Acoustic Analysis of Lahu Nyi Tone System

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ABSTRACT

This study represents the first acoustic analysis of the seven-tone system of Lahu Nyi, a dialect of Lahu, a Tibeto-Burman language spoken in Muang Na subdistrict, Chiang Dao district, Chiang Mai province, Thailand. One male and two female native speakers produced the seven tones in isolation and in a sentence context. Pitch contour analysis showed five long tones in open syllables and two short tones in syllables closed with a glottal stop. Low tones are slightly breathy. Pitch contour modification was observed in the sentence context produced by the male speaker where a high-mid falling tone exhibits a rising contour in the context of a following high-mid falling tone.

Keywords: Lahu Nyi, tone, F0 patterns, glottalization, duration

1. INTRODUCTION

The Lahu language belongs to the Central Loloish branch of the Lolo-Burmese subgroup of Tibeto-Burman languages [9]. 102,876 Lahu people were reported to live in 11 provinces of Thailand in 2015 [4]. Bradley [1] identified five Lahu dialects spoken in the country as (1) Lahu Na; (2) Lahu Nyi; (3) Lahu Shehleh; (4) Lahu Shi Bakeo; and (5) Lahu Shi Banlan. However, Matisoff [9] argued that, based on linguistic criteria, there are only two main dialects of Lahu: Black Lahu (Lahu Na) and Yellow Lahu (Lahu Shi). According to Matisoff [9], Lahu Nyi or Red Lahu is a subvariety of Black Lahu. Consistent with Matisoff’s claim, Bradley [1], Lewis [5] and Sirisai [12] pointed out that the Lahu Nyi and Lahu Na dialects are mutually intelligible.

Most studies of Lahu focused on its phonology and grammar, and Black Lahu has received the most attention. James Matisoff documented its phonology [9], examined the relationship between the high-rising tone and glottalization [6], and wrote the grammar of Lahu [7], the Dictionary of Lahu [8], and the English-Lahu Lexicon [10]. Lewis [5] wrote Lahu-English-Thai dictionary. The phonology of Lahu Bakeo has been documented by Suknaphasawat [13], and the phonology of Lahu Nyi was studied by Sirisai [12].

According to Sirisai [12], the Lahu Nyi dialect spoken in Mae Chan district of Chiang Rai, Thailand has 28 consonants, 9 monophthongs and 6 diphthongs with C(C)V(V)T syllabic structure where T stands for lexical tone.

Lahu Nyi contrasts 7 tones: three pairs of checked vs unchecked tones (i.e., T1/T2; T4/T6; T5/T7) and 1 unchecked mid-level tone (T3). The Chao [2] pitch value and their impressionistic descriptions by Sirisai [12] are shown in Table 1.

Table 1: Lahu Nyi Tones according to Sirisai [12].

<table>
<thead>
<tr>
<th>Tone</th>
<th>Pitch value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>22</td>
<td>A mid-low level tone</td>
</tr>
<tr>
<td>2</td>
<td>22ʔ</td>
<td>A mid-low level tone glottalized tone</td>
</tr>
<tr>
<td>3</td>
<td>33</td>
<td>A mid-level tone</td>
</tr>
<tr>
<td>4</td>
<td>44ʔ</td>
<td>A mid-high level glottalized tone</td>
</tr>
<tr>
<td>5</td>
<td>45ʔ</td>
<td>A high contour glottalized tone</td>
</tr>
<tr>
<td>6</td>
<td>44</td>
<td>A mid-high level tone</td>
</tr>
<tr>
<td>7</td>
<td>45</td>
<td>A high contour tone</td>
</tr>
</tbody>
</table>

On the other hand, Lewis [5] impressionistically described a Lahu Na dialect spoken in Thailand as having 24 consonants plus a glottal stop. According to Lewis [5], Lahu Na has five tones on open syllables (a high and slightly falling tone, a mid-high rising tone, a mid-level tone, a low-level tone and a low falling tone) and two tones with final glottal stops (a high short tone with a glottal stop and a low short tone with a glottal stop). He also mentioned a number of contexts where a ‘tone change’ occurs. For instance, he mentioned that the mid-level tone may become a high rising tone when followed by high tones. It is not clear if these tonal alterations are due to coarticulatory effects or a tone sandhi process.

Acoustic studies on any Lahu dialects in Thailand are rare [3]. Cooper [3] conducted an acoustic analysis of Lahu Shi Balan vowels and tones produced by three native speakers from Chiang Rai. According to Cooper [3], Lahu Shi Balan contrasts five tones in open syllables and two short (cut) tones in closed syllables. He also pointed out that falling
tones are often breathy. However, no acoustic
measurements are available to collaborate this
impressionistic description. To our knowledge,
acoustic analysis of Lahu Nyi tones spoken in
Thailand has yet to be conducted. The aim of this
study is to fill this research gap.

2. THE CURRENT STUDY

The primary aim of this study is to provide, for
the first time, an acoustic analysis of the tone system of a
Lahu Nyi dialect spoken in Muang Na Sub-district,
Chiang Mai, Thailand. Of particular interest is the difference in pitch contours
of tones in open syllables (uncut or unchecked tones)
and in syllables closed with a glottal stop (checked or
cut tones), and between tones in citation forms and in
a sentence context. The presence of creaky
(glottalization) and breathy phonation will also be
explored.

2.1. Speakers

Three native speakers, 1 male (M1) and 2 female
speakers (F1, F2) participated in the study. M1 is 42
years old. He holds a master’s degree in Political
Science. Lahu Nyi is his first language and the
language he uses at home. He is also fluent in Thai
and has a fair command of English and Chinese, a
variety spoken in Yunnan, China. He serves as a
spiritual leader in the village and owns a family
business. F1 (M1’s spouse) is a 30-year old
housewife. She completed 6 years of elementary
school. Lahu Nyi is her first language. She speaks
Thai with a slight accent. She moved from Chiang Rai
to Muang Na Sub-district after getting married about
7 years ago. F2 is 54 years old. Lahu Nyi is her first
language and the language she uses with her family
members. She completed 6 years of elementary
school and received a secondary school certificate.
She is fluent in Thai and has a good command in
Cantonese. She served as the Lahu-Thai interpreter
for King Rama IV at the age of 20. She owns a store
and a coffee shop.

2.2. Stimuli

Stimuli were /CVT/-[tea] syllables (see Table 2)
produced with all seven tones in isolation (by M1 and
F2) and in a sentence carrier (by M1 and F1). Since
Lahu speakers are not used to producing Lahu words
in isolation, each target word was introduced in a
context in which it is used. Once the speakers were
familiar with the target words, the elicitation
procedure proper began.

Table 2: Target words used in the current study.

<table>
<thead>
<tr>
<th>Tone</th>
<th>Context</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>[tea]1</td>
<td>ʔa^1</td>
<td>te^41 te^33</td>
</tr>
<tr>
<td></td>
<td>te^41</td>
<td>Don’t do it.</td>
</tr>
<tr>
<td>[tea]2</td>
<td>ʔa^1</td>
<td>te^33 kʰe^33</td>
</tr>
<tr>
<td></td>
<td>te^41</td>
<td>to eat</td>
</tr>
<tr>
<td>[tea]3</td>
<td>ʔa^1</td>
<td>te^41 kʰe^33</td>
</tr>
<tr>
<td></td>
<td>te^33</td>
<td>robe</td>
</tr>
<tr>
<td>[tea]4</td>
<td>ʔa^1</td>
<td>da^33 we^33</td>
</tr>
<tr>
<td></td>
<td>te^41</td>
<td>to attach</td>
</tr>
<tr>
<td>[tea]5</td>
<td>ʔa^1</td>
<td>te^21 te^21</td>
</tr>
<tr>
<td></td>
<td>te^41</td>
<td>rice plant</td>
</tr>
<tr>
<td>[tea]6</td>
<td>ʔa^1</td>
<td>kʰy^33</td>
</tr>
<tr>
<td></td>
<td>te^41</td>
<td>machine</td>
</tr>
<tr>
<td>[tea]7</td>
<td>ʔa^1</td>
<td>la^41-a^13</td>
</tr>
<tr>
<td></td>
<td>te^41</td>
<td>to feed</td>
</tr>
</tbody>
</table>

For citation tones, target syllables written in Roman
script with a tone mark (e.g. ca^a) were used as
prompts for M1. For F2, index cards with meanings
written in Thai were used. One repetition of each
target word was elicited from M1 and two repetitions
from F2 were included in the analyses.

For tone production in a sentence carrier, target
words in Lahu written in International Phonetic
Alphabets and meanings in Thai were presented on an
index card. The researcher gave the context and the
meanings in Thai and asked each speaker to produce the
target word in Lahu. After being able to produce the
target Lahu word, the speakers (M1 and F1) were
asked to produce the target word in its context first
before producing 5 repetitions of the target syllable
[tea] only in the sentence carrier “I ____ say again.”:

/ʔa^21 te^41 pʰ^447 kʰ^217 kʰ^217 we^33/ (Lahu)
“I _____ one time only to repeat.” (English gloss)

For example, to elicit the target syllable [tea] with
tone 2, the speaker would produce the context word
/ʔa^41 we^33/ or “to eat” first, before producing the
sentence carrier. That is, the speaker would produce
/ʔa^41 we^33 ʔa^21 te^41 (x 5 times) te^41 pʰ^447 kʰ^217 kʰ^217
we^33/ or “to eat I say eat eat eat eat eat again.” To
avoid the ‘list’ effect, the middle three repetitions
(repetitions #2, #3 and #4) were used for further
analyses.

2.3. Recording

Isolated tone production was recorded on Samsung
J7+ cellular phone at 44.1 kHz in a quiet room at
M1’s house and at F2’s house. The recording was then
converted from the MP4 to the .wav format for further
acoustic analysis.

Tone production in a sentence carrier was recorded
at M1 and F1’s house, in the same room, using a
digital recorder (Marantz, PMD661) and a head-
mounted microphone (Shure SM10A) at 44.1 kHz
sampling rate and 16-bit amplitude resolution. Each
target word was excised from its carrier sentence and
stored as separate files for further analysis. All stimuli produced by M1 and F1 in the sentence context were verified by a native listener (F2).

2.4. Acoustic Measurements

A text grid was created for each target sound file using Praat 6.0.31 [11] to label vowel-onset and vowel-offset. Using both the waveform and the spectrogram displays, vowel onset was defined as the onset of the first full glottal pulse and vowel-offset was defined as the end of the last glottal pulse, excluding creak or vocal fry, if any, to avoid F0 tracking errors. F0 values were then automatically extracted from 20 time-intervals between vowel onset and vowel offset using ProsodyPro [15]. Voice quality measurements were performed using VoiceSauce [14].

3. RESULTS

Results of the acoustic analysis of tones produced in isolation will be presented first followed by those in a sentence context.

3.1. Lahu Nyi tones in citation forms

Figures 1 displays raw pitch contours of the seven tones produced in isolation by M1. Vowel duration for both speakers are presented in Table 3.

From Figure 1 and Table 3, we see that Tone 3 and Tone 6 are the shortest and Tone 7 the longest. The remaining tones exhibit intermediate duration value.

Figures 2A and 2B present time-normalized pitch contours produced by M1 and F2 respectively.

<table>
<thead>
<tr>
<th>Tone</th>
<th>Duration (msec)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>speaker</td>
</tr>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>

Overall, pitch contours for all seven tones are similar between the two speakers. These acoustic results led to our proposed pitch values and description of Lahu Nyi tone system as shown in Table 4.
Table 4: Proposed pitch value and description of Lahu Nyi.

<table>
<thead>
<tr>
<th>Tone</th>
<th>Pitch value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>33</td>
<td>A mid-level tone</td>
</tr>
<tr>
<td>2</td>
<td>41</td>
<td>A high-mid falling tone</td>
</tr>
<tr>
<td>3</td>
<td>44?</td>
<td>A high-mid short tone</td>
</tr>
<tr>
<td>4</td>
<td>45</td>
<td>A high-rising tone</td>
</tr>
<tr>
<td>5</td>
<td>21</td>
<td>A low-falling tone</td>
</tr>
<tr>
<td>6</td>
<td>21?</td>
<td>A low-falling tone + slightly breathy</td>
</tr>
<tr>
<td>7</td>
<td>22</td>
<td>A low-level tone + slightly breathy</td>
</tr>
</tbody>
</table>

Interestingly, our Lahu Nyi tone descriptions are largely similar to those of Lahu Na described by Lewis [5] using a larger set of data, but different from those of Lahu Nyi described by Sirisai [12] due, perhaps, to dialectal differences. In addition, we found the two low tones (T5 and T7) to be slightly breathy and exhibited lower Harmonic-to-Noise-Ratio (HNR) between 0-3,500 Hz (1.78 and -2.08, respectively) than all other tones. However, further research with more data is needed to confirm this result.

3.2. Lahu Nyi tones in Sentence Context

Figure 3 and Figure 4 show time-normalized pitch contours of the seven tones produced in a carrier sentence by M1 and F1 respectively.

For M1, evidence of tonal alternations (from citation forms) is observed on T2, T3 and T7, with the most noticeable change occurring on T2. Specifically, T2 demonstrates a slight fall and T7 a slight rise instead of a level contour. No obvious pitch alternations are observed for F1’s production.

4. CONCLUSION

Lahu Nyi spoken in Muang Na subdistrict, Chiang Dao district, Chiang Mai province, Thailand contrasts five lexical tones in open syllables and two lexical tones in syllables closed with a glottal stop. Tones in open syllables (unchecked tones) are longer than tones in closed syllables (checked tones). Glottalization (creaky voice or vocal fry) may accompany a glottal stop in checked tones and low tones are slightly breathy. Pitch contour alterations are observed, particularly for a high-mid falling tone when produced in the context of another high-mid falling tone. More research is needed to confirm the association between low tones and breathiness and pitch contour alternation patterns in different tonal contexts.

5. REFERENCES

Balan, Chiang Mai: Payap Research and Development Institute anthe Summer Institute of Linguistics.


