Lanqi Citation Tones: an Initial Acoustically-based Study

Kristine Rickard
Phonetics Laboratory, Linguistics Program (Arts)
The Australian National University.
u3226925@anu.edu.au

Abstract

Mean fundamental frequency and duration data are presented for the seven citation tones of Lanqi, a previously undescribed Wu dialect from Eastern China. The seven citation tones are on unstopped ("shu") syllables and stopped ("entering or ru") syllables from one male native speaker.

1. Introduction

The aim of this study is to provide an initial description of the tonal acoustics (fundamental frequency – FO and duration) of one native male speaker of Lanqi dialect (兰溪 '*lanxi*' in Mandarin pinyin). Although having only one informant is adequate for this paper, a more comprehensive study requires a greater number of informants. According to Ladefoged (1997), this would include an absolute minimum six informants, ideally three males and three females. This would then show up whether any between-speaker differences, specifically in the phonation onset and offset, and phonation type, are particular to the individual or are specific to the language.

Lanqi is a variety of Wuzhou subgroup of the Wu dialects that are found in Zhejiang and Jiangsu provinces in mainland Eastern China. Lanqi is situated north of Jinhua and south of Hangzhou in the middle of Zhejiang province. The Wuzhou subgroup also consists of Jinhua, Yongkang, Wuyi, Dongyang, Pan'an, Yiwu and Pujiang dialects (Wurm 1987). Lanqi has not previously been described, although many Wu dialects have been, and found to have complex tone systems and tone sandhi. Chao (1976) has given an overall picture of the phonology of the Wu dialects, whereas Ballard (1980) provides an insight into the tone sandhi found in varieties of Wu including Shanghai, Suzhou and Wenzhou. Rose (1990) has given a further description of complex tone sandhi and Rose & Toda (1994) then went on to provide a typology of the tone sandhi rules in the Northern Wu dialects.

Wu dialects are clearly distinguishable from the languages of other Chinese dialect groups as they have a systematic three-way distinction in syllable-initial stops and affricates, and a two-way division of fricatives (Chao, 1976:36). Thus, minimal pairs can occur for voiceless aspirated, voiceless unaspirated and voiced stops ($*p^h$, *p, *b etc.) and affricates (ts^h, ts, dz etc), and between voiceless and voiced fricatives (*s, *z etc). These features are particularly important as they were originally found in Ancient Chinese but have been lost in many dialects. Ballard (1980:84-85) also characterises Wu dialects as having the least amount of change in their tone systems since the 9^{th} century than any other Chinese dialect group. Here, Ballard is referring to the lack of change in the tone systems, originally contrasting 8 tones and merging to contrast a lesser number. The traditional names of the eight tones of the Middle Chinese tone system, as derived from the Qieyun rhyme tables, are given in Table 1.

Table 1: *Qièyùn* tone categories

	Ping	Shang	Qu	Ru
Yin	Ia	IIa	IIIa	Iva
Yang	Ib	IIb	IIIb	Ivb

Ping, Shang and Qu tones are also known as *Shu* tones, in contrast to the *Ru*, or entering tones. Probably all Wu dialects maintain a difference between an upper (yin) and a lower (yang) register, a difference which provided initial support for Yip's (2002) register model of tonal geometry. Although there are problems with the definition of Yip's register, which will be mentioned below. Lanqi does provide some clear evidence in support of her model.

Yip (2002:42) divides the tone levels into two features, a 'Register' feature and a 'Tone' or melody feature. The register feature, [+/- Upper] first divides the levels into two, then the tone feature [+/-High] divides the levels into two again, providing four levels where [+U, +H] and [-U, +H] are not adjoining. Lanqi has seven tones. These are given in Table 2 in terms of their FO shapes, Yip's phonological model of Register (+/- Upper), and

Proceedings of the 10th Australian International Conference on Speech Science & Technology
Macquarie University, Sydney, December 8 to 10, 2004.

Accepted after full paper review

Melody or Tone (H/L), and their Middle Chinese *Qièyùn* tone categories.

Table 2: Lanqi tone system according to Yip's Phonological Model

	Qièyùn	Pitch Contour	Yip Model
Tone 1	Ia	mid level	-U, H
Tone 2	Ib	low falling	- U, HL
Tone 3	IIa, IIb	high falling	+U, HL
Tone 4	IIIa	high rising	+U, LH
Tone 5	IIIb	low rising	-U, LH
Tone 6	IVa	high rising stopped	(+U, LH)
Tone 7	IVb	low rising stopped	(-U, LH)

It can be seen that Lanqi appears to contrast rising and falling pitched tones in both upper and lower register, with one level pitched tone in the middle of the range. The rising pitched tones can also occur on stopped syllables. The pitch of the high falling tone is noteworthy. It does not fall through the whole of the pitch range, and sounds almost like a downstepped calling intonation. The Ib tone, for this speaker at least, has clearly breathy phonation. It can also be seen that the historical categories of IIa and IIb have merged in Lanqi, at least in citation form.

2. **Procedure**

2.1 Corpus

The corpus consisted of a large number of C(V)V morphemes where C is any consonant and V is any vowel or glide, including nasalised vowels. Although the corpus is large and not tightly controlled by phonetically similar tokens, I have not included any syllables ending in a nasal consonant as the stop affects the rhymes of these syllables differently to those in this corpus and should be treated differently.

Table 3.1: Tone 1 Corpus

高 kɔ	high, tall
低 ti	low
粗ts^{h}o	coarse, thick, rough
稀 ɕi	scarce
生ɕæ̃	raw
歪 wa	crooked, askew
弯 wæ̃	to curve, to bend
酽 niɛ	strong (tea)
蚌 xuɑ	clam
糕 gɔ	cake
铺 p^{h}u	to spread, to unfold
开 ke	to open
书 ʃʊ	book
打 k^{h}ɔ	to hit, play
跨 k^{h}wɑ	to step, to stride

Table 3.2: Tone 2 Corpus

斜 sia	oblique, slanting
稠 tɕjʊ	thick; dense
煤 mei	coal
泥 ni	mud
头 tou	head
驴 ly	donkey
横 wæ̃	horizontal
馅 wa	stuffing, filling
圆 yɛ	round
钳 dʒiɛ	tongs, pliers
海 xɛi	sea, ocean
湖 wʊ	lake
鹅 mɣə	goose
蛇 swɑ	snake
桥tʃ^{h}o	bridge
球 tʃiu	ball
抱 tʃia	hug, embrace
填 tia	to fill, to stuff
埋 mɑ	to bury, to cover up
跑 pɔ	run

Table 3.3: Tone 3 Corpus

短 tɣə	short
浅 tsi	shallow
反 fɨa	opposite
陡 tɣw	steep
厚 kɣw	thick; deep
老 lɔ	old
满 mɣ	full
软 nyə	soft
九 tɕiʊ	nine
土 t^{h}u	ground, earth
稻 tɔ	paddy
酒 tʃ^{h}iʊ	wine
伞 swɑ	umbrella
卷 ts^{h}ui	roll
走 tɣə	to walk, to go, to leave
站 k^{h}ɛi	to stand

Table 3.4: Tone 4 Corpus

细 si	thin
正 tɕæ̃	straight, right, correct
脆 ts^{h}ui	brittle, crisp
干 sɔ	dry
虹 xə	rainbow
茶 tɕɑ/e	tea
裤 k^{h}u	pants

Accepted after full paper review

盖 kɛ	to cover
罩 sɔ	to shade, to cover
套 tʰɔ	set
弹 dɣa	bomb
跳 tɕiʊ	to jump
晒 swɑ	sun-drenched

Table 3.5: Tone 5 Corpus

硬 ŋæ̃	hard
嫩 næ̃	tender, delicate
乱 læ̃	chaotic, disorderly, messy
雾 fu	fog
浑 wæ̃	stupid
醋 ɕu	vinegar
帽 mɔ	hat
扇 ɕi	fan
本 pu	volume (book)
扔 kʰwɑ	to throw, to toss

Table 3.6: Tone 6 Corpus

宽 kʰwaʔ	wide, broad
黑 xəʔ	black
一 yɛʔ	one
七 tɕɛʔ	seven
八 pia	eight
铁 tʰiɛʔ	iron
锡 ɕiɛʔ	tin
粥 tsoʔ	congee, porridge, gruel
谷 kwoʔ	millet; cereal, grain
尺 ɕɛʔ	ruler; 1/3 of a metre
吃 tɕɛʔ	to eat
吸ɕɛʔ	to inhale
掐 kʰwaʔ	to pinch
摘 sæʔ	to pick
托 tʰoʔ	to rely on
拖 thɔʔ	to pull, to drag
塞 səʔ	to fill in, to stuff
折 tɕɛʔ	to fold

Table 3.7: Tone 7 Corpus

薄 bɔʔ	thin
嚼 siaʔ	to chew
直 tɕɛʔ	straight
六 lɔʔ	six
十 ɕɛʔ	ten
雪 ɕiɛʔ	snow
麦 mæʔ	wheat
窄 wæʔ	narrow
肉 ɲiɔʔ	meat, flesh
席 siɛʔ	mat
锅 wæʔ	pot; wok, frying pan
末 moʔ	end
捏 niɛʔ	knead
系 boʔ	system
剥 pɔʔ	to shell, to peel
叠 tiɛʔ	to pile up, repeat

2.2 Elicitation and Measurement

Elicitation of the data was performed by Phil Rose in 1988, as part of a study of Wu tones. The tokens were digitized at 10K and analysed using the CSL pitch (sic) extraction routine.

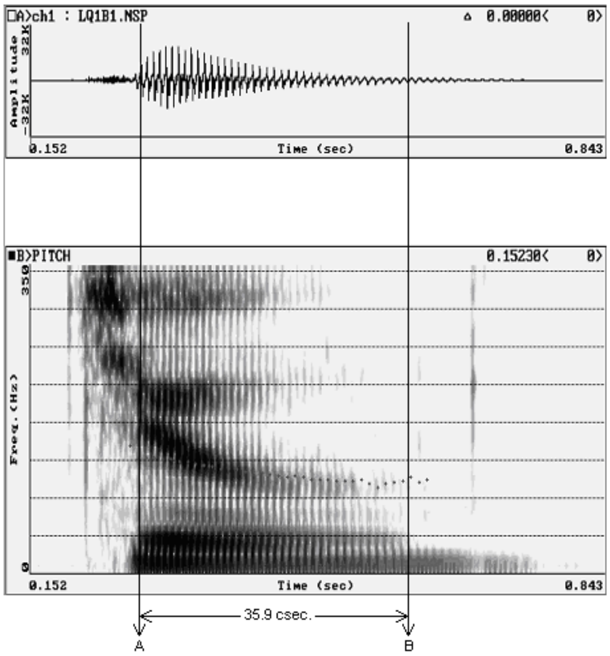

Figure 1: CSL waveform and spectrogram with pitch extraction of *tɕjʊ* 稠 'thick', showing sampling base for tonally relevant F0.

Diagram A in Figure 1. shows a waveform of the low falling Tone 2 token on the morpheme *tɕjʊ,* 'thick'. Diagram B shows the spectrogram with the pitch (sic) extraction shown as dots showing a clear steadily falling pitch from point A, 135Hz to point B, 106 Hz. The setting for frame length is 20 ms and the setting for frame advancement is 10ms. The duration of the tonally relevant F0 was measured from the rhyme onset which is clearly shown as the start of the F-pattern at point A in the spectrogram. Onset can also be determined with the aid of the pitch extraction and waveform where onset is measured from the first clear wave of the vowel. This is clear in Diagram A. The duration was measured up until the end of a visible second formant as in point B or until the pitch extraction clearly ended as is the case in the ru tones. The FO measurements were taken at the following sampling points: 0%, 5%, 10%,

Accepted after full paper review

20%, 40%, 60%, 80%, 95% and 100%, where point A is 0% and point B is 100%. This provided enough detail to replicate the FO shape over the duration of the rhyme.

3. Results

Mean and standard deviation F0 values were calculated at all of the sampling points for each tone. Figure 2 shows the normalised FO values of the tones of all tokens in the corpus. FO is plotted as a function of absolute duration to provide a better representation of between-tone differences. It is clear from Figure 2 that apart from the level tone, there is a distinct upper and lower register for Lanqi tones. Although the lower register rising tone (tone 4) offsets at approximately the same hertz value as the upper register falling tone (tone 3), the distinction between the onset and offset of all upper and lower register contour pairs is clear.

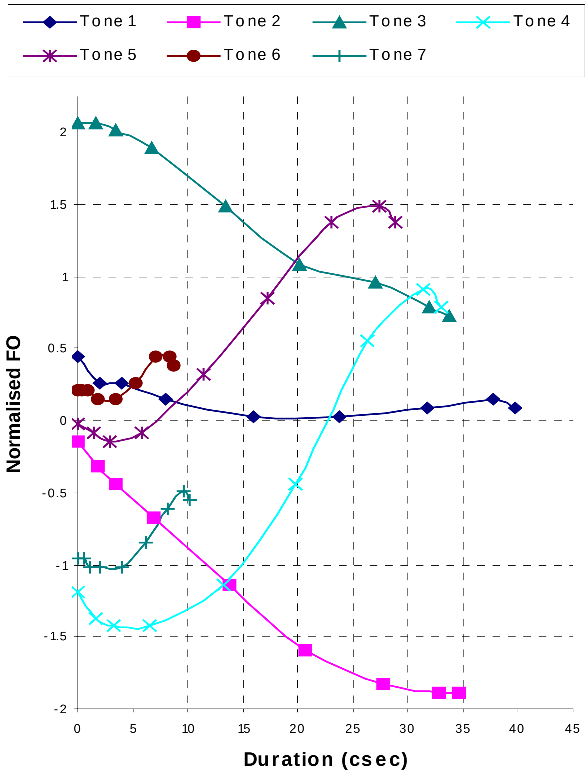

Figure 2: Normalised FO values and mean durations of one Lanqi speaker's seven citation tones.

From the corpus, this speaker has an FO range of 79 Hz, ranging from 94Hz -173Hz. The lower end of the informant's FO range is visible in Tone 2, which, as mentioned above, has breathy phonation. This seems to be a characteristic of the tone however, it is unclear from this data whether the breathiness is a characteristic of the tone or whether it is due to the individual's own FO range. However, this can be confirmed by looking at whether other native speakers with higher FO ranges produce the same phonation type.

Tone 1 is in the middle of the upper and lower registers. This is clear from its FO values in relation to the two falling tones as it occurs in between the offset of the high falling tone, tone 3 and the onset of the low falling tone, tone 2. Tone 2 and tone 3 show a clear contrast between upper and lower register falling tones. The upper falling tone onsets approximately 2 standard deviations above the mean and the lower falling tone offsets at approximately 2 standard deviations below the mean. A similar contrast can also be seen between the upper and lower register entering tones. The mean durations of the rhymes occurring with a yin or upper register tone are also consistently but not perceptually shorter than rhymes with the yang or lower register tones. There is only one level tone, thus there is no distinction in register for level tones.

4. Summary

Lanqi has five clearly defined FO contours, with contour pairs based on a split upper and lower register and where tones 6 and 7 are phonologically allotones of tones 4 and 5 respectively. This data suggests that this system fits the Yip register model as well as the Middle Chinese Qieyun system as described by both Chao (1976) and Ballard (1980) as a typical characteristic of Wu tone systems. However, most Wu tones systems, such as Wenzhou and Zhenhai for example, do not fit Yip's model and Lanqi may be a lone example of Yip's tone model. In most dialects the high falling tone with the features [+U, HL] falls through the whole of the FO range and is not limited to the [+Upper] domain. However, the situation in Lanqi is that the high falling tone, [+U, HL] is confined to the [+Upper] register, thus providing some support for Yip's model but behaving somewhat differently to the other Wu dialects.

Although this study does provide an initial account of the tonal acoustics of Lanqi, a more adequate study of the tonal acoustics still needs to be done. This would ideally include the mean amplitude readings of all tokens, a greater number of phonetically similar tokens of each tone category and data from more informants as mentioned earlier.

5. Acknowledgements

I would like to thank Phil Rose for providing the recording and for his helpful comments. I would also like to thank my two reviewers for their comments.

Accepted after full paper review

6. References

Ballard, William L. (1980). *On Some Aspects of Wu Tone Sandhi*. Journal of Asian and African Studies, 19: 83-163.

Chao Yuen Ren. (1976). *Contrasting Aspects of the Wu Dialects*. In Anwar S. Dil (Ed.), Aspects of Chinese Sociolinguistics: essays by Yuen Ren Chao, pp 34-47. Stanford, California: Stanford University Press.

Ladefoged, P. (1997). *Instrumental techniques for fieldwork.* In Hardcastle & Laver (Eds.), Handbook of Phonetic Sciences, pp 137-166. London: Blackwell.

Rose, Phil. (1990). *Acoustics and Phonology of Complex Tone Sandhi*. Phonetica, 47:1-35.

Rose, Phil & Toda, Takako (1994). *A Typology of Tone Sandhi Rules in Northern Wu*. In Kitamura H. et al. (Eds.), Current Issues in Sino-Tibetan Linguistics, pp 267-273. Osaka: Organising Committee, 26th International Conference on Sino-Tibetan Languages and Linguistics.

Wurm, S et al, (Eds). (1987) Language Atlas of China. Pacific Linguistics Series C, No. 102. Canberra:Longmans/Australian National University Research School of Pacific Studies.

Yip, Moira. (2002). *Tone*. Cambridge: Cambridge University Press.

Accepted after full paper review