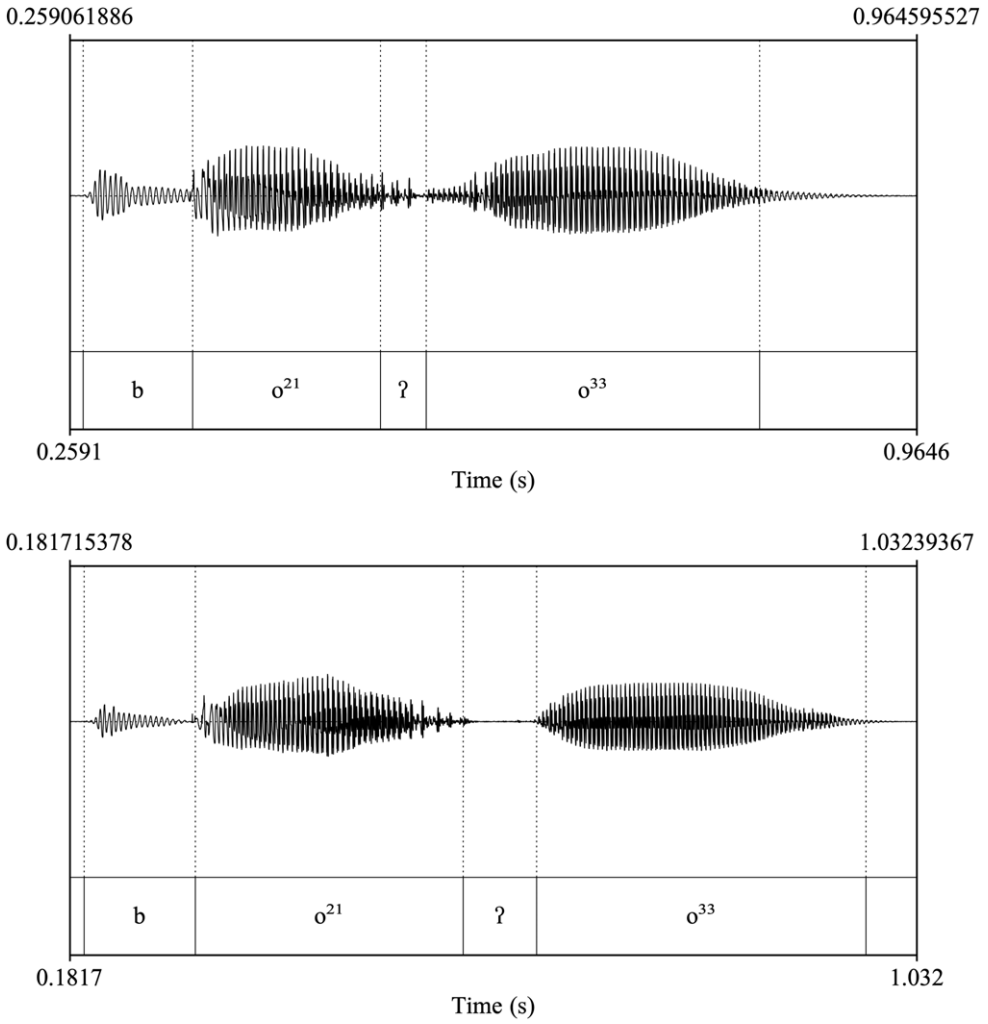

Figure 3. Waveforms of the word *bo*^{21} *ʔo*^{33} 'ant' produced by JXX.

closure of the vocal folds, but often without full closure. This aligns with the crosslinguistic tendency of glottal stops to be realised with incomplete closure in intervocalic positions (Ladefoged & Maddieson, 1996:75; Garellek, Chai, Huang & Van Doren 2023). Figure 3 shows the waveforms of the word *bo*^{21} *ʔo*^{33} 'ant' produced by speaker JXX successively. As indicated in the waveform at the top of Figure 3, in the first production, /ʔ/ is pronounced with irregular voicing and the non-modal voicing seems to continue into the following vowel. In the second production of this word, /ʔ/ shows full occlusion surrounded by irregular voicing, as a long silent closure period can be observed for the intervocalic /ʔ/ in the waveform at the bottom of Figure 3.

Table 1 gives the mean voice onset times (VOT) for voiceless plosives in the word-initial position. These measurements are based on data from two older speakers, JJZ and JXX, across 71 and 155 tokens respectively. VOT ranges between about 10 ms and 30 ms for the unaspirated plosives. By contrast, for the voiceless aspirated plosives, VOT ranges between about 80 ms to 120 ms.

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Table 1. Mean voice onset times for plosives from two speakers (JJZ and JXX), rounded to the nearest millisecond (ms)

	Speaker JJZ			Speaker JXX		
	Mean (ms)	SD	Number	Mean (ms)	SD	Number
p	16	6.0	4	13	4.7	19
p^h	95	24.3	10	105	31.4	25
t	14	3.7	17	13	7.6	29
t^h	80	17.8	16	92	23.8	39
k	26	8.9	10	24	7.0	23
k^h	117	25.1	14	95	24.9	20

The affricates distinguish three places of articulation: bilabial, alveolar and alveolopalatal. The bilabial affricates [pɸ, pɸ^h, bβ], as mentioned above, can only occur before /ɨ/ and are in complementary distribution with the bilabial plosives. The distribution of alveolopalatal affricates /tɕ, tɕ^h, dʑ/ is restricted, and they can only precede /i/, /ɥ/, /j/ and /w/. By contrast, the alveolar affricates /ts, ts^h, dz/ have a wider distribution in Kua'nsi, and only /i, ɥ, j/ cannot occur after them.

tɕ	tɕju^{21}k^{h}u^{33}	[tɕju^{21}k^{h}u^{33}]	'hammer'
tɕ^h	tɕ^{h}ju^{55}	[tɕ^{h}juʔ^{55}]	'one.clf.gen'
dʑ	dʑju^{33}mu^{21}	[dʑju^{33}mu^{21}]	'road'
ts	tswa^{33}	[tswa^{33}]	'narrow'
ts^h	ts^{h}wa̱^{33}	[ts^{h}wa̱^{33}]	'sharp'
dz	dzwa^{21} lwa^{13}	[dzwa̱^{21} lwa̱^{13}]	'good AUG'

Kua'nsi has a large inventory of fricatives. They show five places of articulation: labiodental, alveolar, alveolopalatal, velar and glottal with a voiceless vs. voiced contrast, except for the glottal fricative /h/. Some of the fricatives have very limited distributions in Kua'nsi. The labiodentals /f, v/, except in Mandarin loan words, occur before /ɨ/. The voiced alveolar fricative /ʑ/ only occurs before /u/, and the voiced velar fricative /ɣ/ only occurs before /a, ɔ/.

Figure 4 shows averaged Fast Fourier Transformed spectra for the four voiceless fricatives /f, s, ɕ, x/ of Kua'nsi. It can be seen that /x/ has the lowest spectral energy almost at any points. /s/ has more spectral energy above 6 kKz than any other fricatives, while within the range of around 3–6 kHz, /ɕ/ has more spectral energy. The spectral energy of /f/ fluctuates mostly between 20–30 dB in the whole spectral range of 1–12 kHz.

Similar to many other Ngwi languages, for example, Central Lisu (Tabain, Bradley & Yu, 2018), /h/ and /ʔ/ in Kua'nsi also cause the following vowels to be nasalised. This close relationship between nasalisation and glottal consonants is found in many languages and is termed rhinoglottophilia by Matisoff (1975).[2] In Kua'nsi, all vowels after /h/ are nasalised, regardless of the position of /h/ in the word as illustrated in the following examples.

[2] See Johnson, Barlaz, Shosted and Sutton (2019) for a recent quantification of spontaneous nasalisation after glottal consonants in Thai, which shows a different pattern of nasalisation from what Matisoff (1975) suggests.

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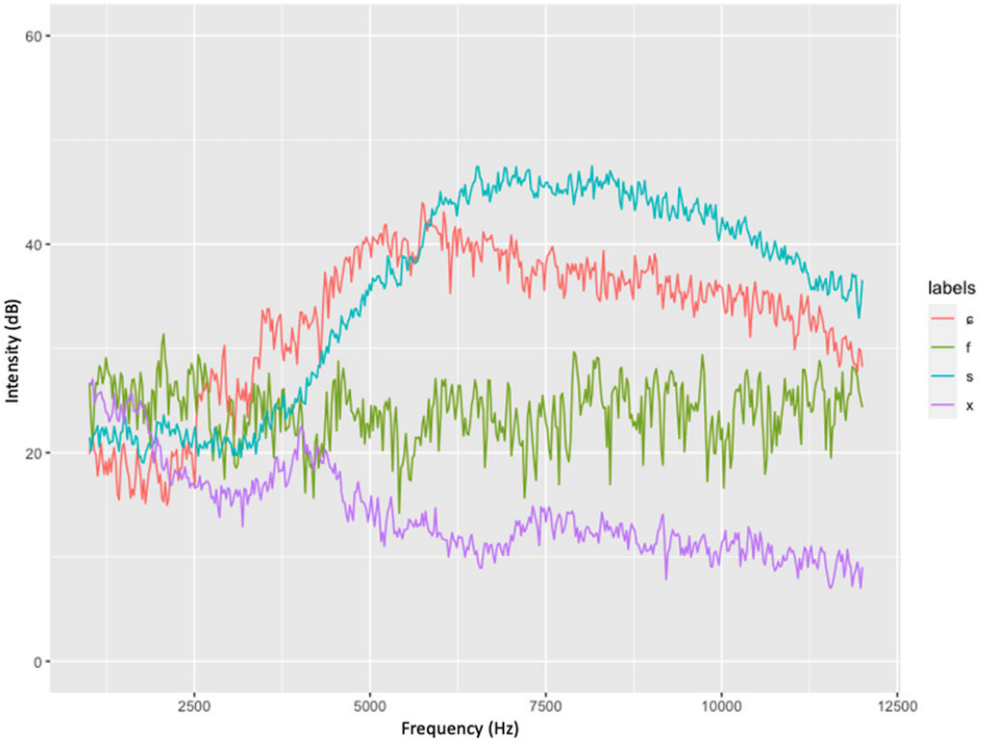

Figure 4. (Colour online) Plot of averaged Fast Fourier Transformed spectra for the four voiceless fricatives of Kua'nsi as produced by the female speaker JXX. Data are sampled at the temporal midpoint of the fricative. Only the spectral range between 1 kHz and 12 kHz is shown. The plot is based on 91 tokens: 6 /f/, 16 /ɕ/, 37 /s/ and 32 /x/. Note that in the dataset presented here, all /f/ tokens are followed by /ɨ/; /ɕ/ is only followed by /i/; and /s/ is followed by [ʐ̩]. /x/ is followed by a variety of vowels.

h	$ha^{21}dzɨ^{33}$	$[hã^{21}dzʐ̩^{33}]$	'mouse'
	$hi^{21}pɔ^{33}$	$[hĩ^{21}pɔ^{33}]$	'belly'
	ho^{33}	$[hõ^{33}]$	'moon'
	$hjo^{21}ʑu^{21}$	$[hjõ^{21}ʑu^{21}]$	'thin rope'
	$ȵi^{55}mɔ^{21}hɔ^{21}$	$[ȵi^{55}mɔ̃^{21}hɔ̃^{21}]$	'besides'

On the other hand, the nasalisation of vowels after /ʔ/ is not prevalent in Kua'nsi. When /ʔ/ occurs word-initially, the following vowels are not nasalised. When it occurs intervocalically, the vowels are nasalised. However, this kind of nasalisation is only found in the male speaker JJZ's speech, while vowels after /ʔ/ are not nasalised in the female speaker JXX's speech as indicated in her pronunciation of the word *bo*^{21} *ʔo*^{33} $[bo^{21}ʔo^{33}]$ 'ant' in the above example in Figure 3. It should be noted that this description of vowel nasalisation after an intervocalic /ʔ/ is based on only three words in the data. While it is clear that vowels are not nasalised after a word-initially /ʔ/, the exact status of vowels nasalisation after an intervocalic /ʔ/ is unclear given the limitation of the data.

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ʔ	ʔa^{33}na̲^{21}	[ʔa^{33}na̲^{21}]	‘crow’
	ʔo̲^{21}ju^{33}	[ʔo̲^{21}ju^{33}]	‘eel’
	ka^{33}ʔo^{21}	[ka^{33}ʔõ^{21}]	‘goose’
	bo^{21}ʔa^{21}	[bo^{21}ʔã^{21}]	‘duck’

Kua’nsi nasals distinguish four places of articulation: bilabial, alveolar, alveolopalatal and velar. Like the velar plosives, the velar nasal /ŋ/ also cannot occur before /i, ɛ, j/. This restriction does not apply to other nasal consonants. Vowels after nasal consonants tend to be nasalised, but there is no phonemic distinction between nasal and oral vowels in Kua’nsi.

There is one voiced lateral approximant /l/ in Kua’nsi. The distribution of this consonant is not restricted. Except /ɨ/, other vowels can follow the lateral approximant /l/.

There are three central approximants /j, w, ɥ/ in Kua’nsi. The distributions of approximants /j, w, ɥ/ are restricted. /j/ can occur with /a, o, u, ɛ/. /w/ can occur with /a, o, ɛ, i/. Compared with /w/ and /j/, the voiced labio-palatal approximant /ɥ/ has a more limited distribution in Kua’nsi. Only the front vowels /i, ɛ, a/ occur after /ɥ/, and it only occurs in a handful of words. The approximants /j, w/ alone can occur as the syllable onset more frequently, but only one word /ɥɛ^{33}lwa^{33}/ ‘bell’ in the data shows that /ɥ/ can occur as a syllable onset.

The approximants /j, w, ɥ/ can follow other consonants to form a consonant cluster as a syllabic onset, as illustrated by the examples below. Each of the approximants has different distributions in consonant clusters. /j/ forms clusters with bilabials (plosives and nasal), alveolars (plosives, nasal, fricative, affricates and lateral) and glottal (plosive and fricative): /p, p^{h}, b, t, t^{h}, d, ʔ, ɕ, tɕ, tɕ^{h}, dʑ, m, n, l, h/. /w/ can occur after all plosives, alveolar fricatives /s, z/ and affricates /tɕ, tɕ^{h}, dʑ/, velar fricative /x/, glottal fricative /h/ and three nasals /n, m, ŋ/. /ɥ/ only occurs after alveolopalatal fricatives and affricates /ɕ, ʑ, tɕ, tɕ^{h}, dʑ/. The vowels that can occur after these approximants are also restricted. /a, o, u, ɛ/ can occur after /j/; /a, o, ɛ/ can occur after /w/; and only the front vowels /i, ɛ, a/ can occur after /ɥ/.

j	tɕja^{21}kə̲^{33}	[tɕja^{21}kə̲^{33}]	‘cold’
	p^{h}ja^{21}	[p^{h}ja^{21}]	‘sprinkle’
w	ʔu̲^{33}tɕwa^{55}	[ʔu̲^{33}tɕwa^{55}]	‘star’
	p^{h}wa^{33}	[p^{h}wa^{33}]	‘tie up’
ɥ	tɕɥa^{21}	[tɕɥa̲ʔ^{21}]	‘nail’

Syllabic nasals

The nasal consonants /m, n, ɲ, ŋ/ in Kua’nsi can occur as syllabic consonants and form the nucleus of a syllable, but only when there is a homorganic consonant as the onset of the following syllable. This means that syllabic nasals only occur word-initially or inter-syllabically, and never word-finally. There is no restriction on the consonants after syllabic nasals, and it can be another nasal, for example, /u^{55}m̩^{21}mo^{33}/ ‘aunt (wife of father’s brother)’. The occurrence of syllabic /ɲ/ is restricted. Although it is theoretically possible, it has not been found that /ɲ/ occurs inter-syllabically in the lexical data. It is mostly found as the negative marker /N̩^{21}-/, whose place of articulation is conditioned by the following syllable onset of the verb.

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n	$n̩^{21}ta̲^{21}nɔ^{55}$	$[n̩^{21}ta̲^{21}nɛi^{55}]$	‘tomorrow’
	$k^hwa^{21}n̩^{21}sɨ^{33}$	$[k^hwa^{21}n̩^{21}sz̩^{33}]$	‘Kua’nsi’
m	$m̩^{21}pɨ^{21}$	$[m̩^{21}pɨ^{21}]$	‘comb’
	$u^{55}m̩^{21}mo^{33}$	$[u^{55}m̩^{21}mo^{33}]$	‘aunt (wife of father’s older brother)’
ŋ	$ŋ̩^{21}ka^{55}$	$[ŋ̩^{21}ka^{55}]$	‘head’
	$tsɨ^{21}mɔ^{55}ŋ̩^{21}k^hɔ^{21}$	$[tsz̩^{21}mɔ̃^{55}ŋ̩^{21}k^hɔ^{21}]$	‘fog’

In Kuamasi, a closely related Central Ngwi language to Kua’nsi, the corresponding syllable in cognate words contains a vowel. According to the word list provided by Castro et al. (2010), some cognate words of the above examples in Kuamasi are: /ʔa^{33}ta^{33}nɯ^{55}/ ‘tomorrow’, /ŋɯ^{21}ka^{55}/ ‘head’, /mo^{21}/ ‘not (negation)’. It seems that the syllabic nasals in Kua’nsi come from different sources and the historical development needs further examination.

The duration of syllabic nasals is significantly different from non-syllabic nasals (one-way ANOVA, $p < 0.001$), as shown in Figure 5. The left box shows the distribution of the duration of non-syllabic nasals (n=219), and the right one shows that of syllabic nasals (n=17). The boxplots reflect the interquartile range with the median indicated by a horizontal line in the middle of the box. Nearly three-quarters of non-syllabic nasals have durations of less than 100 ms, while most syllabic nasals are longer than 100 ms.

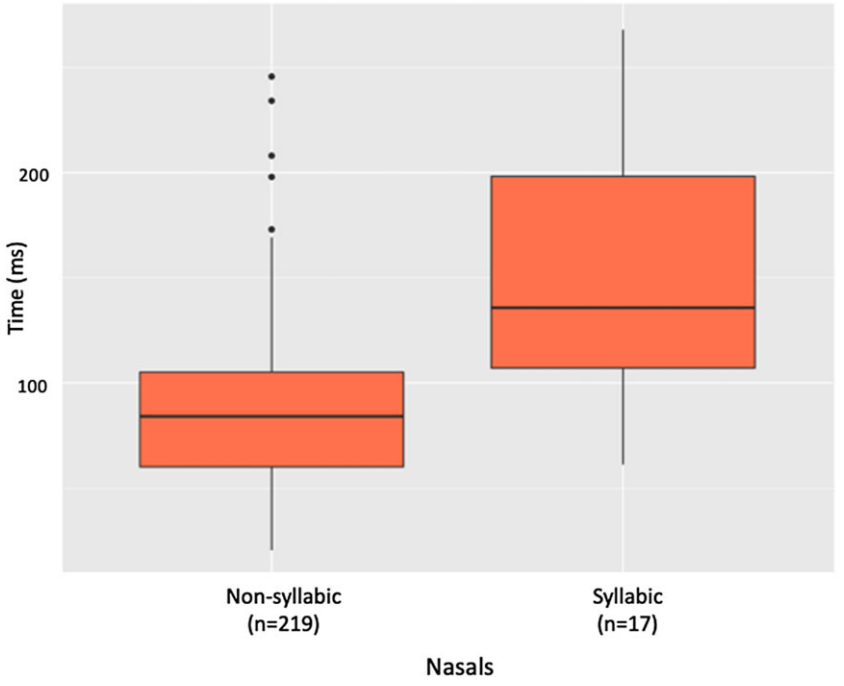

Figure 5. (Colour online) Distribution of duration of non-syllabic and syllabic nasals in Kua’nsi as produced by the female speaker JXX. The left box shows the distribution of the duration of non-syllabic nasals (n=219), and the right one shows that of syllabic nasals (n=17).

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Preglottalised consonants

Kua'nsi has a series of preglottalised sonorants. The difference between preglottalised and non-preglottalised nasals is illustrated in the following (near) minimal pairs. Although the nasals /m, n, ŋ/ have preglottalised counterparts, there are no examples showing that the palatal /ɲ/ can also be preglottalised.

ˀm	ˀma^{21}	[ˀma̰^{21}]	'old'
m	mɔ^{33}	[mɔ^{33}]	'think'
ˀn	ˀno^{33}	[ˀno^{33}]	'soybean'
n	no^{55}	[no^{55}]	'hear'
ˀŋ	ˀŋu^{21}mo^{33}	[ˀŋu^{21}mo^{33}]	'May, five months'
ŋ	ŋa^{33}	[ŋa^{33}]	'bite'
ˀl	ˀlo̱^{21}dzo̱^{33}	[ˀlo̱^{21}dzo̱^{33}]	'tomb'
l	lo^{21}dzɨ^{33}	[lo^{21}dzz̩^{33}]	'stone'

The evidence for the preglottalised nasals can be found in the waveform and spectrogram of the recordings. When JJZ pronounced the preglottalised nasals, the closing of the glottis is often signalled by a small pulse in the waveform as well as a visible shadow at the corresponding time in the spectrogram, as circled in the waveforms and spectrograms of two words, /ˀma̰^{21}/ 'old' and /ˀmja^{21}kwa^{21}/ 'donkey' in Figure 6. Figure 7 shows the waveform and spectrogram of /mi^{55}la^{55}/ [mi^{55}la̰^{55}] 'night' produced by JJZ. As indicated in Figure 7, the small pulse before the preglottalised nasals as observed in Figure 6 is absent in the production of the non-preglottalised nasal.

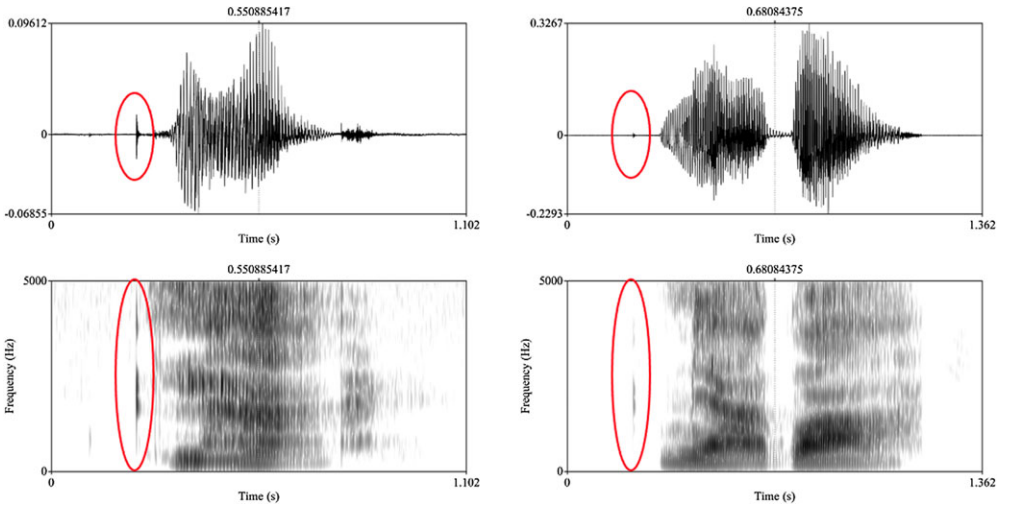

Figure 6. (Colour online) Waveforms and spectrograms of /ˀma̰^{21}/ 'old' (left) and /ˀmja^{21}kwa^{21}/ 'donkey' produced by the male speaker JJZ. The circled parts show the closing of the glottis.

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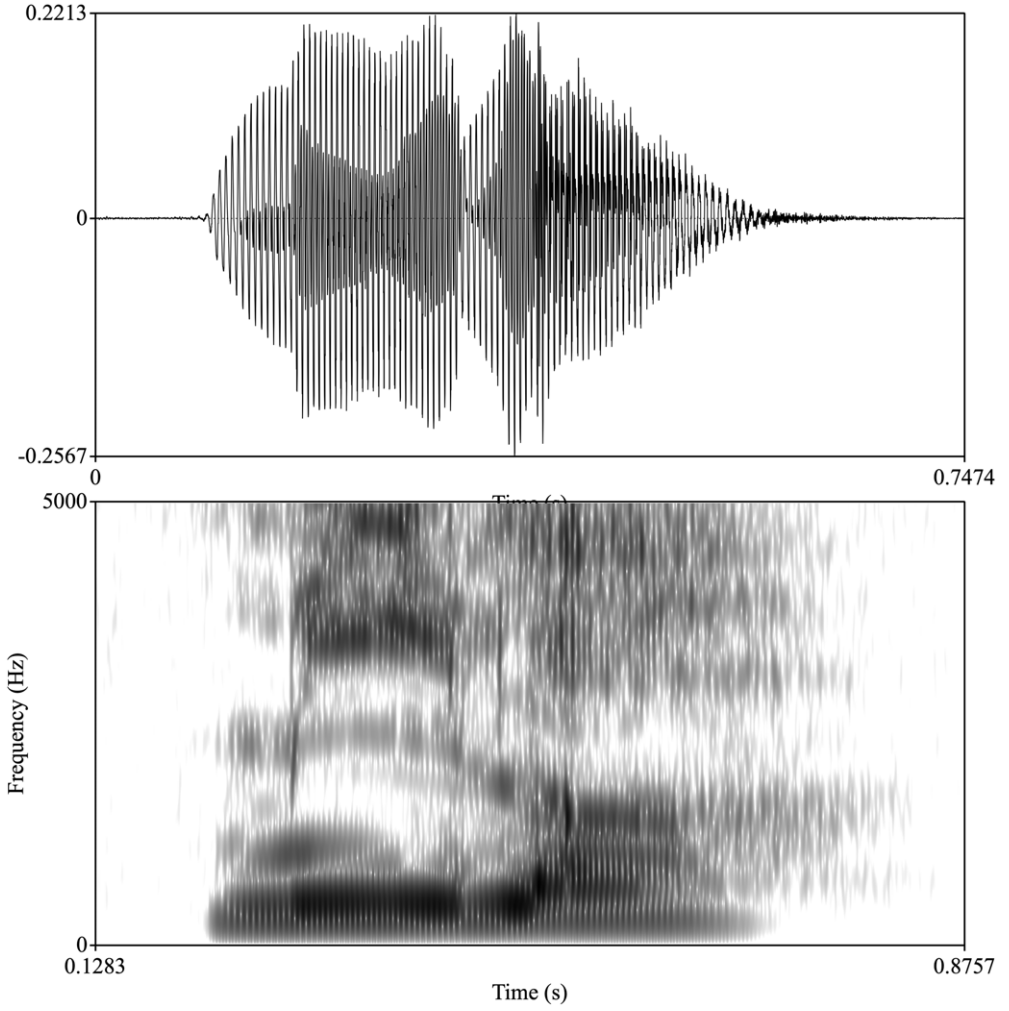
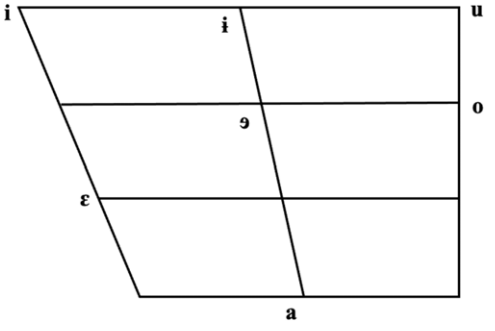


Figure 7. Waveform and spectrogram of /mi^{55}la^{55}/ 'night' by the male speaker JJZ.

Vowels



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i	ti^{21}	[ti^{21}]	‘hit’
i̲	ti̲^{21}	[ti̲^{21}]	‘CLF:meal’
a	ta^{33}	[ta^{33}]	‘hold’
a̲	ta̲^{21}	[ta̲^{21}]	‘step on’
ɔ	tɔ^{55}	[tɔ^{55}]	‘return’
ɔ̲	bɔ̲^{33} xu^{55}	[bɔ̲^{33} xu̱^{55}]	‘throw PFV’
o	tsɨ^{55}to^{21}	[tsz̩^{55}to̱^{21}]	‘honest, well-behaved, gullible’
o̲	ʔa^{33}to̲^{21}	[ʔa^{33}to̱̱^{21}]	‘fire’
u	mu^{55}tu^{55}	[mu^{55}tu^{55}]	‘bamboo’
u̲	gu̲^{21}	[g̊u̲^{21}]	‘wear (cloth)’
ɛ	dɛ^{21}	[dɛ^{21}]	‘push’
ɛ̲	tɛ̲^{21}	[tɛ̲^{21}]	‘burn’
ɨ	ni^{21}pʰɨ^{21}	[ni^{21}pɸʰɨ^{21}]	‘jealous’
ɨ̲	pʰɨ̲^{33}	[pɸʰɨ̲^{33}]	‘open’
[z̩]	sɨ^{55}	[sz̩ʔ^{55}]	‘long’
[z̲̩]	sɨ̲^{21}kʰu^{55}	[sz̲̩^{21}kʰu^{55}]	‘fruit’

There are seven modal vowels in Kua’nsi, and each modal vowel has a tense counterpart as indicated by an underlined vowel symbol. The phonemic contrast between each vowel is established by their occurrence in sequence /tV/ when it is available in the data, as illustrated in the examples above. However, such a sequence is not possible for [z̩] and /ɨ/, as they have limited distribution in Kua’nsi and cannot occur after /t/. A diphthong [ɛi] is found in the data, but it is in free variation with /ɔ/; thus, it is not considered a phonemic vowel. For example, JXX produced /tsɔ^{21}tsɔ^{33}/ ‘thing’ [tsɔ^{21}tsɔ^{33}] while another speaker JHS produced this word [tsɛi^{21}tsɛi^{33}] as in the phrase /tsɔ^{21}tsɔ^{33} ʔu̲^{21}/ ‘borrow something’.

The vowel /ɨ/ has a fricative allophone, the syllabic high central fricative vowel [z̩], after alveolar fricatives and affricates /s, z, ts, tsʰ, dz/, while the high central [ɨ] allophone occurs after bilabial affricates [pɸ, pɸʰ, bβ], the bilabial nasal /m/ and labiodental fricatives /f, v/. Sequences of an alveolar affricate or fricative plus the high front vowel [i] do not occur in Kua’nsi. In the Chinese linguistics tradition, the symbol [ʅ] is often used to represent the fricative vowel (Handel, 2015). The fricative vowel has less friction than the voiced alveolar fricative /z/. This is shown in the spectrogram of the word *zɨ*^{55} [zz̩^{55}] ‘boat’ in Figure 8. Sometimes the frication is not strong and the vowel seems to be the voiced continuation of the preceding fricative, a similar case to the realisation of the front lingual fricativised /z/ and /z̲/ vowels in Nuosu Yi (Edmondson, Esling & Lama, 2017).

Kua’nsi vowels show a contrast between modal (‘lax’) and laryngealised (‘tense’) phonation, which is also widely attested in many other Ngwi languages, for example, Central Lisu (Tabain et al., 2019), Southen Yi (Kuang, 2011) and Nuosu Yi (Edmondson, Esling & Lama, 2017), as well as in Bai varieties such as Heqing Bai (Zhao, 2010) and Jianchuan Bai (Edmondson, Esling & Li, 2021). In Kua’nsi, each lax vowel has a corresponding tense vowel. The tense vowels are restricted to low and mid tones, while the lax vowels can occur with all tones. Figure 9 shows the waveforms and spectrograms of the CV syllable sequence /tsu/

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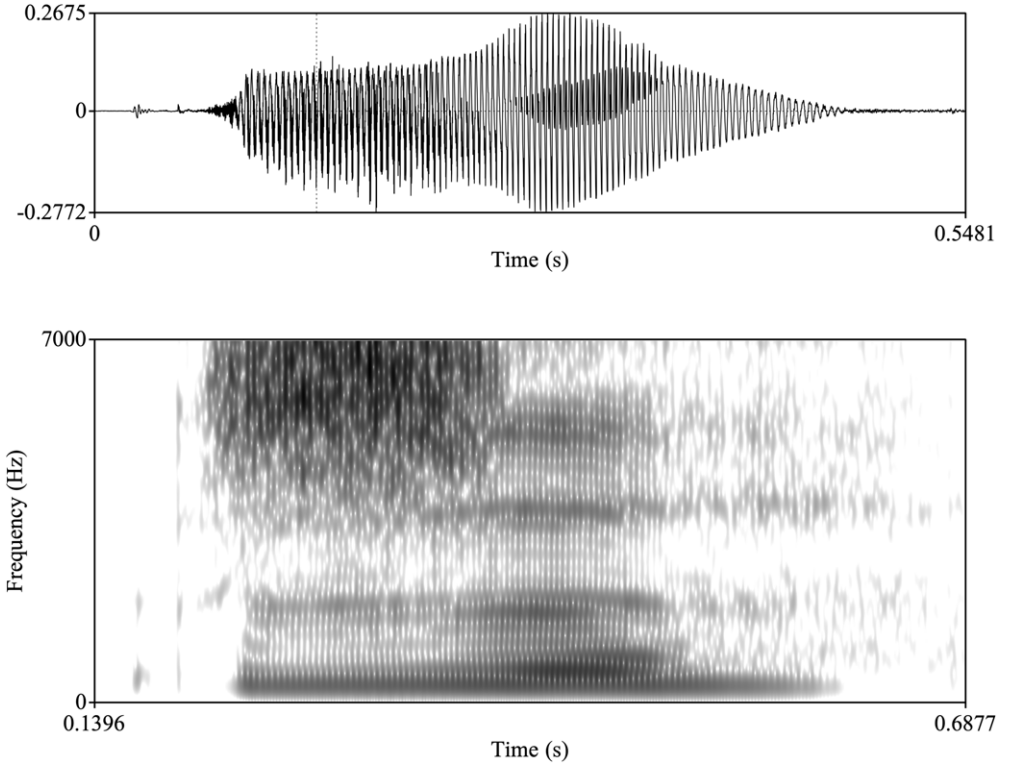

Figure 8. The spectrogram of the word *zi*^{55} [zz$_{i}^{55}$] 'boat'.

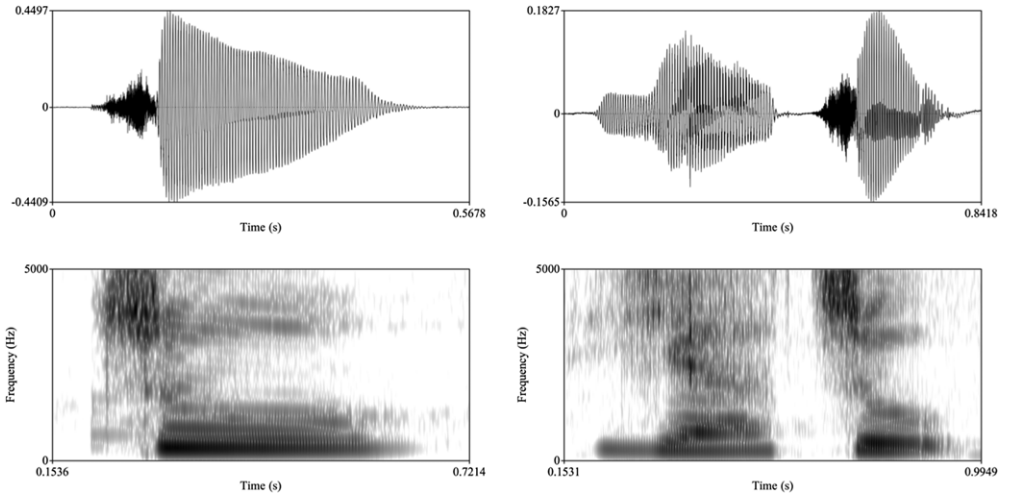

Figure 9. Waveforms and spectrograms of /tsu^{21}/ 'tea' (left) and /ja^{21}tsu̲^{21}/ 'loom'.

with a low falling tone /21/ in two different words, /tsu^{21}/ 'tea' and /ja^{21}tsu̲^{21}/ 'loom, weaving machine'. The waveform and spectrogram of the tense vowel /u̲/ in /tsu̲^{21}/ on the right shows aperiodic noise, especially near the end of articulation.

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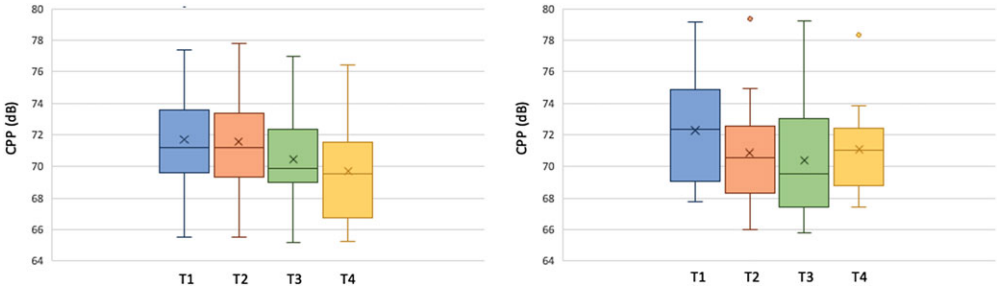

Figure 10. (Colour online) Means of CPP of /a^{21}/ (left, 21 tokens) and its tense counterpart /a̲^{21}/ (right, 14 tokens) produced by the female speaker JXX in four ranges of vowel duration (T1: 0–25%; T2: 25–50%; T3: 50–75%; T4: 75–100%).

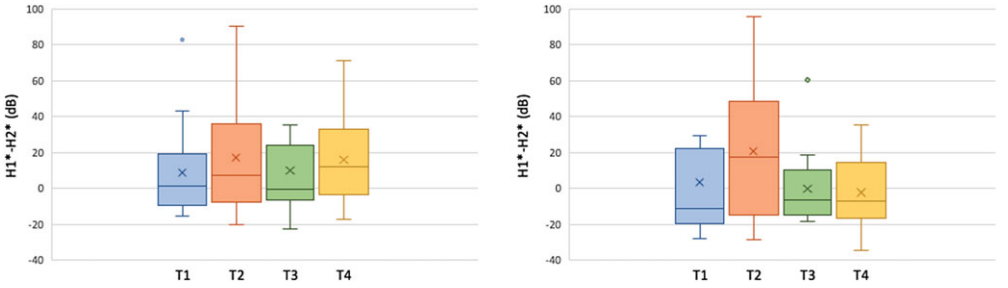

Figure 11. (Colour online) Means of H1*–H2* of /a^{21}/ (left, 21 tokens) and its tense counterpart /a̲^{21}/ (14 tokens) produced by the female speaker JXX in four ranges of vowel duration (T1: 0–25%; T2: 25–50%; T3: 50–75%; T4: 75–100%).

The cross-linguistic difference between tense and lax vowels has been complex to describe phonetically. The investigation of the phonation contrast relies on several phonetic measures, such as H1*–H2* (the difference between the first and the second harmonic, corrected by formant), and CPP (Central Peak Prominence), which have been useful for analysis of other languages. For example, Kuang (2013: 38) shows that CPP and all H1*-related measures, both H1* itself and its relative strength (H1*–Hn*, H1*–An* measures), contribute to the phonation contrast significantly in three Ngwi languages, Southern Yi, Bo, and Hani. Figures 10 and 11 show the mean CPP and H1*–H2* of /a^{21}/ and /a̲^{21}/ in Kua'nsi at four stages of vowel duration. Both vowels show a similar range of CPP values around 65–80 dB. While the lax vowels show peak CPP values between T2 and T3, the tense vowels show lower CPP values at the same points. The measurements of H1*–H2* seem unable to distinguish the phonation types significantly, although the tense vowels tend to have a lower value of H1*–H2* during T1 and a higher value of H1*–H2* during T2. Since the dataset is limited in the number of tokens for different tense vowels with different tones, further study would be necessary to find out any differences between these vowels in more detail.

In addition, laryngealised phonation also occurs with the nasals, e.g., [n̰^{21}, m̰^{21}] are also found in the data, but the tense phonation on the nasals is not a phonemic distinction. All the syllabic nasals can be realised as either lax or tense phonation. Figure 12 shows two waveforms and spectrograms of /m̩^{21}pi̲^{21}/ 'comb'. The right spectrogram does not show aperiodic noise on the first syllable /m̩^{21}/, while the left spectrogram shows aperiodic noise on both syllables. This indicates that the syllabic nasals can either be laryngealised or not. This means that the tenseness on the syllabic nasals is possible but variable.

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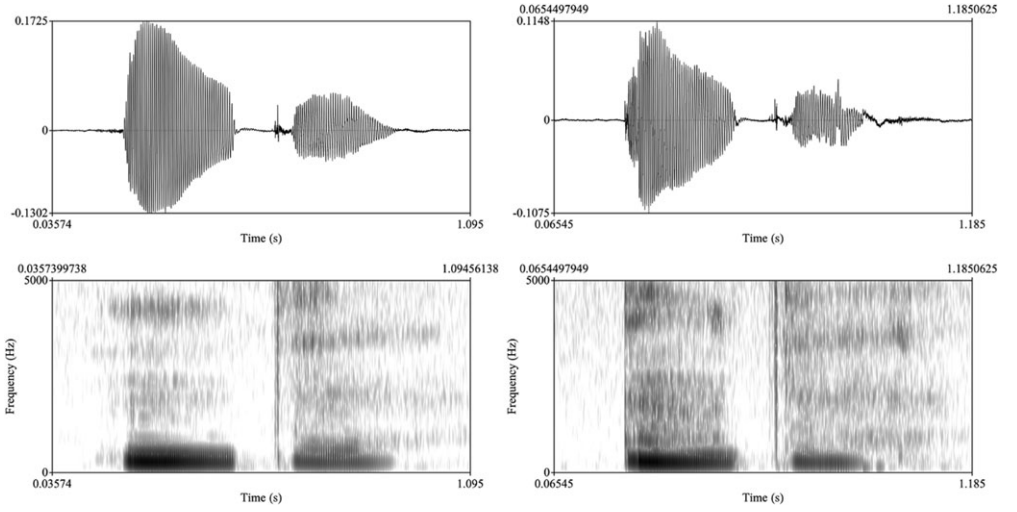

Figure 12. Waveforms and spectrograms of the word *m̩²¹ pɨ̲²¹* 'comb': [əm²¹pɸɨ̲²¹] and [əm̩²¹pɸɨ̲²¹]. The waveform on the right shows aperiodic noise on both syllables.

Figure 13 shows the plots of mean Kua'nsi vowel formants F1 and F2 for two speakers. The allophones of /ɨ/, [ɨ] and [z̩], are measured and plotted separately. F1 and F2 were measured at the midpoint. The measurements were taken only from monosyllabic words or the final syllable of polysyllabic words to avoid the effect of the following consonants. This analysis did not control for the place and manner of articulation of the syllable onset.

The vowel /ə/ can be realised by four vowels [ɔ, ə, ɯ, ɤ] but mostly [ɔ]. Duan (1998) proposes /ɯ/ and /ɤ/ as two different phonemes in Kua'nsi, but such a phonemic distinction is not found in the dataset presented here. Instead, it is found that /ə/ has great allophonic variation. The variation is not related to the place of articulation of preceding consonants, as it is constantly observed in the data that the formants of /ə/ in the same word can be of great difference. For example, Figure 14 shows the plots of formants of /ə/ in /tʰə²¹/ 'bucket' by JXX. These tokens fall into two different groups whose F2 are in different ranges. This suggests that /ə/ in these tokens is realised by two different surface vowels, [ɔ] and [ɤ].

Tone

Kua'nsi has three phonemic lexical tones: low-falling /21/, mid-level /33/, and high-level /55/, as exemplified by the minimal set given below, based on the sequence /ta/. The lax vowels can occur with all three tones, while tense vowels can only occur with /21/ and /33/. The f0 trajectories for these tones are shown in Figure 15.

pɨ³³li³³ta²¹	[pɸɨ³³li³³ta²¹]	'sour, sharp-tasting'
ta³³	[ta³³]	'take, hold'
a⁵⁵ta⁵⁵i³³	[a⁵⁵ta⁵⁵i³³]	'uncle (father's older brother)'
ta̲²¹	[ta̲²¹]	'step (on)'
ta̲³³	[ta̲³³]	'hold in arms, hug'

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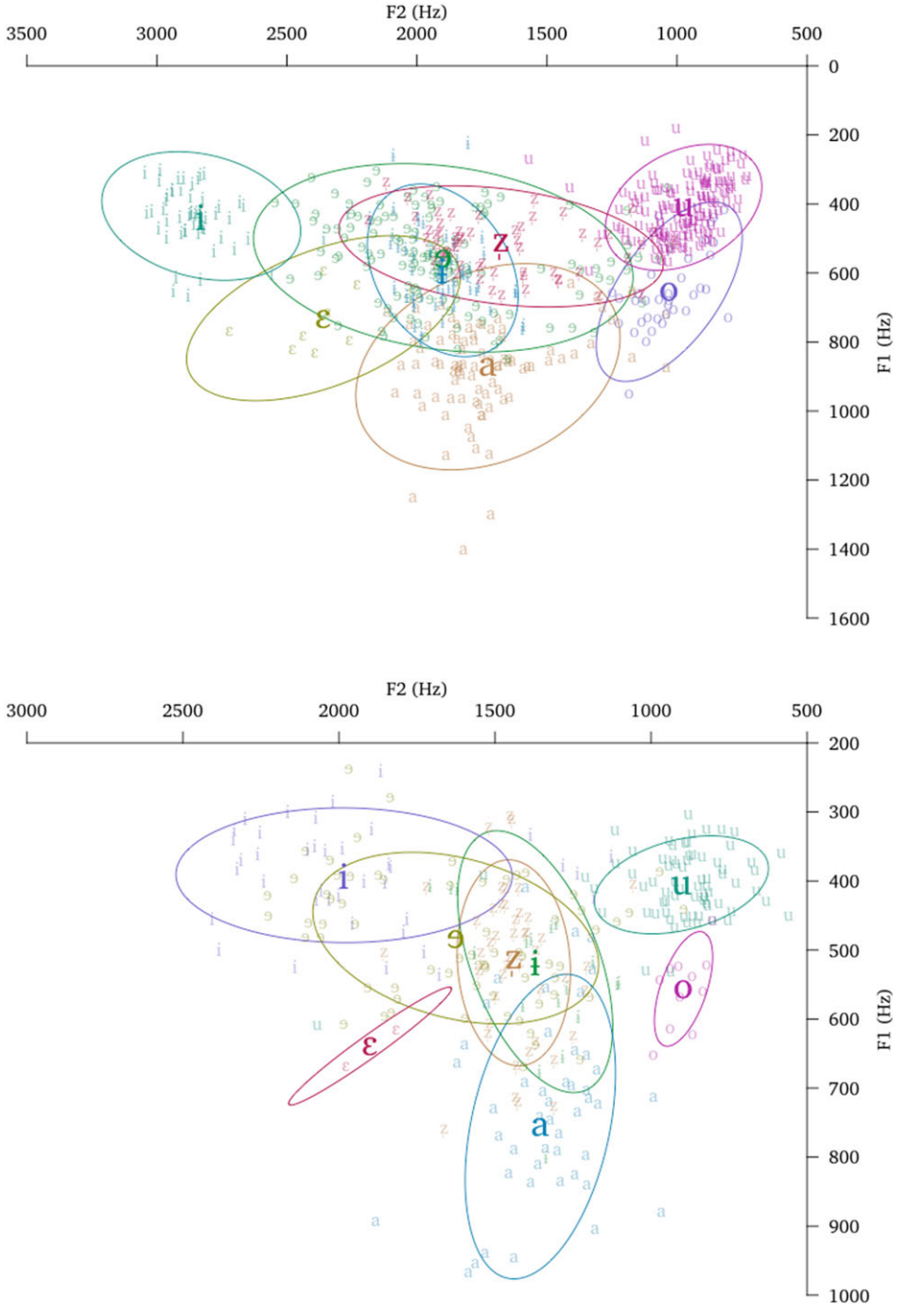

Figure 13. (Colour online) Plots of mean Kua'nsi vowels formants for two speakers, JXX (above, female) and JJZ (male), based on 648 and 309 tokens respectively. The plots were generated by the PhonR package (McCloy, 2016) in R (R core team, 2018).

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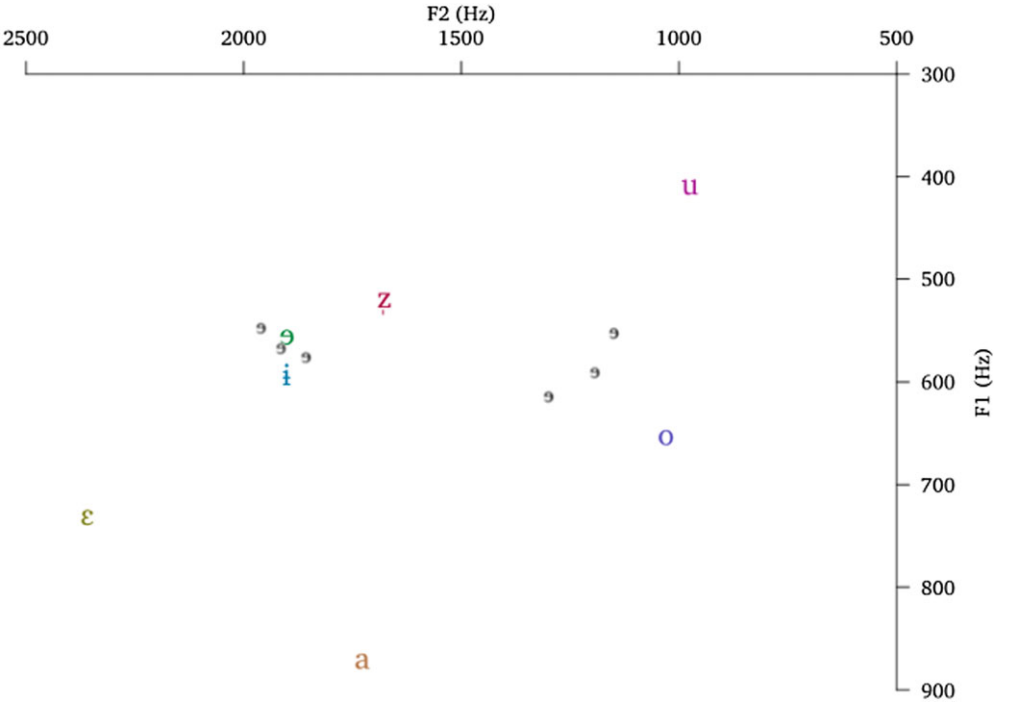

Figure 14. (Colour online) Plots of formants of /ɔ/ in /$t^{h}ɔ^{21}$/ 'bucket' recorded with JXX with plots of mean formants of vowels.

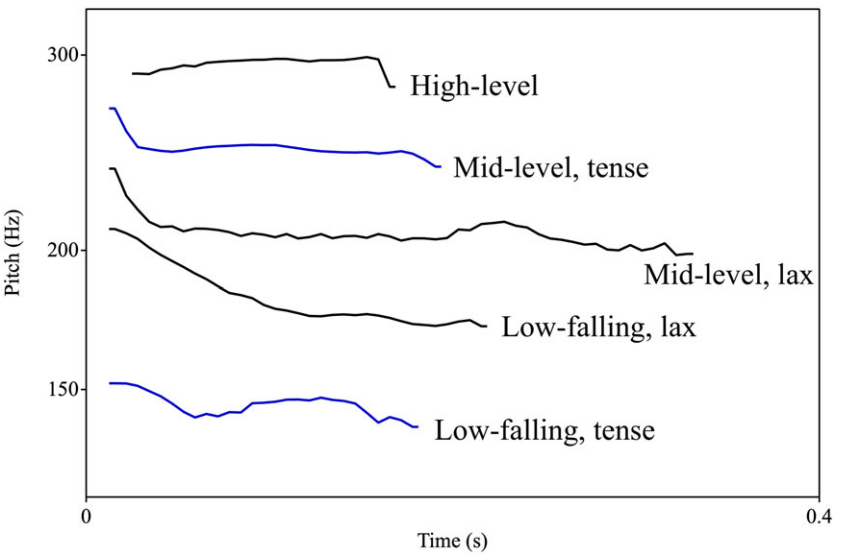

Figure 15. (Colour online) Plot of Kua'nsi f0 trajectories for the tones in Kua'nsi on the same sequence /ta/ in (near) minimal pairs produced by the speaker JXX. Note that /ta^{21}/ does not occur in the data of JXX's speech. The trajectory of the low falling lax tone is based on the sequence /da/ in the word /$ʔa^{33}da^{21}$/ 'swing'.

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Besides these three tones, there are two other contour tones found in the text data, a high falling tone /51/ and a low rising tone /13/. /51/ occurs when a word-final syllable with /55/ tone is contracted with the following syllable consisting of a single vowel with /21/ tone, for example, *xu*^{55} 'PFV' + =*a*^{21} 'SFM' → [xwa^{51}] 'PFV.SFM'. However, this is not systematic. The outcome of this tonal fusion sometimes will be /21/ or close to /21/, for example, *ŋu*^{55} '1SG' + =*a*^{21} 'CM' → [ŋwa^{21}] '1SG.CM'. The other contour tone found in the data is a rising tone /13/, but it is only found in augmentative particle *dwa*^{13}∼*lwa*^{13} 'AGMT, very' and in reduplication of some words.

The tones in loanwords are not stable. The tone of the same word borrowed into Kua'nsi would have various tones among different speakers. Even within the speech of the same speaker, the tones in the loanwords are not consistent. For example, the Chinese word 办法 *bànfǎ* 'method' can be found in the transcription of the recorded passage. This word is borrowed into Kua'nsi, and its tone varies each time it occurs in the speech. It appears as [pan^{51}fa^{213}] the first time, and the original Mandarin tones are maintained. When the word occurs the second time in the recording, the tone on the second syllable becomes /13/. The tonal change does not indicate any syntactic or semantic function, but rather it reflects the inconsistent adaptation of loanwords. The loanwords from Chinese have been borrowed recently since it became the dominant language in the last few decades. On the other hand, those words borrowed from Heqing Bai, the more dominant local language before the prevalent use of Mandarin Chinese, have adapted the Kua'nsi phonology, and it is hard to distinguish between loanwords from Heqing Bai and native Kua'nsi words only based on the phonology.

Syllable structure

The canonical Kua'nsi syllable consists of an initial consonant, a vowel and a tone. However, there are other possible syllable structures. Minimally, a syllabic nasal with a low-falling tone can be a syllable nucleus and directly form a single syllable. Maximally, two consonants can occur together at the onset of the syllable, which is followed by a vowel associated with a tone. In the textual data, it is found some syllables can be contracted. This results in a new syllable that contains two vowels in the syllable nucleus. For example, *tɔ*^{55} 'return' + =*a*^{21} 'SFM' → *tɔa*^{21} 'return.SFM'. All possible syllable structures are listed below, where 'N' represents syllabic nasals or vowels. Syllables in Kua'nsi are all open, i.e., there is no syllable coda. The words below exemplify the possible syllable structures in Kua'nsi. Note that sequences like CCVV and CCCVV are not found in the data.

N	/n̩^{21}-da^{55}/	[n̩^{21}da^{55}]	'NEG-drink'
CV	/gu^{21}/	[g̊u^{21}]	'chew'
CVV	/tɔa^{21}/	[tɔa^{21}]	'return.SFM'
CCV	/p^{h}ja^{55}/	[p^{h}ja^{55}]	'cloth'

For word-initial syllables, the vowel nucleus does not always require a consonant syllable onset. The glottal stop /ʔ/ can occur word-initially as the syllable onset when there is no other word-initial consonant. There is no contrast between these syllables with or without the glottal stop; for example, both *u*^{33}*nu*^{21} and *ʔu*^{33}*nu*^{21} mean 'dog'.

Syllables with the structure CVV are only found in text data. This type of syllable is usually formed as a result of syllable contraction. The syllable contraction in Kua'nsi happens when the case marking clitic /=a^{21}/ or sentence-final marking clitic /=a^{21}/, which share the same phonological shape, is attached to a word. When the vowel nucleus in the final

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syllable of the hosting word is one of the three vowels /ɛ, ɘ, ɨ/, the vowel is reduced to /ɘ/ and the contracted syllable has the structure CVV. More specifically, it will be /CɘA/. If the vowel in the final syllable of the hosting word is not one of these vowels /ɛ, ɘ, ɨ/, other types of syllable contraction will occur but the structure of the contracted syllable does not produce a new type of syllable structure. See Huang (2024: 41–46) for more details about the syllable contraction in Kua'nsi.

Transcription of the recorded passage

This passage was produced by the female speaker JXX and is transcribed phonemically, using the symbols presented in the consonant and vowel charts unless it is a Chinese loanword which may have a different syllable structure, diphthong and/or tone. Note that many vowels in the word-finally syllables are lengthened. Vowel length is not a phonological contrast in Kua'nsi, and non-final syllables do not show a significant difference in terms of duration. Lengthening usually occurs at the final syllable of a phonological word, typically when speakers are thinking while speaking, listing different items or finishing up the speech.

ʔu^{33}tsʰu^{33} ni^{33} ʔmi^{21}xi^{33} | hja^{33}mu^{33} dzɨ^{33} | pi^{21}sai^{33} ‖
sun and wind 3DU TOP compete
'sun and wind is competing (with each other)'

hja^{33}mu^{33} dzɨ^{33} | ʔa^{33}di^{33} tɕʰju^{55} tu^{55} | nɘ^{21}kan^{55} ‖
3DU TOP who one.GEN.CLF more hardworking
'they two want to see who is more hardworking'

ʔa^{33}di^{33} tɕʰju^{55} pan^{51}fa^{213} tu^{55} dza^{55} | su^{21} pi^{21}sai^{33} ‖
who one.CLF:GEN method more have COMP compete
'(they want to) compete who has more ideas'

hja^{33}mu^{33} | dzɨ^{33} a^{21} su^{21} ba^{21} ŋa^{55}mu^{33} | ʔmɘ^{33}dɘ^{21}
3DU reciprocally PROX COMP say 1DU ground
ku^{21}bi^{33}=a^{21} tsʰa^{33} xu^{21}=a^{21} ‖ ʔa^{33}di^{33} tɕʰju^{55} | ʔa^{33}di^{33} tɕʰju^{55} |
above=CM person DIST=CM who one.CLF:GEN who one.CLF:GEN
pʰja^{55} ʔjo̱^{21} xu^{55} tsɨ^{55} xwa^{33} su^{21} bi^{21} su^{21} ba^{21} |
cloth take.off PFV CAUS DIST COMP compete COMP say
'they talk to each other like this: those people on the ground, let's compete and see who can make them take off their clothes'

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dza^{33} ka^{55}~ka^{55} xɔ^{21} dzɨ^{33} ʔmi^{21}xi^{33} | ʔmi^{21}xi^{33} | ʔmi^{21}xi^{33} | pan^{51}fa^{13} mɔ^{33}
CONJ RDP~most front TOP wind wind wind method think
'and then the wind thinks about this'

i^{33} su^{21} ba^{21} | ŋu^{55} do^{21} dzwa̲^{21} ŋu^{55} do^{21} dzwa̲^{21} xwa^{33}ka^{21} dzɨ^{33} |
3SG COMP say 1SG intensively blow 1SG intensively blow then TOP
ts^{h}a^{33} | p^{h}ja^{55} dzwa̲^{21} xu^{55} xu^{21} gɔ^{55} tsɨ^{55} su^{21} | dzwa̲^{21} ʔjo̲^{21}
person cloth blow PFV all give CAUS COMP blow take.off
xu^{55} xu^{21} tsɨ^{55} su^{21} ba^{21} a^{33}ni^{21} ‖
PFV DIST CAUS COMP say but
'he says: if I blow intensively, then I can blow off their clothes. I can make them take off their clothes; however'

i^{33} dza^{33} dzwa̲^{21} u^{21}ɲi^{33} dzwa̲^{21} dza^{33} dzwa̲^{21} wo̲^{21}tɕ^{h}i^{21} dzɨ^{33} ‖
3SG while blow strongly blow while blow strongly TOP
'the more strongly he blows'

ts^{h}a^{33} xu^{55} dzɨ^{33} p^{h}ja^{55} dza^{33} gu^{21} di̲^{33} tɕjo^{21} ‖ ba̲^{21} lɔ^{55} dzwa^{13}~dzwa^{21}
person DIST TOP cloth while wear DI pile.up buckle NMLZ RDP~good
ba̲^{21} tɔ^{55} | i^{33}=a^{21} do^{21} tɕja^{33}ka̲^{21} mu^{33} xwa^{33}ka^{21} dzɨ^{33} ‖
buckle return 3SG=CM intensively cold NMLZ then TOP
'the more clothes those people put on; they buckle their clothes tightly; if they feel more cold then'

la̲^{21}p^{h}a^{33} la^{21} p^{h}ja^{55} tsa^{21} tɔ^{55} xwa^{33}ka^{21} dza^{33} ‖
hand again cloth grab return then CONJ
'they will grab their clothes more tightly and then'

i^{33} dza^{33} wo̲^{21}tɕ^{h}i^{21} dza^{33} dzwa̲^{21} dzɨ^{33} ‖
3SG while strongly while blow TOP
'the more strongly the wind blows'

ʔmi^{21}xi^{33} dza^{33} wo̲^{21}tɕ^{h}i^{21} dzɨ^{33} ts^{h}a^{33} xu^{21} dzɨ^{33} p^{h}ja^{55} dza^{33} gu^{21} di̲^{33} tɕjo^{21} ‖
wind while strongly TOP person DIST TOP cloth while wear DI pile.up
'the more strongly the wind blows, the more clothes they will put on'

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i^{33}=a^{21} tɕja^{33}ka̲^{21} dzɨ^{33} dza^{33} pʰja^{55} do^{21} tɕja^{33} tɕjo^{21} | tɕʰi^{21}
3SG=CM cold TOP while cloth intensively CLF.once pile.up PROG
dzwa̲^{21} xu^{55} xɔ^{33} n̩^{21}-du^{33} ‖
blow PFV succeed not-able.to
'the colder they feel and the more clothes they will put on; the wind does not succeed'

xwa^{55}ka^{21} dza^{33} la^{21} | la^{21} ʔu^{33}tsʰu^{33} | ʔu^{33}tsʰu^{33} | ʔu^{33}tsʰu^{33} pi^{21} |
then CONJ again again sun sun sun compare
ʔu^{33}tsʰu^{33} | pi^{21} ‖
sun compare
'then, the sun (starts) competing'

xwa^{55}ka^{21} dza^{33} ʔu^{33}tsʰu^{33} dzɨ^{33} | ʔu^{33}tsʰu^{33} ka^{21} lu^{33} dza^{33} ʔu^{33}tsʰu^{33} i^{33} i^{21}=a^{21}
then CONJ sun TOP sun arrive come CONJ sun 3SG 3PL=CM
do^{21} tso^{33} do^{21} tso^{33} dza^{33} tɕʰja^{21} ‖
intensively shine intensively shine CONJ one.CLF:once
'then the sun comes and the sun shine strongly; all the sudden'

tsʰa^{33} xu^{33}=a^{21} dzɨ^{33} tsʰu^{55} ɡu^{33} n̩^{21}-di^{21}=a^{21} |
person DIST=CM TOP hot play NEG-want=SFM
tsʰu^{55} ɡu^{33} n̩^{21}-di^{21}=a^{21} ka^{21}dza^{33} ‖
hot play NEG-want=SFM then
'the people feel very hot and they cannot bear it'

dza^{33} tsʰu^{55} dzɨ^{33} dza^{33} pʰja^{55} tɕʰi^{21} tɕʰju^{55} ʔjo̲^{21} xu^{55} |
while hot TOP while cloth one one.CLF:GEN take.off PFV
'the hotter they feel, the less clothes they wear'

dza^{33} tsʰu^{55} dzɨ^{33} dza^{33} pʰja^{55} tɕʰi^{21} tɕʰju^{55} ʔjo̲^{21} xu^{55} xwa^{55}ka^{21} dza^{33} ‖
while hot TOP while cloth one one.CLF:GEN take.off PFV then CONJ
'the hotter they feel, the more clothes they take off'

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ts^{h}u^{55}	gu^{33}	n̩^{21}-di^{21}=a^{21}	dza^{33}	p^{h}ja^{55}	ʔjo̱^{21}	xu^{55}	ga^{21}	‖
hot	play	NEG-want=SFM	CONJ	cloth	take.off	PFV	completely	

'if they cannot bear with the hot weather, they will take off all the clothes'

tsui^{33}xou^{55}	ka^{21}	dza^{33}	‖ ʔu^{33}ts^{h}u^{33}	pi^{21}	xu^{55}=a^{21} ‖
finally	then	CONJ	sun	compare	PFV=SFM

'finally, the sun wins'

ʔmi^{21}xi^{33}	ʔu^{33}ts^{h}u^{33}=a^{21}	pi^{21}	da^{21}	xɔ^{33}	n̩^{21}-di^{21} ‖
wind	sun =CM	compare.to	win	succeed	NEG-able.to

'the sun win the wind in this competition'

Abbreviation

1, 2, 3	first, second, third person	NEG	negation
CAUS	causative	NMLZ	nominaliser
CLF	classifier	PFV	perfective
CM	case marker	PROG	progressive
COMP	complementiser	RDP	reduplication
CONJ	conjunctor	RECP	reciprocal marker
DIST	distal	SFM	sentence final marker
DU	dual	SG	singular
GEN	general	TOP	topic

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Appendix

Possible CV syllables and CC clusters in Kua'nsi. The table in this appendix shows possible CV syllable and CC clusters in Kua'nsi. The blank cells indicate the CV syllable is possible and attested in the data. Grey-shaded cells filled with a dash indicate the sequence is not allowed in Kua'nsi. Grey-shaded cells filled with a question mark mean that such a sequence is possible but is not confirmed in the data, given that a similar CV combination is found in which other consonants of the same place and manner of articulation occur. Black-shaded cells indicate the overlap of the approximants /j, w, ɥ/.

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Table A. Possible CV syllables and CC clusters in Kua'nsi

	a	i	[z]	[ɨ]	o	ɘ	u	ɛ	ɥ	j	w
p			-	-				ʔ	-		
pʰ			-	-				ʔ	-		
b			-	-					-		
t			-	-					-		
tʰ			-	-					-		
d			-	-					-		
k		-	-	-				-	-	-	
kʰ		-	-	-	ʔ			-	-	-	
g		-	-	-	ʔ			-	-	-	
ʔ			-	-				ʔ			
ts		-		-					-	-	
tsʰ		-		-	ʔ				-	-	
dz		-		-					-	-	
tɕ	-	-		-	-		-	-			
tɕʰ	-	-		-	-		-	-			
dʑ	-	-		-	-		-	-			
m/ˀm			-	-					-		
n/ˀn			-	-					-		
ɲ/ˀɲ			-	-				ʔ	-	-	-
ŋ/ˀŋ		-	-	-					-	-	
f		-	-		-	-	-	-	-	-	-
v	ʔ	-	-		-	-	-	-	-	-	-
s				-					-	-	
z				-				ʔ	-	-	
ɕ	-		-	-	-	-		-			-
ʑ	-		-	-	-	-		-		ʔ	-
x			-	-				-		-	
ɣ		-	-	-	-		-	-	-	-	-
h			-	-				ʔ	-		
ɥ			-	-			-				
j			-	-							
w		-	-	-			-				
l/ˀl			-	-					-		
[pɸ]	-	-	-		-	-	-	-	-	-	-
[pɸʰ]	-	-	-		-	-	-	-	-	-	-
[bβ]	-	-	-		-	-	-	-	-	-	-

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