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Project: The Phonetics of the Yunlong dialect of the Bai Language

1. About the Bai Language

The Bai language is spoken in Dali Autonomous Prefecture, Yunnan, China, in communities of Jianchuan, Bijiang, Dali, Xiaguan, Yulong, Eryuan, and Heqing. Speakers of the Bai language are also found in places around the Prefecture such as Weixi, Baoshan, Lijiang, Chuxiong, and Kunming. There are approximately 1.3 million speakers of Bai according to Yunnan consensus data of 1990 (Wiersma 2003), and many Bai speakers are bilingual. In addition to bilingualism involving Mandarin, bilingualism involving Naxi, Lisu, and Yi are also common.

The Bai language is classified as Tibeto-Burman by Wiersma(2003), and Matisoff (2001,2003), but as Sinitic by Greenburg (1953) and Benedict (1982). More specifically, some scholars has argued that Bai is closely related to the Yi (Loloish) group based on some of its syntactic and phonological features (Zhao, 1982; Wu, 2000).

2. The informant

My informant for this project is a 34-year-old female native speaker of the Yunlong dialect of Bai who acquired Bai and Southwestern Mandarin simultaneously as a child. She grew up at Yunlong, Dali, and later moved to Kunming for college at the age of 18. She also learned Standard Chinese (Putonghua) as part of her curriculum as required by the Communist Party, and speaks Kunminghua (the Kunming dialect of Southwestern Mandarin) for daily communication with colleagues and family members. She now teaches Chinese at an elementary school in Kunming and rarely speaks in the Bai language on daily bases. She almost only uses the Bai language with her parents whom she meets two or three times a year and with other speakers of Bai from her hometown Yunlong. My informant was never taught the script of Bai, nor is she aware of any writing system or romanization of the language. She is by no means trained in linguistics and is not familiar theoretically with the phonetics or phonology of the Bai language. Due to the nature of this project as a practice of describing a language I don't speak, no more informants were interviewed. However, more informants are needed to produce a more accurate documentation.

3.Syllable structure

Each syllable in Bai is tone bearing. The primary syllable pattern of the dialect of Bai that my informant speaks is (C)V(V). In other words, each syllable is consisted of at least one vowel, sometimes two. A consonant onset is optional. No consonant clusters are permissible as syllable onset. Neither did any consonant appeared as codas. There are 29 consonants, seven monophthongs, and nine diphthongs in the Yunlong dialect of Bai spoken by my informant.

4. Consonants

There are 29 consonants in utterances of my informant, as shown in the table below. Among the 29 consonants, nine are plosives, four are nasals, seven are fricatives, six are affricates, in addition to three approximants: one bilabial, one palatal, and one lateral. My informant has six places of articulation, bilabial, labio-dental, alveolar, alveolo-palatal,

palatal, as well as velar.

		Bilabial		***Labio-dental***		***Alveolar***		***Alveolo-palatal***		***Palatal***	***Velar***	
		Voiceless	***Voiced***	***Voiceless***	***Voiced***	***Voiceless***	***Voiced***	***Voiceless***	***voiced***	***Voiced***	***Voiceless***	***Voiced***
Plosive	***unaspirated***	p	b			t	d				k	g
	aspirated	p^h				t^h					k^h	
Nasal			m				n			ɲ		ŋ
Fricative				f	v	s	z	ɕ			x	ɣ
Affricate	***unaspirated***					ts	dz	tɕ	dʑ			
	aspirated					ts^h		$tɕ^h$				
Approximant			w							j		
Lateral Approximant							l					

Table 1: consonant inventory

4.1 Plosives

Stops occur in four places of articulation: bilabial, alveolar, and velar. All voiceless stops distinguish aspiration. Although most Bai dialects only distinguish voicing in some plosives, my informant distinguished in all the plosives possible. The following figures show the distinction between voiced and voiceless stops.

The following table shows near-minimal sets of voiceless aspirated, voiceless unaspirated, and voiced stops with different places of articulation.

	bilabial	alveolar	velar
Voiceless aspirated	sun [ɲi44[1] p^hi31]	road [t^hɔ33]	hide (verb) [tsɔ42 k^hɯu33]
Voiceless aspirated	salt [pi34]	chop [tɔ43]	sell [kɯu32]
voiced	low [bi33]	big [dɔ32]	thick [gɯu33]

Table 2: near-minimal sets of plosives

The following figures illustrates the difference among voiceless aspirated, voiceless unaspirated, and voiced stops in my informant's utterances.

For bilabial stops, figure 1 shows the spectrogram and waveform of the word for sun, [ɲi44 p^hi31], with a 126 ms. VOT in /p^h/. Figure 2 shows the spectrogram and waveform of the word for salt, [pi34], with a very short VOT of 15 ms. in /p/. Figure 3 shows the

1. a 1-5 numbering system was adopted for transcription of tones in this project, with 1 being the lowest and 5 being the highest.

spectrogram and waveform of the word for low, [bi33], with a -104 ms. VOT in /b/, and voicing is clearly shown on the spectrogram.

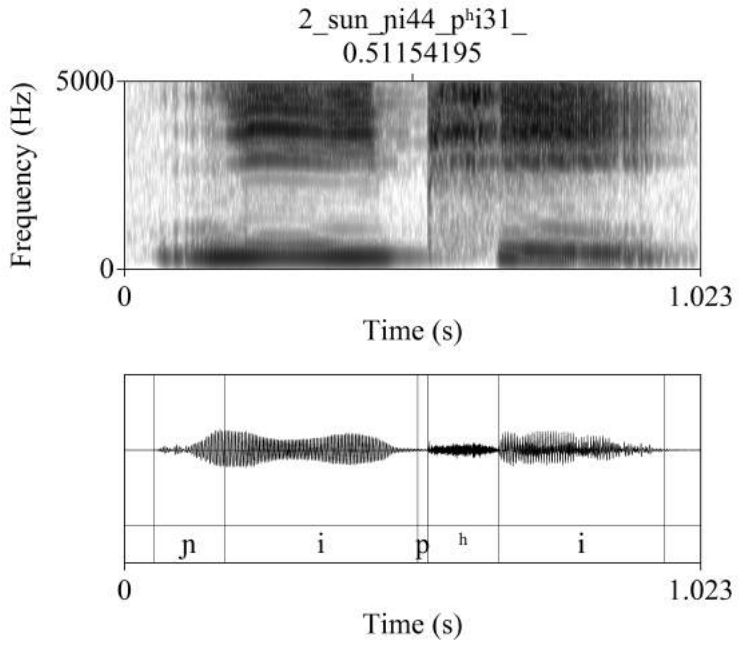

Figure 1: spectrogram and waveform of [ɲi44 pʰi31], with a 126ms VOT in /pʰ/

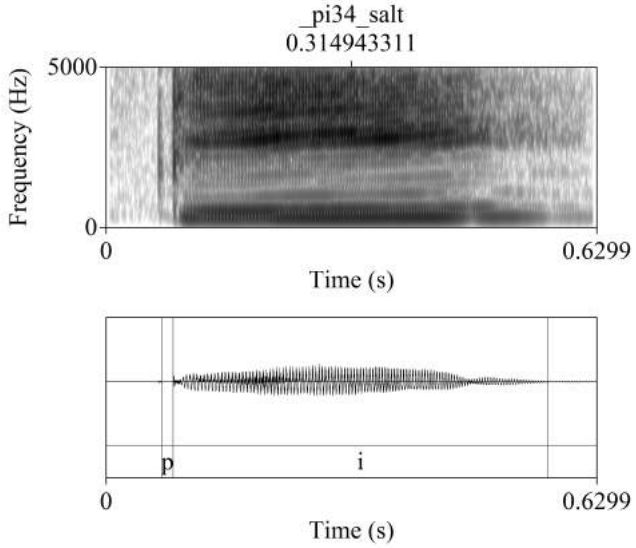

Figure 2: spectrogram and waveform of [pi34], with a 15 ms. VOT in /p/

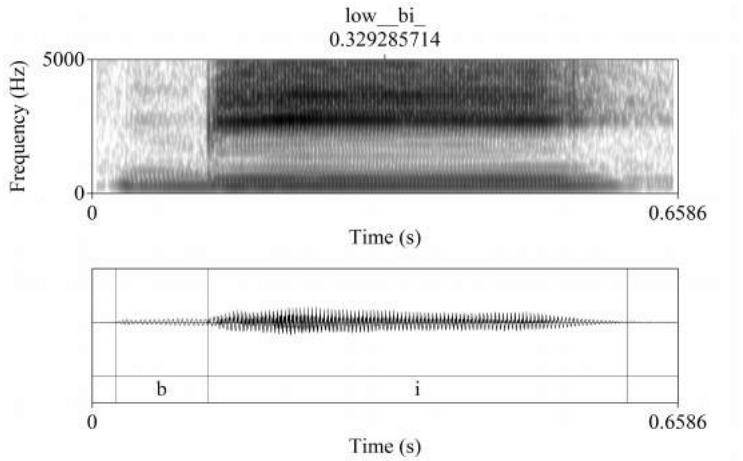

Figure 3: spectrogram and waveform of [bi33], with a -104 ms. VOT in /b/

For alveolar stops, figure 4 shows the spectrogram and waveform of the Bai word for road, [tʰɔ33], with a 134 ms. VOT in /tʰ/. Figure 5 shows the spectrogram and waveform of the word for the verb chop, [tɔ43], with a 15 ms. VOT in /t/. Figure 6 shows the spectrogram and waveform of the word for big, [dɔ], with a -208 ms. VOT in /d/, and with clear signs of voicing on the spectrogram.

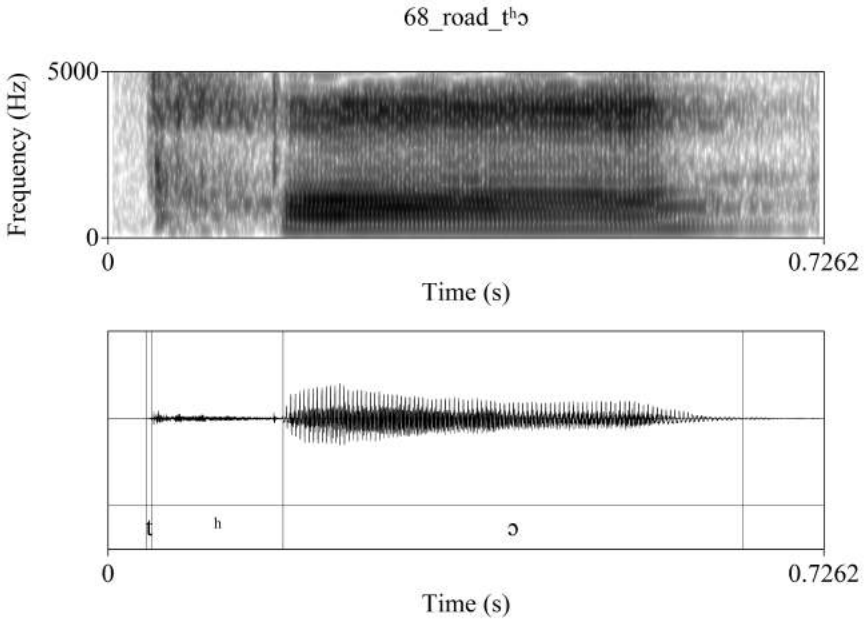

Figure 4: spectrogram and waveform of [tʰɔ33], with a VOT of 134 ms in /tʰ/

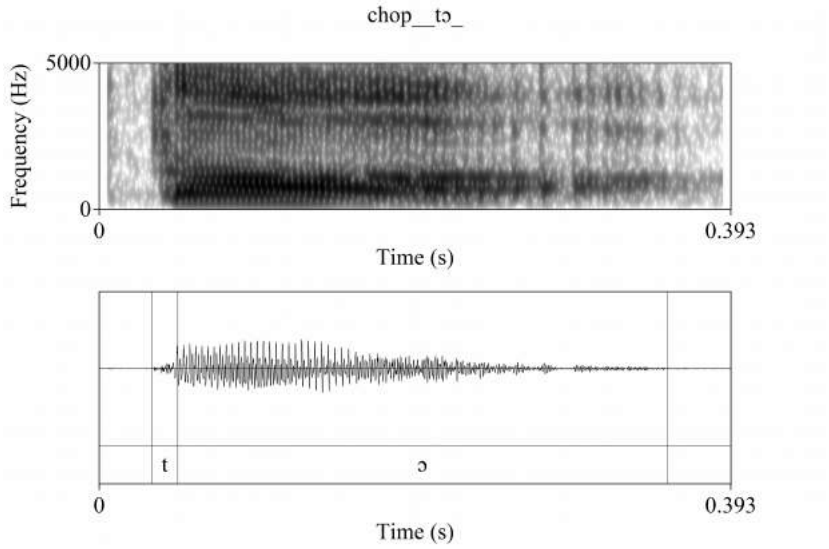

Figure 5: spectrogram and waveform of [tɔ43] with a very short VOT of 15 ms in /t/

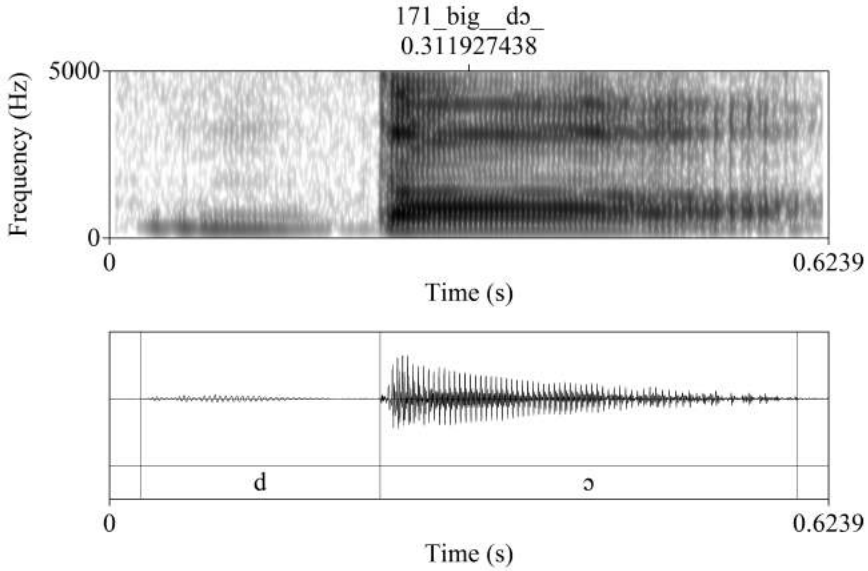

Figure 6: spectrogram and waveform of [dɔ32], with a -208 ms. VOT in /d/

For velar stops, figure 7 shows the spectrogram and waveform of the Bai word for the verb hide, [tsɔ42 kʰɯu33], with a 66 ms. VOT in /kʰ/. Figure 8 shows the spectrogram and waveform of the word sell, [kɯu32], with a 23 ms. VOT in /k/. Figure 9 shows the spectrogram and waveform of the word for thick, [gɯu33], with a -121 ms. VOT in /g/, and with clear signs of voicing on the spectrogram.

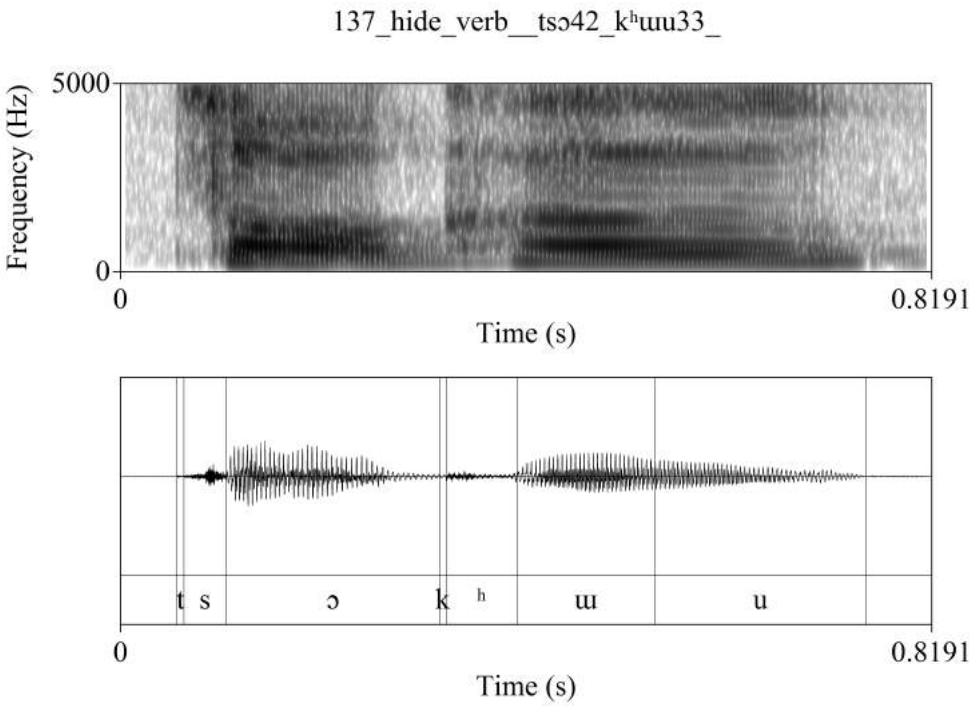

Figure 7 spectrogram and waveform of [tsɔ42 kʰɯu33], with a 66 ms. VOT in /kʰ/

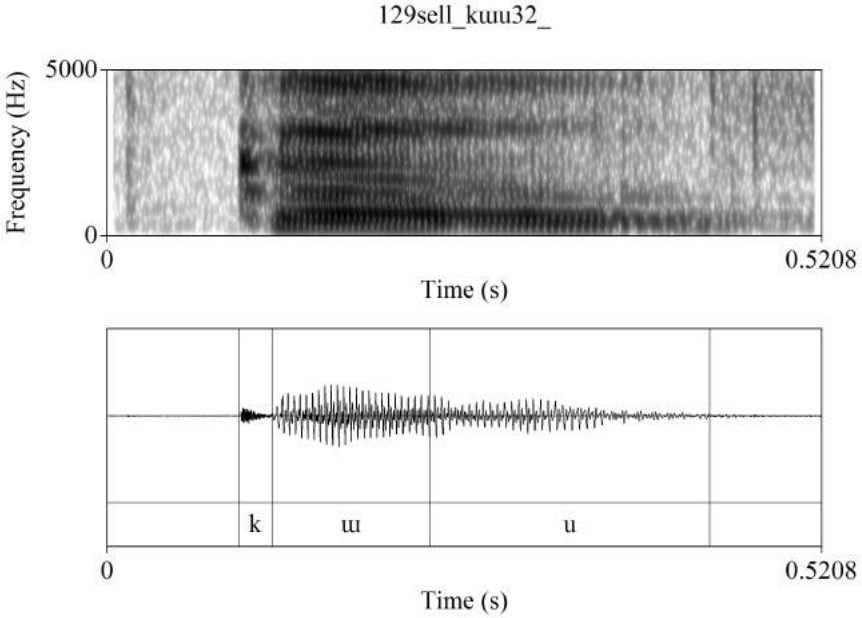

Figure 8 spectrogram and waveform of [kɯu32], with a 23 ms. VOT in /k/

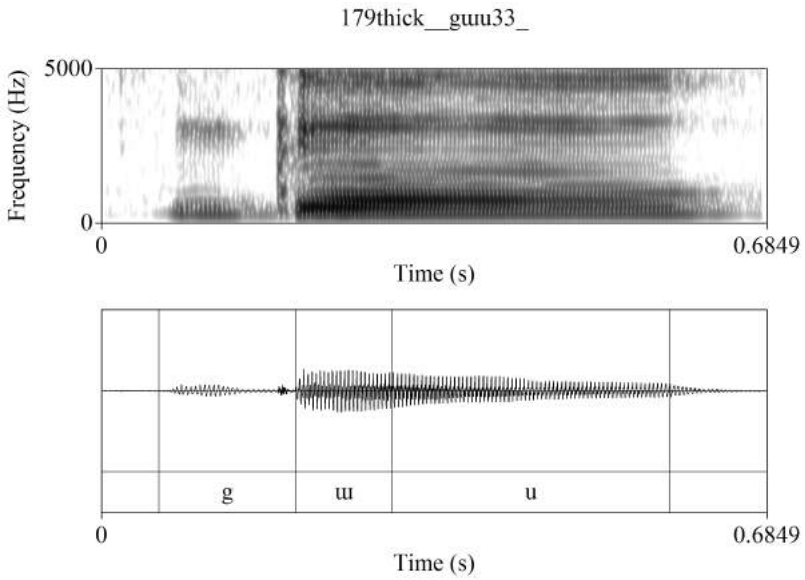

Figure 9 spectrogram and waveform of [guu33], with a -121ms. VOT in /g/

4.2 Fricatives

Seven fricative phonemes presented in my informant's utterances of reading a word list containing 206 items. The fricative phonemes are /f/, /v/, /s/, /z/, /ɕ/,/x/, and /ɣ/. Among them, the labio-dental fricatives, the alveolar fricatives, as well as the velar frivatives distinguish between the feature of voicing, whereas /ɕ/ doesn't have a voiced counterpart. One syllabic fricative /ʮ/ is also present as an allophone of the high back rounded vowel phoneme /u/.

4.2.1 Labio-dental fricatives

The labio-dental fricatives /f/ and /v/ distinguish between voicing. The following table of minimal pairs of /f/ and /v/ show the phonemic status of /f/ and /v/. The figures below the list show the difference between /f/ and /v/ in my informant's utterances. In figure 10, the spectrogram and waveform of the Bai word for “good” [fe34], there is no sign of voicing during the fricative, whereas in figure 11, the fricative part of the spectrogram and waveform of the word [ve32] (to stalk, to accompany) is clearly voiced. Similarly, in figure 12, the spectrogram and waveform of [fa34], the Bai word for “law”, the fricative /f/ is voiceless, whereas in figure 13, the spectrogram and waveform of the word sock ([va34]), there is clear indication of voicing.

	Minimal pair 1	Minimal pair 2
/f/	[fe34] good	[fa34] law
/v/	[ve32] to stalk, to accompany	[va34] sock

Table 3 /f/, /v/ minimal pairs

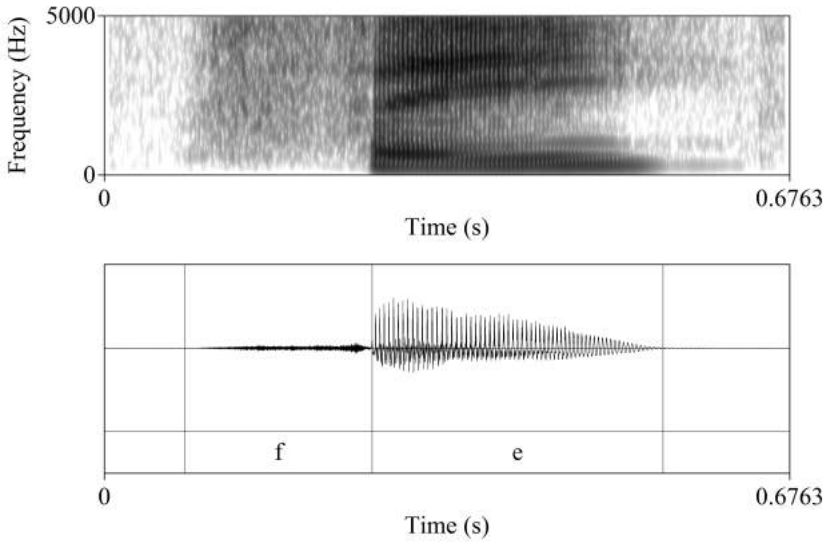

Figure 10 spectrogram and waveform of [fe34]

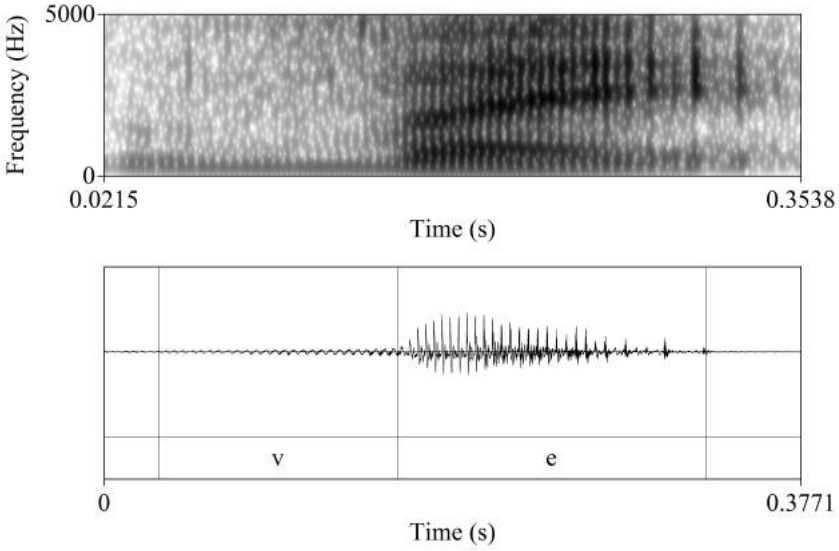

Figure 11 spectrogram and waveform of [ve32]

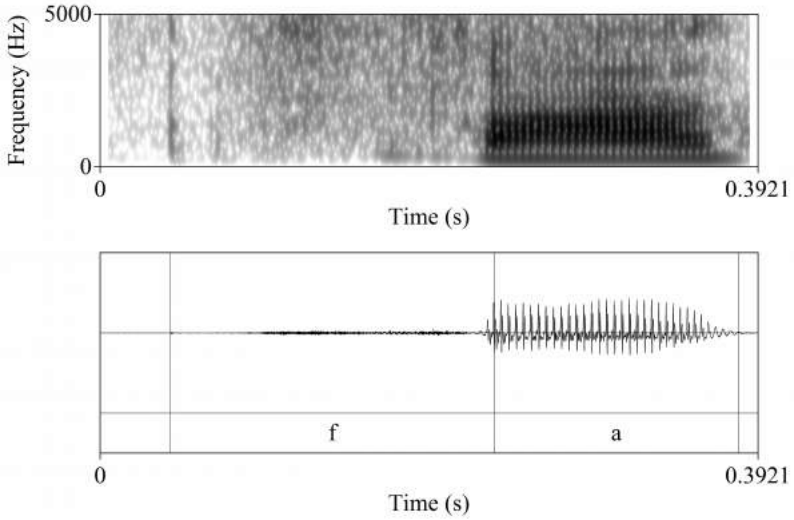

Figure 12 spectrogram and waveform of [fa34]

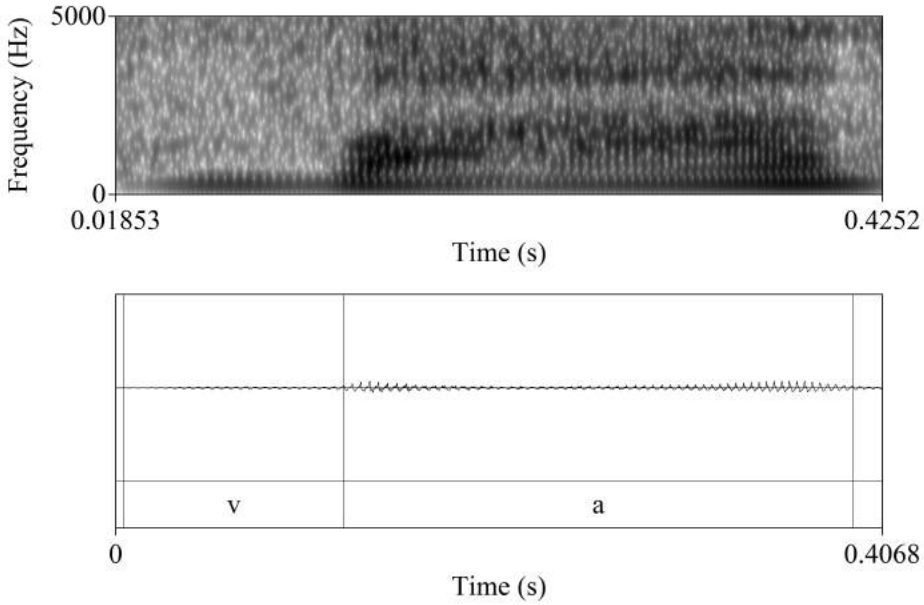

Figure 13 spectrogram and waveform of [va34]

4.2.2 Alveolar fricatives

Like the labio-dental fricatives, alveolar fricatives also distinguish between voicing. The following is one of several minimal pairs of the voiceless and voiced alveolar fricatives. The following figures illustrate the difference between /s/ and /z/. In figure 14, there is no sign of voicing in [s] on the spectrogram whereas in figure 15, the spectrogram shows that the fricative at the beginning is no-doubtedly voiced.

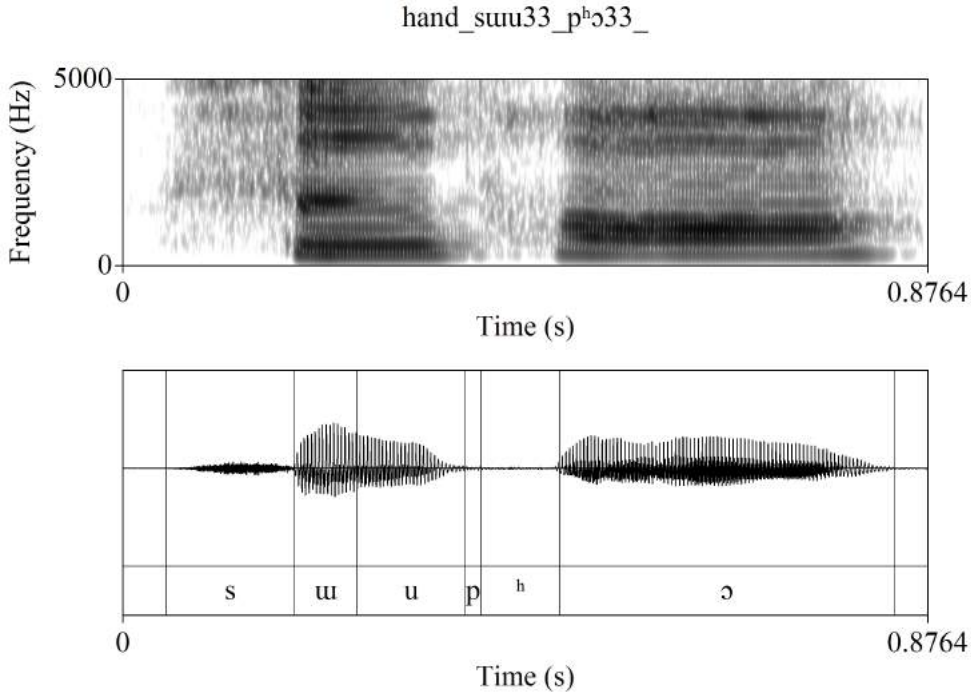

Figure 14 spectrogram and waveform of [sɯu33 pʰɔ33]

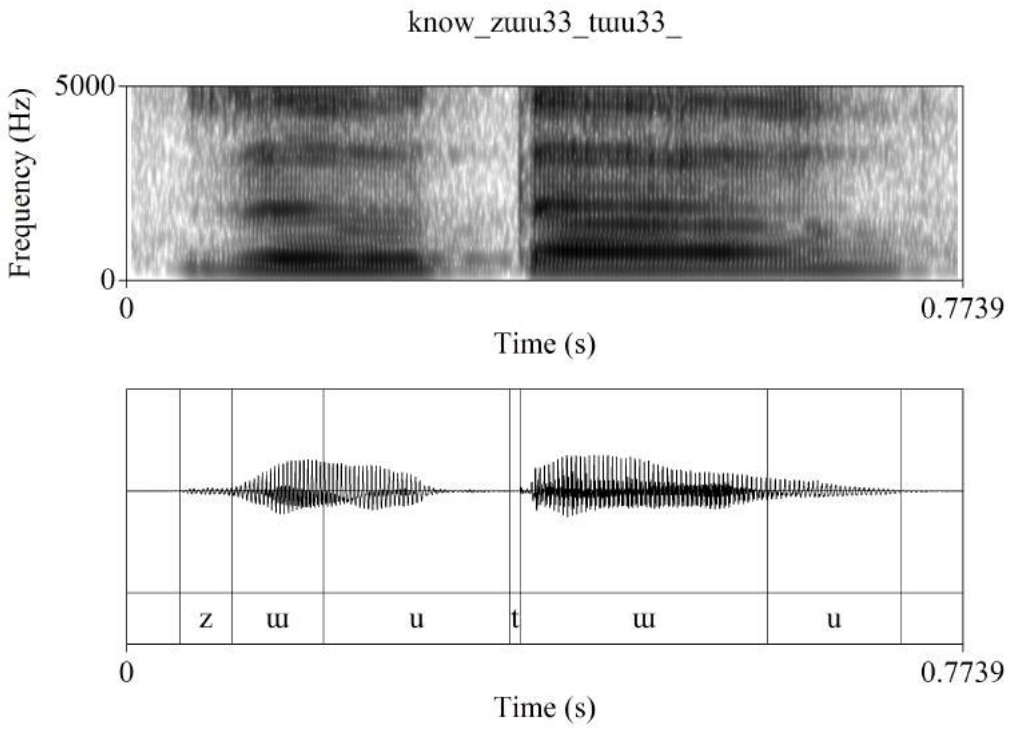

Figure 15 spectrogram and waveform of [zɯu33 tɯu33]

4.2.3 Palato-alveolar fricatives

The palato-alveolar fricatives /ɕ/ doesn't have a voiced counterpart and the following minimal pairs show its phonemic status.

Minimal pair 1	Minimal pair 2
[sɛ55] color [ɕɛ55] star	[sɔ55] forgive; give up [ɕɔ55] repair

Table 4 Minimal pairs of /ɕ/ and /s/

4.2.4 Velar fricatives and their allophones

There are two velar fricatives in the Yunlong dialect of Bai: the voiceless /x/, and the voiced /ɣ/. The following table of minimal pairs along with the figures show the phonemic status of the voiced and voiceless velar fricatives. In figure 16, the spectrogram of the velar fricative /x/ shows its voicelessness, whereas in figure 17 the dark bar at the bottom of the spectrogram indicates that the velar fricative /ɣ/ is voiced.

	Minimal pair 1	Minimal pair 2	Minimal pair 3
/x/	/xɛ55zɨ32/ cooked rice	/xɯu31/ (prep.) inside	/xɯu33/ thread
/ɣ/	/ɣɛ32/ to cut (paper or cloth) with knife	/ɣɯu31/ leak	/ɣɯu33/ back

Table 5 Minimal pairs of /x/ and /ɣ/

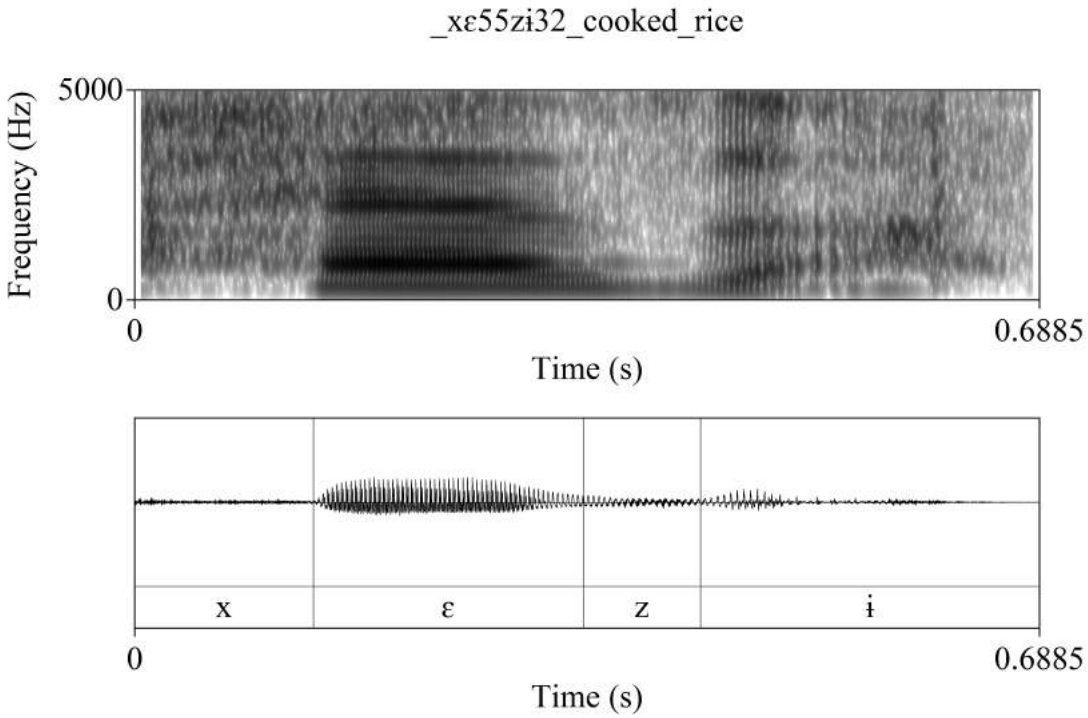

Figure 16 spectrogram and waveform of [xɛ55zɨ32]

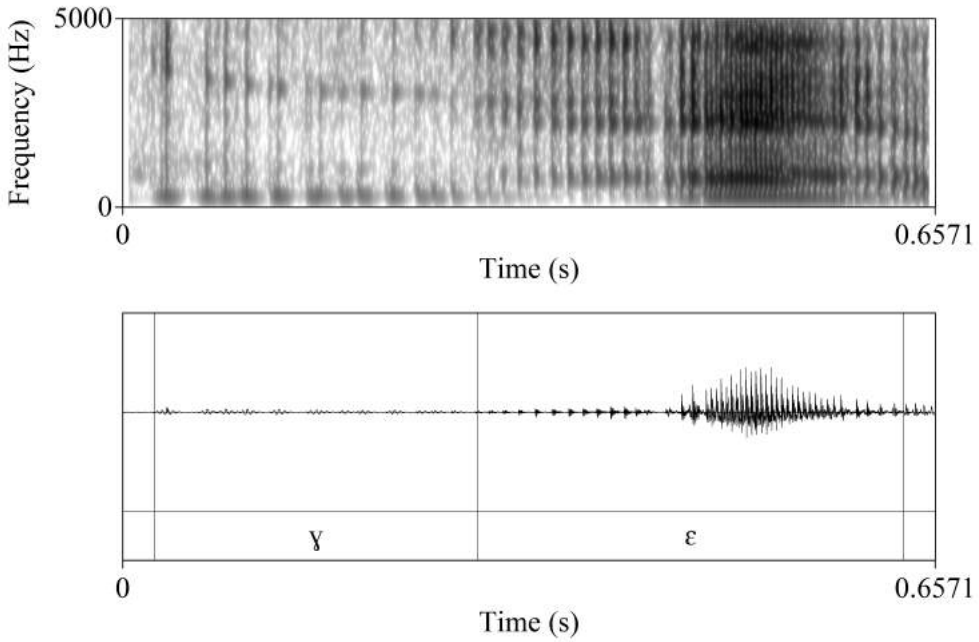

Figure 17 spectrogram and waveform of [ɣɛ32]

The voiceless velar fricative /x/ has an allophone of /χ/, the voiceless uvular fricative. /x/ is realized as /χ/ in front of the high back unrounded vowel [ɯ]. The following words show the environment where the uvular fricative allophone occurs:

1. hate [χɯu33]
2. black [χɯu33]
3. cooked (adjective) [χɯu33 nɔ33]

4.2.5 Syllabic fricative

One syllabic fricative [ɣ̩] is present in my informant's utterance. The fact that my informant cannot think of any words pronounced as [fu] or [vu] but instead asked me if I meant [fɣ̩] or [vɣ̩], and that when asked if words like [tʰɣ̩], [tɣ̩], [dɣ̩], etc. existed, the speaker responded as if the combination of a consonant followed by [ɣ̩] is not possible, led me to believe that [u] does not occur after the fricatives [f] and [v], and that the syllabic fricative [ɣ̩] only appears after [f] and [v] hence qualifying [ɣ̩] as an allophone of [u] which is realized when it is following [f] or [v]. The following words show the environment in which the fricative vowel [ɣ̩] occurs.

1. [vɣ̩33ɕi33] rain (noun)
2. [wɔ41vɣ̩33ɕi33] to rain (verb)
3. [vɣ̩32 tɕi22] thing, object
4. [pi43 fɣ̩44tɯ42ne32] nose
5. [fɣ̩43 kua42] pen

4.3 Affricates

Affricates only occurred at two places of articulation in the dialect of Bai spoken by my informant, the alveolar, and the alveolo-palatal. There are 6 affircate phonemes in total in my informant's utterances, namely /tɕ/, /tɕʰ/, /dʑ/, /ts/, /tsʰ/, and /dz/. The affricates produced at both places of articulation all distinguish between the feature of voicing, and, in the voiceless ones, distinguish between the feature of aspiration. The following two tables show near-minimal sets of voiceless aspirated fricatives, voiceless unaspirated fricatives, and voiced fricatives of the two different places of articulation.

	Alveolar
Voiceless aspirated	spit [tsʰɨ44 tɕʰe33]
Voiceless unapirated	this year [kɛ44 tsɨ44 sua33]
Voiced	paper [dzɨ33]

Table 6 near-minimal set of voiceless aspirated, voiceless unaspirated, and voiced alveolar affricates

	Alveolo-palatal
Voiceless aspirated	get angry [tɕʰi33 tsa33]
Voiceless unaspirated	numerous [tɕi34]
Voiced	push [dʑi33 kʰɯu33]

Table 7 near-minimal set of voiceless aspirated, voiceless unaspirated, and voiced alveolar affricates

The following figures illustrate the difference between voiceless aspirated affricates, voiceless unaspirated africates, and voiced affricates produced at both places of articulation. In figure 18, a VOT of 160 ms. is indicative of the aspiration in the affricate /tsʰ/ of the verb spit [tsʰɨ44 tɕʰe33]. Figure 19 is the spectrogram and waveform of the utterance [kɛ44 tsɨ44

sua33] which is the Bai word for “this year”. The figure shows a VOT of 96 ms in /ts/ indicating the lack of aspiration, In figure 20, the spectrogram and waveform of the Bai word for paper, [dzɨ33], one can see that voicing started far before the releasing of the consonant [d], with a VOT of -76 ms. in /dz/. The same is true for figures 21, 22, and 23. In figure 21, the verb for “get angry”, [tɕʰi33 tsa33], has a VOT of 158 ms. in /tɕ/, in figure 22, the spectrogram and waveform of the Bai word for “great in number”, [tɕi34], has a 101 ms. VOT in /tɕ/, and in figure 23, the verb push, [dʑi33 kʰɯu33], has a -50 ms. VOT in /dʑ/.

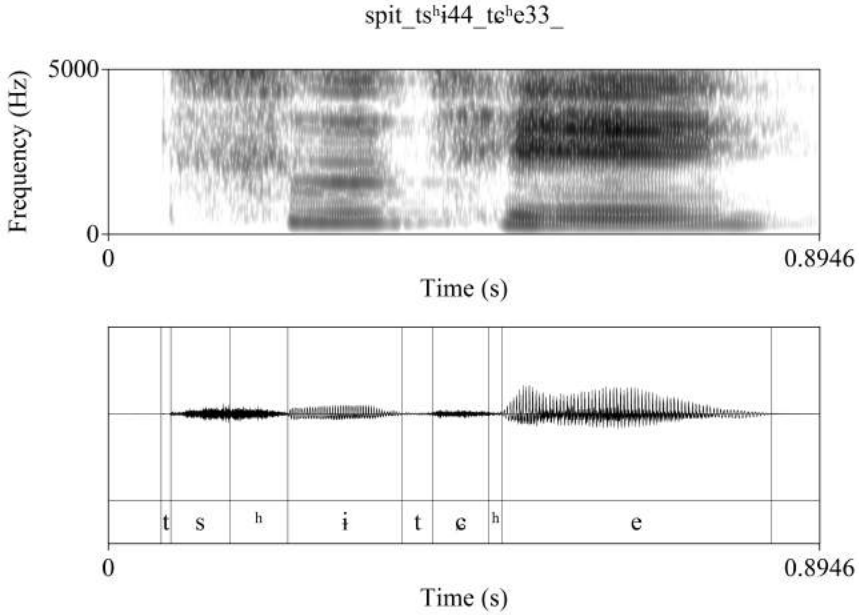

Figure 18 spectrogram and waveform of [tsʰɨ44 tɕʰe33], with a 160 ms VOT in /tsʰ/

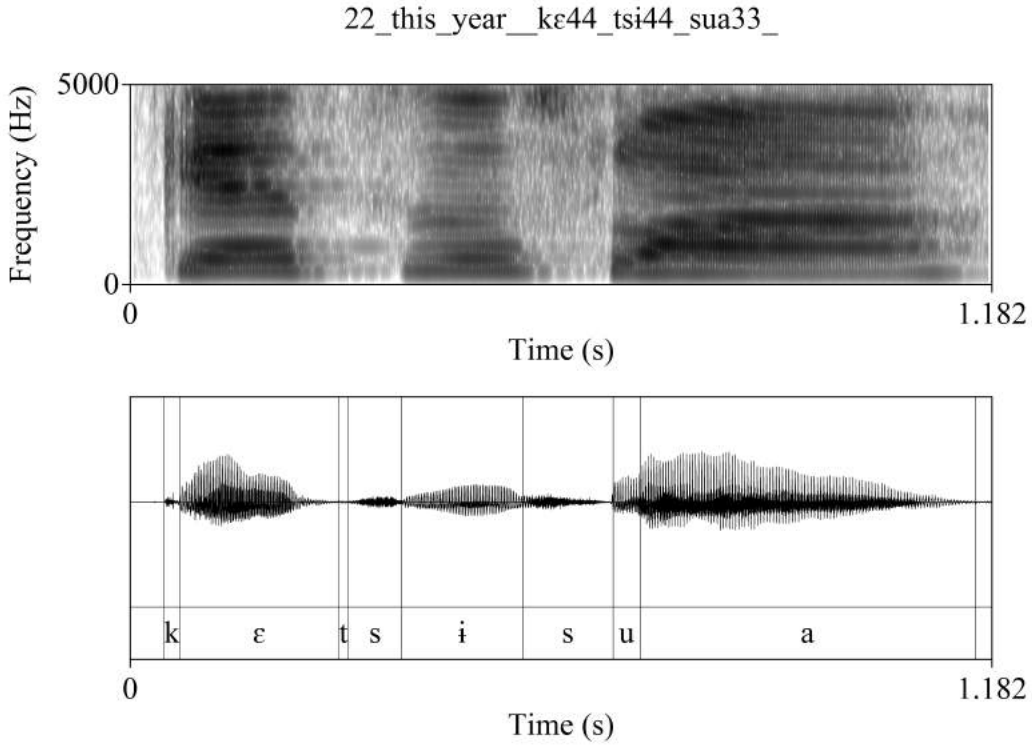

Figure 19 spectrogram and waveform of [kɛ44 tsɨ44 sua33] with a 96ms. VOT in /ts/

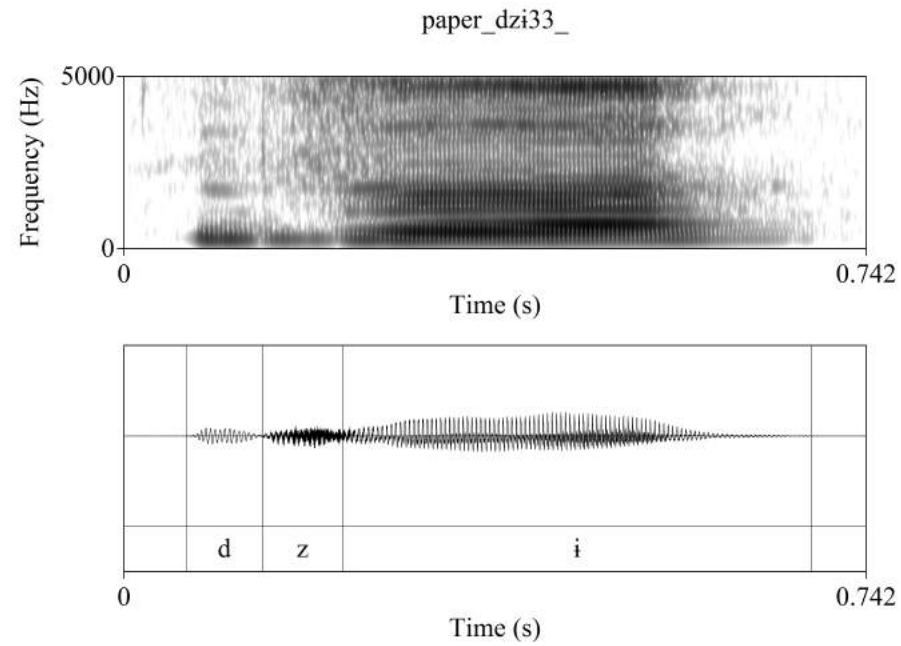

Figure 20 spectrogram and waveform of [dzɨ33] with a -76 ms. VOT in /dz/

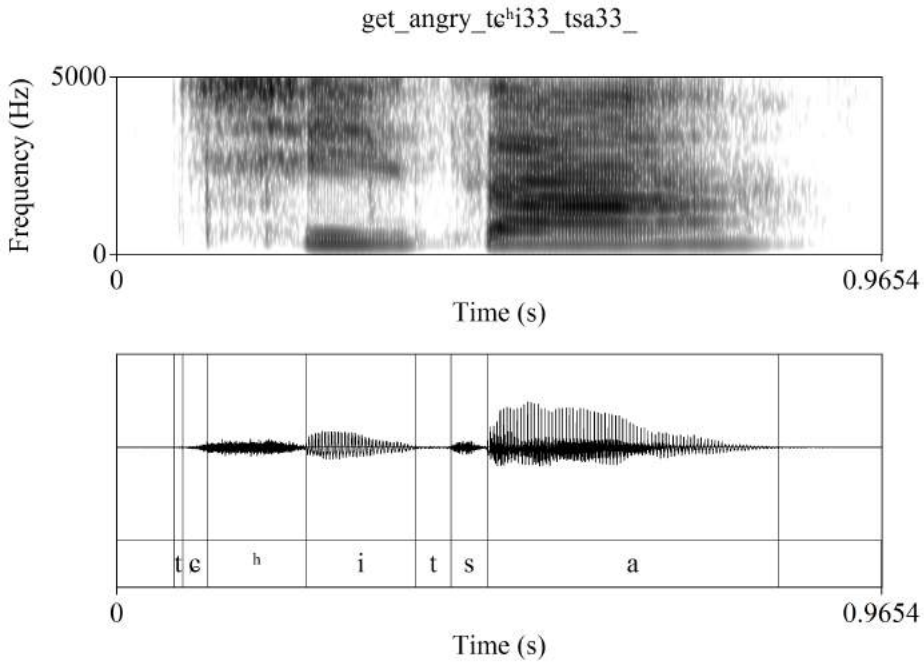

Figure 21 spectrogram and waveform of [tɕʰi33 tsa33] with a 158 ms. VOT in /tɕʰ/

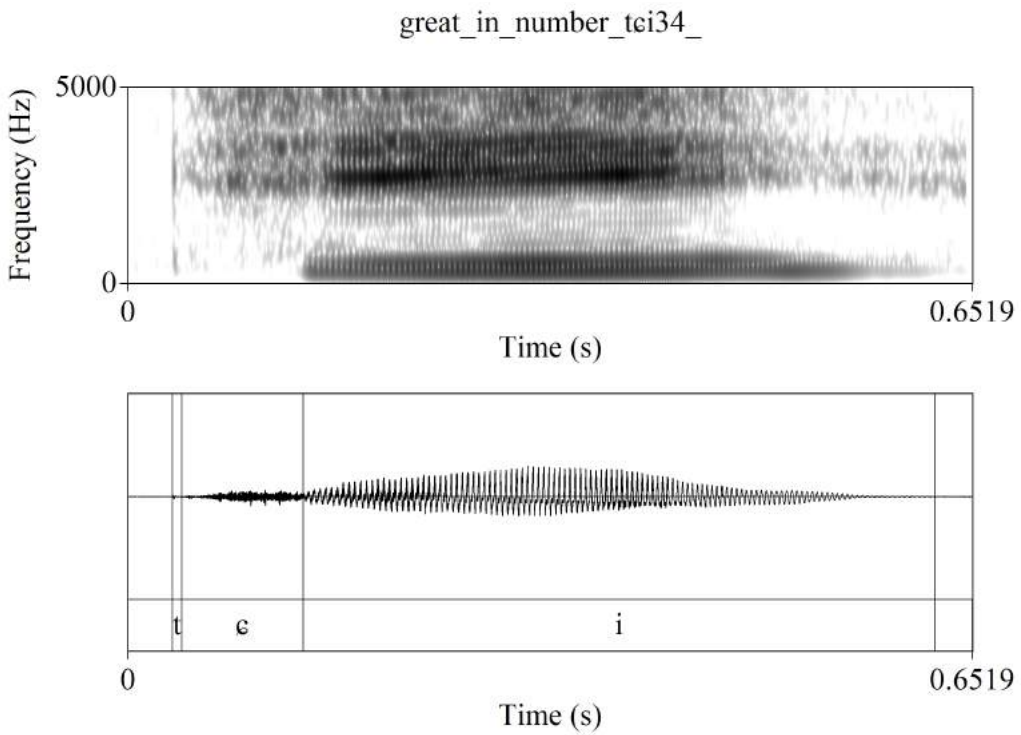

Figure 22 spectrogram and waveform of [tɕi34] with a 101 ms. VOT in /tɕ/

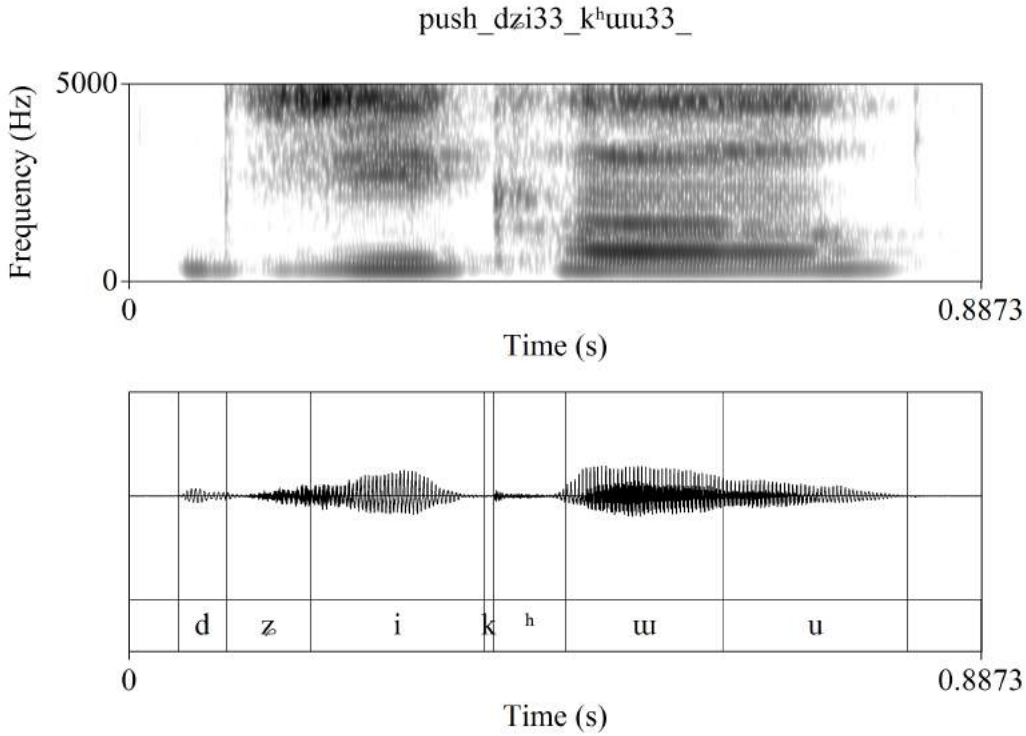

Figure 23 spectrogram and waveform of [dʑi33 kʰɯu33] with a -50 ms. VOT in /dʑ/

4.3.1 Phonemic status of the affricates

The following minimal set shows that the alveolar affricates and the alveolo-palatal affricates are not allophones of each other.

Minimal pair 1:

- [tɕɔ44] sedan chair
- [tsɔ31] long

Minimal pair 2:

- [tɕʰɔ44] to bend upwards
- [tsʰɔ44] rub with force

4.4 Nasals

There are four nasal stops in the dialect of Bai that my informant speaks: /m/, /n/, /ɲ/, and /ŋ/. All of them can only occur as onset of a syllable. The table below shows a minimal set of /n/, /ɲ/, and /m/, and a near-minimal set of /ŋ/, /n/ and /m/ (only varying in the tone of /ma/). My informant was unable to find a minimal pair for /ŋ/ and /ɲ/. However, since the velar nasal also occurs preceding front vowels (e.g. to bite [ŋa33]) and the palatal nasal also occurs in front of back vowels (e.g. ear [ɲɔ43tɯu̱ʔ41pʰɒ33]), it is unlikely that the two are allophones.

Minimal set 1 (/ɲ/, /n/, and /m/)	Minimal set 2 (/ŋ/, /n/ and /m/)
[ɲɔ31] stir fry	[ŋa33] bite (verb)
[nɔ55] count on, rely on	[na33] take
[mɔ33] mother	[ma34 kʰəʊ44] push

Table 8 minimal sets of nasal stops

4.5 Approximants

There are three approximants in my informant's dialect of Bai. They are /w/, /j/, and /l/. As is mentioned in the beginning of this paper, all three of the approximants can only be found in the onset of a syllable. The following are some examples of the environment in which the approximants can occur.

/w/

1. to rain (verb) [wɔʔ42vɣ̱33ɐi33]
2. write [wɛ31]
3. bent [wɛ34 nɔ33]

/j/

1. carry something on the back [jɛʔ42]
2. knife [ji33 ta33 dzi33]
3. medicine [jɔ33]
4. eat [jɯu33]
5. encounter/run into [jy33 tɯu33]

/l/

1. butterfly [kuɔ55 li44]
2. root [teɪ33 leɪ32]
3. alcohol(drink) [li32 tɕʰi44]

5. Vowels

5.1 Phonological analysis

5.1.1 Monophthongs

There are seven monophthong vowel phonemes in the Bai dialect spoken by my informant. The vowel phonemes are: /i/, /e/, /ɛ/, /a/, /ɯ/, /u/, and /ɔ/. The figure below illustrates the vowel phonemes in the Yunlong dialect of Bai on a vowel chart, and the table following shows lip-rounding, front-ness and jaw position of the vowels.

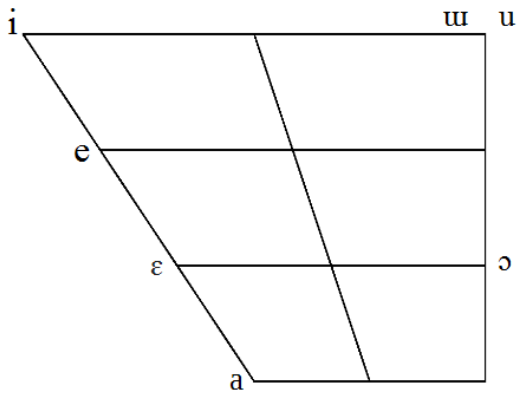

Figure 24 vowel inventory

	Front	Back-unrounded	Back-rounded
Close	i	ɯ	u
Close-Mid	e		
Open-mid	ɛ		ɔ
Open	a		

Table 9 vowel phonemes in the Yunlong dialect of Bai

Two near-minimal set containing all of the vowel phonemes is found among the words in the word list pronounced by the informant. The minimal set is listed below:

	/m/	/p/
/i/	[mi21] thin bamboo strip	[pi55] (direction) left
/e/	[me21] door	[pe21] (noun)skin, hide
/ɛ/	[mɛ21] bright	[pɛ21] to compensate, pay for
/a/	[ma21] hair	[pa34] grandfather (non-biological)
/ɯ/	[mɯ21] to make noise	[pɯ21] float
/u/	[mu34 ti34] purpose	[pu21] dip
/ɔ/	[mɔ] escape	[pɔ21] half

Table 10 near-minimal sets of all vowel phonemes

5.1.1.1 Allophones of monophthongs

Two of the monophthongs have noticeable allophones, as illustrated in the table below.

Monophthong phoneme	Allophone	Environment
/u/	[ʮ]	after labio-dental fricatives /f/ and /v/
	[u]	after consonants other than /f/ and /v/
/i/	[ɨ]	after alveolar affricates /tsʰ/, /ts/, and /dz/, as well as alveolar fricatives /s/, /z/
	[i]	zero onset, after stops, nasals, alveolo-palatal affricates, alveolo-palato fricatives, bilabial approximants, and palatal approximants

Table 11 monophtong allophones

5.1.2 Diphthongs

There are nine diphthongs in the Yunlong dialect of Bai. The diphthongs are: /iɛ/, /ia/, /iɯ/, /iɔ/, /ɯu/, /ue/, /uɛ/, /ua/, and /uɔ/. The following table shows the instances where these diphthongs occurred.

Phoneme	Pronunciation	Meaning of word
/iɛ/	[ȶiɛ55]	star
/ia/	[lia33]	bright
/iɯ/	[kəʔ31 tʰiɯ44]	sit
/iɔ/	[ȶiɔ33]	scarce
/ɯu/	[kɯu32]	ride
/ue/	[kʰue33]	vomit
/uɛ/	[kuɛ44]	bizarre
/ua/	[kʰua44]	slow
/uɔ/	[kuɔ55 li44]	butterfly

Table 12 examples of diphthongs

5.1.2.1 Allophones of diphthongs

The diphthong /ui/ is realized as [y] when it appears after alveolo-palatal consonant /ȶ/ palatal approximant /j/, as well as alveolo-palatal affricates /tȶ/, /tȶʰ/, and /dʑ/. When following consonants /g/, /k/, /kʰ/, /ŋ/ /ɣ/, and /x/, /ui/ is realized as [ui]. The following table reiterates the environments where the allophones appear.

phoneme	allophone	environment
/ui/	[y]	after /tȶ/, /tȶʰ/, /ȶ/, /dʑ/, /j/
	[ui]	after /g/, /k/, /kʰ/, /ŋ/ /ɣ/, /x/

Table 13 allophones of diphthong /ui/

5.2 Acoustic analysis

The following table lists the F1 and F2 values of all the phoneme and their allophones that occur in the utterance of my informant. All measurements were done using Praat.

Phoneme	Allophone	F1 (Hz)	F2 (Hz)
/i/	[i]	400	2770
	[ɨ]	575	1600
/e/	[e]	720	2550
/ɛ/	[ɛ]	940	2140
/a/	[a]	1100	1510
/ɯ/	[ɯ]	390	1130
/u/	[u]	425	930
	[ʏ]	430	1120
/ɔ/	[ɔ]	900	1040

Table14 F1 and F2 values of vowel phonemes and allophones

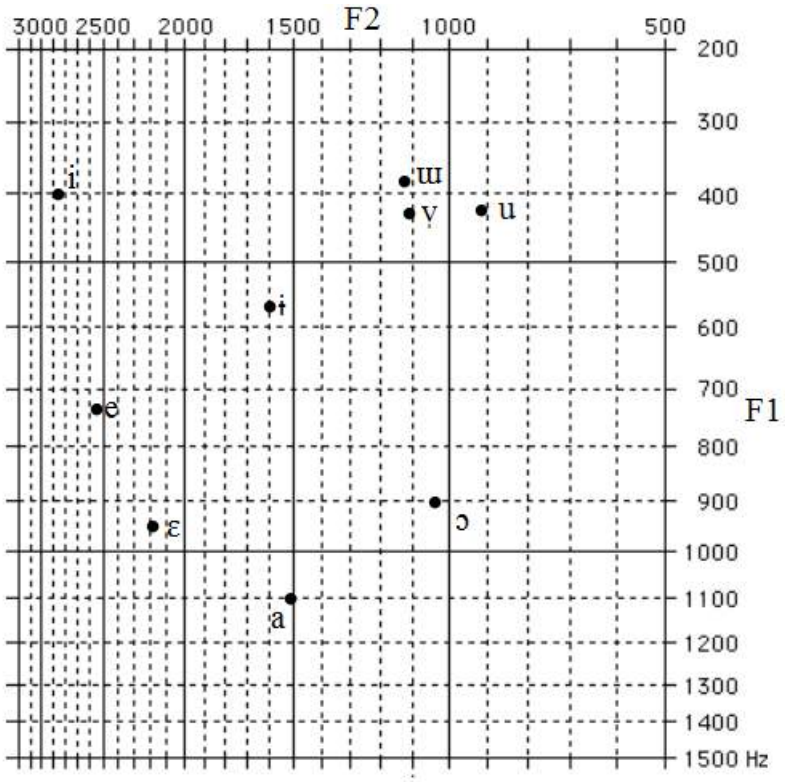

Figure 25 Chart of F1 and F2 values of each allophone

The 9 figures below show formant contours of words containing each of the phonemes and allophones listed above.

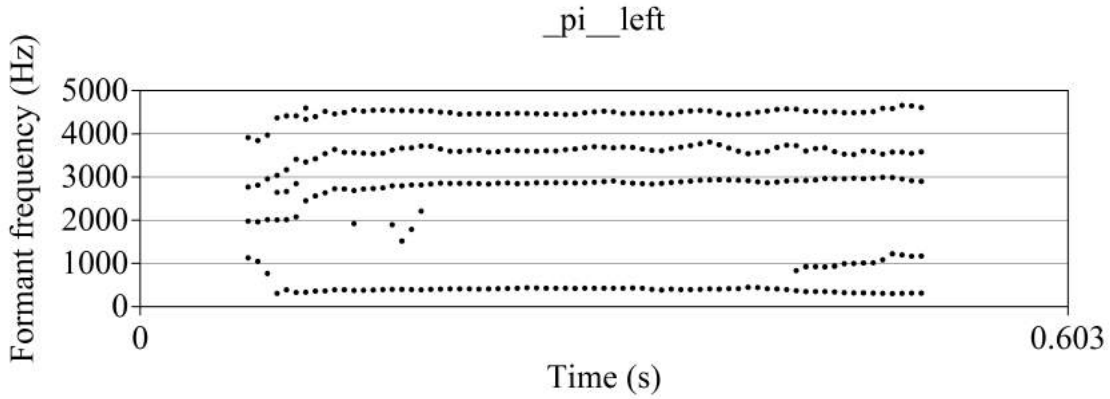

Figure 26 formant contours of [pi34] with an F1 of 409Hz and F2 of 2860Hz in [i]

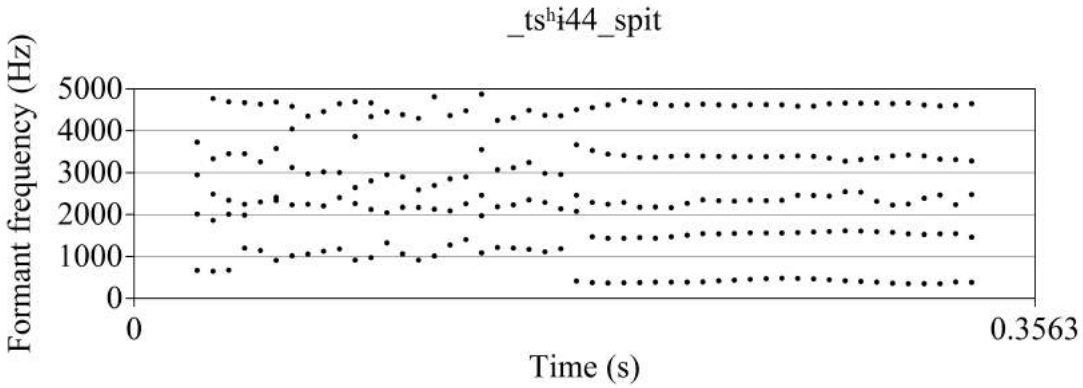

Figure 27 formant contours of [tsʰɨ44] with an F1 of 450Hz and F2 of 1570Hz in [ɨ]

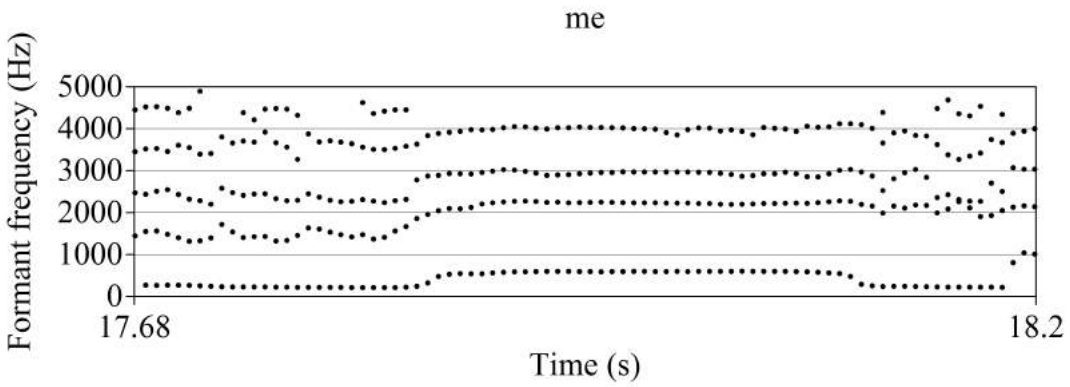

Figure 28 formant contours of [me21] with an F1 of 600Hz and an F2 of 2300Hz in [e]

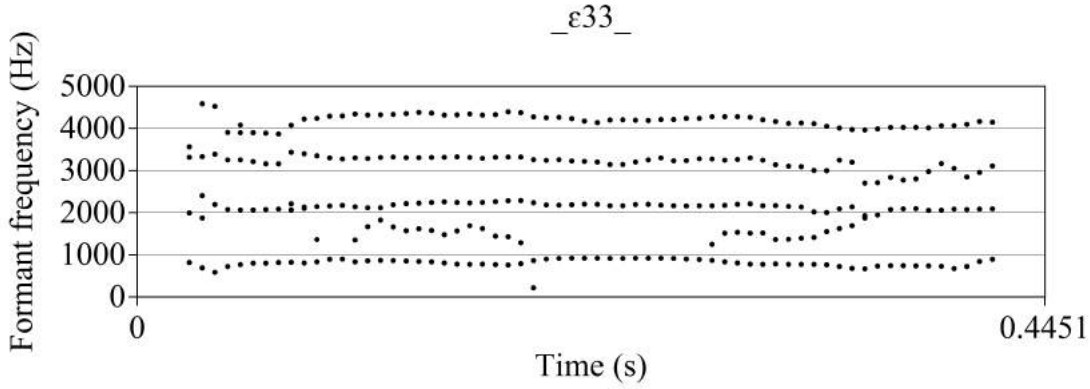

Figure 29 formant contours of [ɛ33] with an F1 of 900Hz and an F2 of 2200Hz in [ɛ]

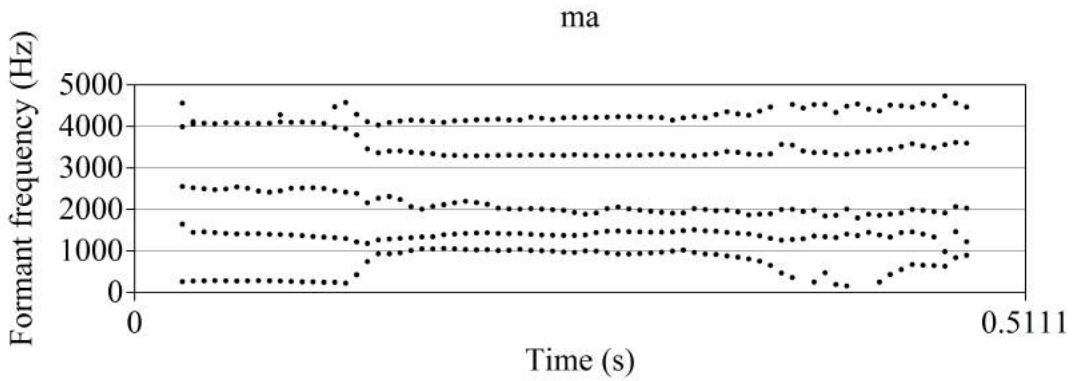

*Figure 30 formant contours of [m*a33*] with an F1 of 1000 and an F2 of 1450 in [*a*]*

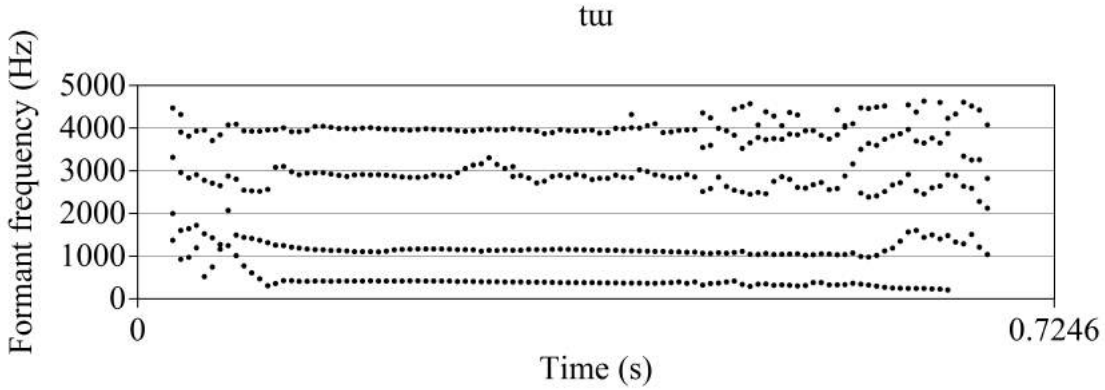

Figure 31 formant contours of [tɯ32] with an F1 of 400 and an F2 of 1140 in [ɯ]

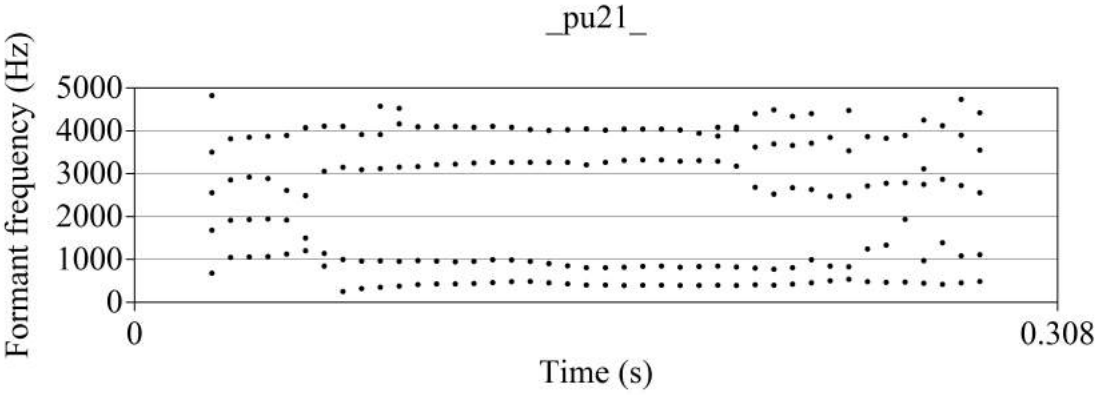

Figure 32 formant contours of [pu21] with an F1 of 410Hz and an F2 of 900Hz in [u]

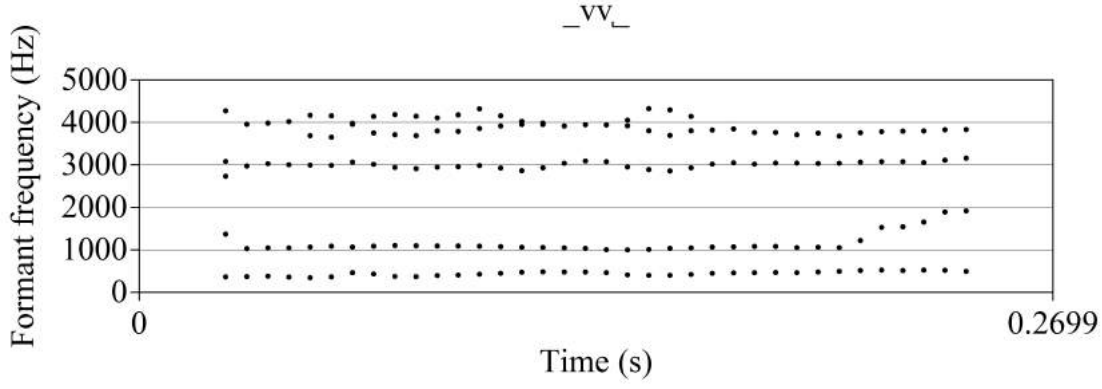

Figure 33 formant contours of [vɣ33] with an F1 of 415 and an F2 of 1055 in [ɣ]

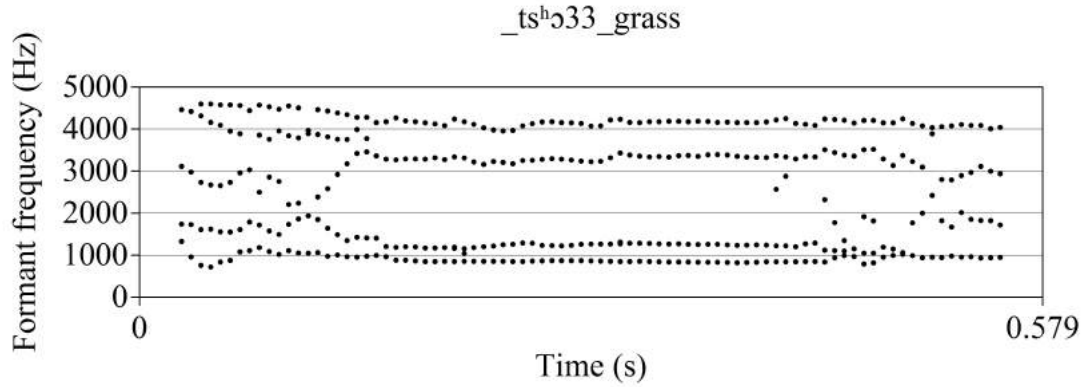

Figure 34 formant contours of [tsʰɔ33] with an F1 of 840 and an F2 of 1250 in [ɔ]

6. Tones

There are eight tones in my informant's dialect of Bai. Among them, there are three level tones, four falling tones, and one rising tone.

The tones appeared in my informant's utterances are listed as follows.

Level tones	55
	44
	33
Falling tones	42
	32
	31
	21
Rising tone	34

Table 15 tones occurred in the utterance of the informant

One minimal set of the eight tones is shown in the following table.

Level tones	55	[tɕi55]	season (noun)
	44	[tɕi44]	to carry something for someone
	33	[tɕi33]	leech
Rising tone	34	[tɕi34]	great in number
Falling tones	42	[tɕi42]	to drag
	32	[tɕi32]	to avoid
	31	[tɕi31]	to make to somewhere on time
	21	[tɕi21]	to sing

Table 16 minimal set of eight tones

6.1 Level tones

There are three level tones in the dialect my informant speaks: an extra-high level tone, which often occurred in words borrowed from Mandarin, a high level tone, and a mid-high level tone. The figure below shows the tone contours of the three level tones.

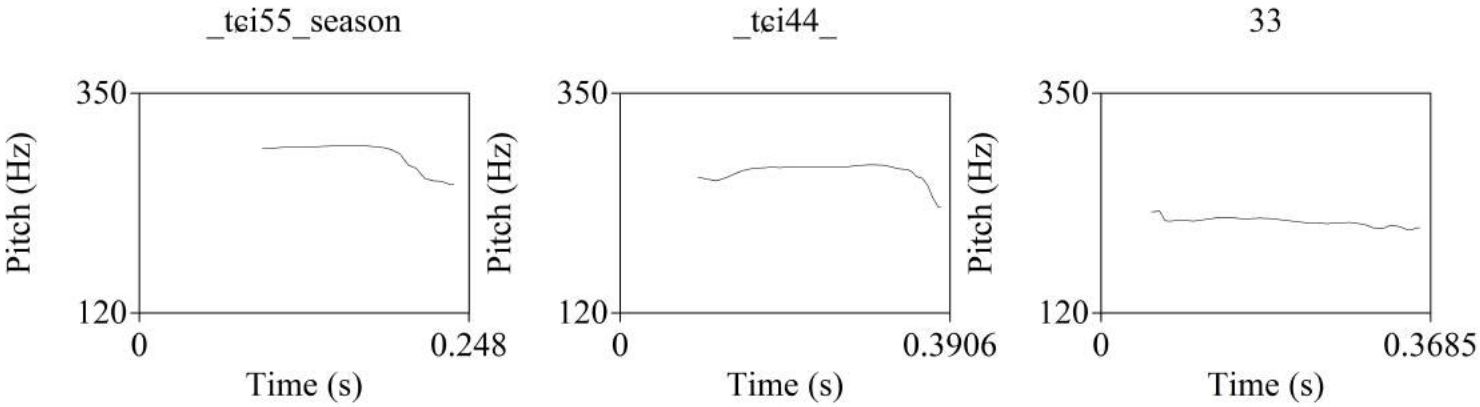

Figure 35 F0 contours of level tones

In the case of my informant, the F0 of the extra-high level tone ranges between 270-303Hz, the F0 of the high level tone ranges from 236Hz to 270Hz, and the F0 of the mid-high level tone ranges between 202Hz to 236Hz.

6.2 Rising tone

There are one rising tone in the dialect spoken by my informant. This tone starts at similar ranges of the mid-high level tone (33), and ends in the similar range of the high level tone (44). The following figure shows the pitch contour of the word [tɕi34].

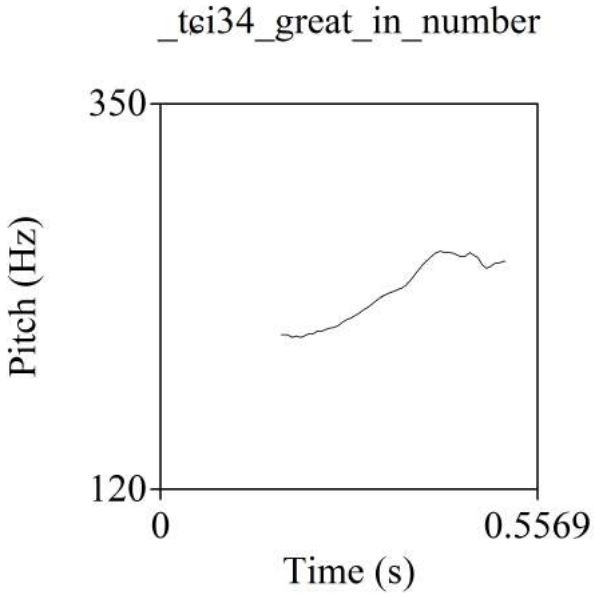

Figure 36 F0 contour of the rising tone

6.3 Falling tones

There are four falling tones in my informant's dialect: 42, 32, 31, 21. The tones 42 and 32 have similar ending points, but 42 starts at a higher pitch. Although 32 and 31 have similar starting points, 31 has a bigger difference in between the starting point and the ending point. 42 and 31 has similar pitch difference, but 42 often sounds more abrupt and tense than 31. There is not enough data to prove whether 42 and 31 are allotones. The 21 tone is the lowest that occurred in the recordings, and my informant's voice became creaky sometimes when pronouncing a word bearing this tone. The figure below compares and contrasts the pitch contours of the four falling tones.

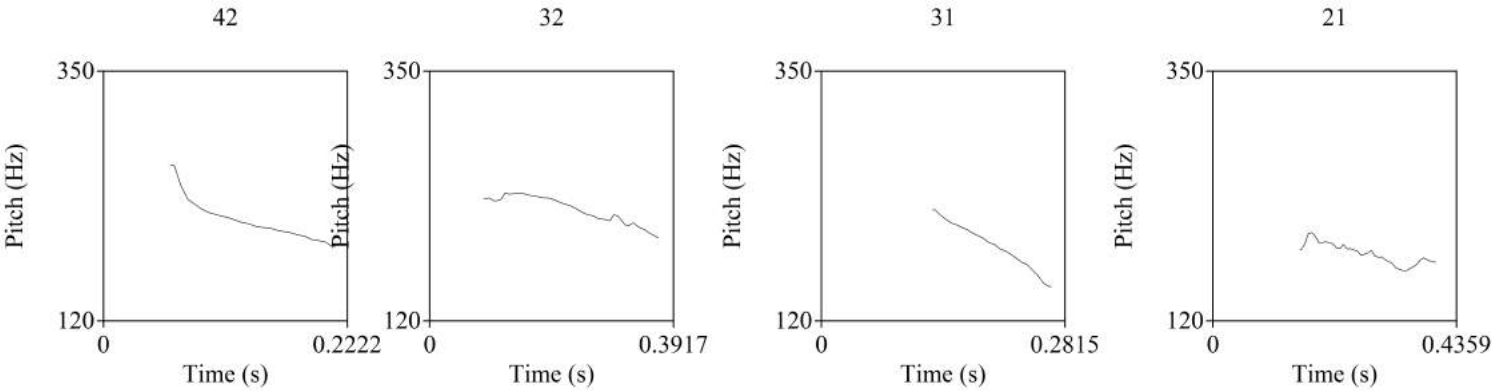

Figure 37 F0 contours of the four falling tones

7. Future research

I have noticed during the sessions I had with my informant that in the cases where she produced certain words (especially words that are not borrowed from Mandarin) multiple times, that sometimes certain vowels would be nasalized, but sometimes not, in the same word. I would like to explore if nasalization of vowels is a free variation in my informant's dialect of Bai. I am also curious about how the phonetics and phonology of the words borrowed from Mandarin into this dialect are different from that of the non-borrowed ones.

References

Since the purpose of this project is to practice describing a language that I do not speak, my data came only from my informant. The following books and articles are consulted for general typological information (classification, number of speakers, regions spoken, etc.) of the language.

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