

Lhasa Tones

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Abstract

This paper describes tones on citation syllables in Lhasa Tibetan. Acoustic data from six speakers showed that Lhasa has a high vs. low tonal contrast on the one hand; and its tonal melodies are highly constrained by syllable types on the other hand. Lhasa tones served as a typical case in Tibetan tonogenesis: First, the high vs. low tonal contrast results from the historical prevocalic voicing distinction; Second, tonal melodies are further developed from F0 perturbations of postvocalic consonants.

Index Terms: tones, Lhasa Tibetan, syllable types

1. Introduction

While Old Tibetan is a typical atonal language with about 220 consonant clusters, modern Tibetan languages exhibit a variegated scenario of tonal developments: with the simplification of consonant clusters, Tibetan languages constitute a tonality continuum from completely non-tonal to highly tonal such that there is no clear dichotomy between a tonal and non-tonal language ([1]; [2]).

Lhasa Tibetan occurs as a highly developed tone language; and its tonology is typical in the tonal development of Tibetan languages. It is generally agreed that phonologically speaking, Lhasa tones have a high vs. low contrast, whereas it remains controversial how many contour contrasts Lhasa Tibetan has (see [3] for a brief review). This is mainly attributable to the fact that tone contours are highly constrained by syllable types in Lhasa Tibetan. Phonetically speaking, six different tonal melodies are detected in Lhasa Tibetan ([4]). That is, the complementary distribution of pitch patterns leads to different phonological interpretations. On the other hand, this implies that Lhasa tonology is still under development. Historically speaking, the high vs. low tonal contrast results from the loss of the historical prevocalic voicing distinction, which is further developed from the simplification of the prevocalic consonant clusters. Similarly, historical postvocalic consonants also play an important role in the tonal development of Lhasa Tibetan – they helped define the tonal contours.

This paper examines Lhasa tones on citation syllables on the basis of two acoustic studies. The first study aims at understanding the correlation between syllable type and tonal contours by using controlled speech material. The second study is a thorough examination of all possible Lhasa syllables. The purpose is to give a clear description of Lhasa tones on the one hand, and shed light on tonogenesis and tonal development in Tibetan languages in general on the other hand.

2. Methodology

This paper focuses on the monosyllabic citation tones. Lhasa Tibetan has four syllable types; each can be associated with a high or a low tone. As the acoustic part of an EMA study (see [5] for details), the first study used meaningful monosyllabic

words or morphemes with a labial initial consonant [p m] and a low vowel [a ε] in all the eight possible syllable type and tone combinations as test syllables, as listed below from 1) to 8).

- 1) high toned long syllables (CVSonorant): [peɪ] “abundance, auspiciousness” [paɪ] “photo” [paŋ] “lawn” [mɛɪ] “Mrigasira” [maɪ] “red” [maŋ] “base”
- 2) low toned long syllables (CVS): [peɪ] “wool” [paɪ] “to burn” [pam] “to be strong (future tense)” [mɛɪ] “residence” [maɪ] “Tibetan ghee” [maŋ] “many”
- 3) high toned aspirated syllables (CVh): [pah] “brave” [mah] “low”
- 4) low toned aspirated syllables (CVh): [pah] “bine” [mah] “mother”
- 5) high toned checked syllables (CVʔ): [paʔ] “to speculate (past tense)” [maʔ] “battle”
- 6) low toned checked syllables (CVʔ): [paʔ] “to contaminate” [maʔ] “first syllable for son-in-law”
- 7) high toned checked syllables (CVNʔ): [paŋʔ] “height” [maŋʔ] “plebeian”
- 8) low toned checked syllables (CVNʔ): [pamʔ] “to be strong (past tense)”

Lhasa was reported as having long and short open (CV) syllables, and was thus treated as being contrastive in vowel duration in the literature (e.g., [6]; [3]). But in citation monosyllables, long open syllables, 1) and 2), are normally pronounced with a liquid coda, and short open syllables, 3) and 4), are actually aspirated, i.e. pronounced with a final glottal fricative.

The test syllables, written in Tibetan script, were presented to the speaker in a random order on an LCD monitor. Each target syllable was embedded in a carrier frame: X, ji ke_{Tibetan} Character t_{this} X sa_{is}/j_{is} ‘X, this is X’. 10 to 15 repetitions were recorded by using the Carstens AG500 EMA system with a synchronized audio recording. Three Lhasa female speakers were recorded. They were all the first year or second year undergraduate students, 20 to 21 years old, in the Minzu University of China in Beijing. In this paper, only the acoustic data on the citation position (i.e. the first X position in the carrier sentence) were analyzed. The audio recording was digitized with a sampling rate of 11,025 Hz. Target syllables were manually annotated in the EMU speech database system and were then processed and analyzed with the EMU/R package in the R environment (<http://emu.sourceforge.net/>). F0 curves were extracted on the voicing part of a rime in a syllable. That is, F0 curves on the voicing initial [m] were not included.

In the second study, all possible Lhasa monosyllables, totally over 4,400 syllables, were used as test material. Three Lhasa speakers, two female and one male and all university students, were recorded either in a quiet environment during fieldwork or in a soundproof room. Audio sounds were recorded directly into a laptop computer through an external USB sound card with a sampling rate at 16 kHz. The recorded

monosyllables were annotated automatically first and then corrected manually in Praat (<http://www.praat.org/>). F0 curves were extracted every 10 milliseconds. Samples with abrupt F0 values were excluded automatically by an evaluation program.

3. Results

3.1. Controlled study

Figure 1 gives the mean F0 contours associated with the eight different syllable type and tone combinations in Lhasa Tibetan from the three female speakers. The F0 contours were averaged for each combination in the citation position across all the repetitions of all the tested syllables.

As summarized in Table 1, the F0 contour patterns are quite consistent across all the three speakers.

First, there is a clear high vs. low tonal contrast. This feature is especially apparent on the onset parts of the F0 curves. The high tones have a high F0 onset at around 270-320 Hz and the low tones a low F0 onset at around 190-240 Hz. However, the offset part of a low tone could be as high as a high tone and vice versa. Historically, the high-low contrast was induced by the loss of the voicing contrast of initial consonants. Historical voiceless initials and prefixed sonorant initials became high-toned, and historical voiced obstruent initials and plain sonorant initials became low-toned.

Second, tonal contours are highly correlated with syllable types. CVS is long and all the others are short. And the short syllables further differ in whether they are checked or not. It has been debated whether Lhasa has two, four, or six tones. It's quite clear from the acoustic data presented here that the complementary distribution of F0 contours leaves room for different phonological interpretations. A two-tone analysis may emphasize that the high-low contrast, or the so-called "register contrast", is the only phonological distinction for Lhasa tones ([7], [8]). A four-tone analysis may treat the difference in quantity or glottal stop as phonological contrast (see [2]: 491-492 for a review). And a six-tone analysis treats both quantity and glottal stop differences as phonological ([4]).

The acoustic results from this study are, in general, consistent with those from T. Hu, Qu and Lin ([4]). The only difference is that this study further distinguishes two types of checked syllables: CVN? vs. CV?. An eight-tone analysis is therefore proposed. Although CVN? and CV? share similar F0 contour patterns, the former is considerably longer than the latter. Interestingly, this durational difference has a critical consequence. A sharp drop in F0 signifies the presence of a glottal stop ([9]), and is thus redundant in nature. On the other hand, the sharp F0 drop effect will disappear when the glottal stop is deleted, which is common in natural conversational speech. Consequently, CV? syllables will obtain an F0 contour similar to the corresponding CVh syllables, as syllable-final aspiration is usually deleted in natural conversational speech, too. In contrast, a slower drop in F0 is not a redundant feature, and the falling pitch is always attested in the production of CVN? syllables. Actually, the glottal stop in CVN? syllables is reported to be weak or deleted in the literature (e.g. [6]: 13). In other words, CVN? is becoming a long syllable with the loss of the glottal stop coda. To sum up shortly, the emergent citation tones in Lhasa Tibetan is demonstrating a new direction of development: while short tones on CVh and CV? syllables tend to merge, short tones on CVN? are further emerging as contrastive tones (see 3.2 for further discussion).

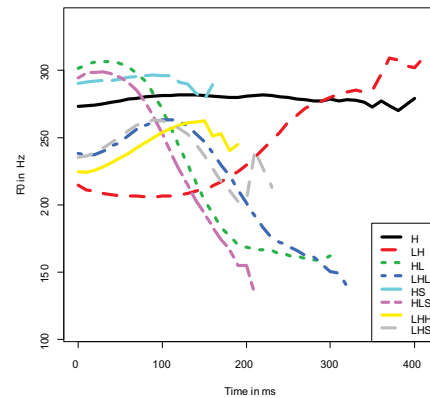


Figure 1: Lhasa tones (Speaker FS1). High CVS: H; long CVS: LH; high CVh: HS; low CVh: LHH; high CV?: HLS; low CV?: LHS; high CVN?: HL; low CVN?: LHL.

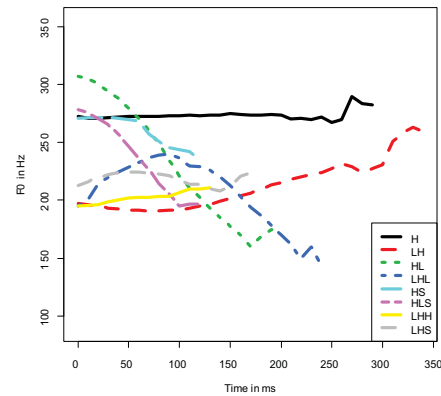


Figure 2: Lhasa tones (Speaker FS2). High CVS: H; long CVS: LH; high CVh: HS; low CVh: LHH; high CV?: HLS; low CV?: LHS; high CVN?: HL; low CVN?: LHL.

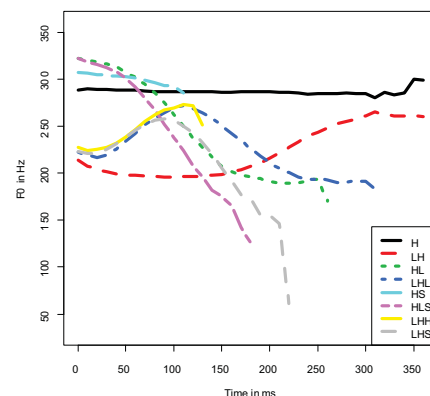


Figure 3: Lhasa tones (Speaker FS3). High CVS: H; long CVS: LH; high CVh: HS; low CVh: LHH; high CV?: HLS; low CV?: LHS; high CVN?: HL; low CVN?: LHL.

Table 1. *Syllable types and tones in Lhasa Tibetan.*

tone	syllable	F0	historical coda	label
high	CVS	long level	-l, -m, -n,	H
low		long rising	-ŋ, -ɾ	LH
high	CVh	short level	-∅	HS
low		short rising		LHH
high	CV?	short falling	-b, -g,	HLS
low		short rising-falling	-d(FS5)	LHS
high	CVN?	short(?) falling	-ms, -ŋs,	HL
low		short(?) rising-falling	(-d, -s)	LHL

3.2. All syllables

A thorough examination of all possible syllables in Lhasa Tibetan revealed that distinguishing CV? from CVN? is more complicated than expected. As indicated by the column ‘historical coda’ in Table 1, syllables with historical -d and -s codas are grouped with CVN? syllables in general. However, in Speaker FS5, syllables with the historical -d are grouped with CV? syllables. That is, the CVN? also includes a few CV? syllables, as both stop codas and -s coda have merged into a glottal stop in Lhasa Tibetan.

Figures 4-6 summarized mean pitch curves averaged across the tokens from each of the eight categories. Pitch values were converted to semitones with a reference F0 at 75 Hz. And the digit in the parenthesis immediately after the tone label denotes the number of tokens.

As can be seen from the figures, the pitch patterns are, in general, consistent with those in controlled study. First, there is a clear high vs. low contrast. Second, CVN? is comparatively shorter than CVS but considerably longer than CV? and CVh. The means of the tone duration for the four syllable types are summarized in Table 2. As mentioned in 3.1, both HL and LHL are becoming long tones. It is also noted that these syllables are produced without perceptible glottal stops in most cases, no matter they are associated with a historical -ms, -ŋs, -d or -s coda. In short, the final glottal stop is dropped for the tone HL and LHL¹. And interestingly, the tonal contours are retained when the final glottal stop is dropped.

In controlled study in 3.1, CV? syllables, though considerably shorter, share a similar F0 contour with CVN? syllables, namely HLS and LHS have contour shapes similar to HL and LHL respectively. But as can be observed from Figures 4-6, CV? syllables are more likely to be grouped with CVh syllables, rather than to be grouped with CVN? syllables. It seems that HLS and LHS tones couldn’t manifest a full final falling and are thus becoming similar to HS and LHH tones respectively.

In summary, while long HL and LHL tones are emerging from CVN? syllables, tones on two types of short syllables, CV? and CVh, show a merging tendency. And this may be attributable to the durational difference triggered by the development of consonant codas.

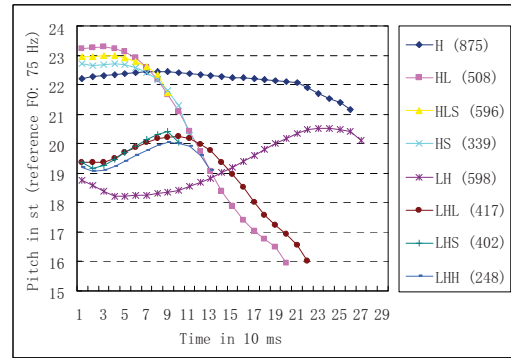


Figure 4: *Lhasa tones (Speaker FS4).*

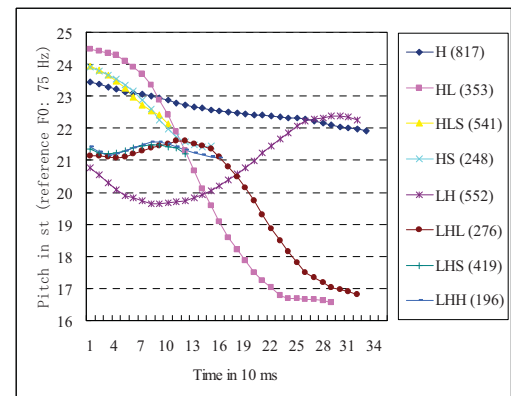


Figure 5: *Lhasa tones (Speaker FS5).*

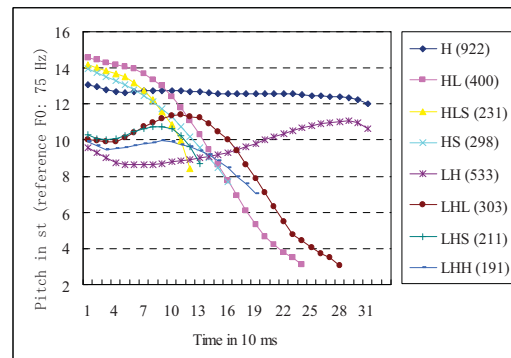


Figure 6: *Lhasa tones (Speaker MS1).*

Table 2. *Mean durations and standard deviations for the tone durations on the four syllable types in Lhasa Tibetan.*

syllable	mean	SD	n
CVS	300	55	4297
CVh	155	63	1520
CV?	106	29	2400
CVN?	248	67	2257

4. Conclusion and discussion

This paper gives an acoustic phonetic description of syllable tones in Lhasa Tibetan. Results from the controlled study show that (1) there is a clear high vs. low tonal contrast; and (2) tonal contours are highly correlated with syllable types in Lhasa Tibetan. An eight-tone analysis is thus proposed: (1) historical CVSonorant syllables remain as long syllables

¹ Glottalization may be perceived in the final L part of the tone. That is, the low frequency is sometimes characterized by creaky voice in Lhasa Tibetan.

bearing a high level tone (H) or a low rising tone (LH); (2) historical short CV syllables are now pronounced as short CVh syllables with a high level tone (HS) or low rising tone (LHH); (3) historical short CVStop syllables are now realized as short CV? syllables with a high falling tone (HLS) or low rising-falling tone (LHS); (4) historical short CVNStop syllables are now realized as long CVN(?) syllables with a high falling tone (HL) or a low rising-falling tone (LHL). Data based on all Lhasa syllables further confirmed that while the high falling tone HL and low rising-falling tone LHL are emerging as distinctive tonal contours, the short tones on CVh and CV? syllables demonstrate a tendency to merge.

The Lhasa case of tonogenesis basically collaborates the tonal developmental mechanisms proposed in Hombert, Ohala and Ewan ([10]). That is, tone emerges when an intrinsic F0 perturbation comes to be used extrinsically. The historical voicing has a lowering effect on F0 such that a low (L) tonal onset is induced. The glottal stop also has a lowering effect on F0 such that an L tonal offset is induced². The syllable-final aspiration merely has a limited lowering effect on F0, and consequently the CVh syllable has a comparable F0 contour with its CVS counterpart. In summary, all perturbations in Lhasa Tibetan have an F0 lowering effect. By contrast, the unperturbed F0 stays as a high (H) tonal element. Thus, a rising F0 contour was induced by historical voicing, a falling F0 contour was induced by the glottal stop, and a rising-falling F0 contour was induced by both of them.

5. References

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² Hombert, Ohala and Ewan ([10]) concluded that glottal stop has a raising effect on F0. However, glottal stop could induce a sharp drop in F0, too ([9]). Moreover, as noted in Tan and Kong ([11]: 17), the glottal stop in Lhasa is characterized by glottalization. That is, glottal closure is realized as creaky voice in a sense of Ladefoged's ([12]) "continuum of phonation types" (see also [13]).