

SOME ACOUSTIC PROPERTIES OF TONES IN BURMESE

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1. PHONOLOGICAL TONES

On the basis of Trubetzkoy's definitions of phoneme, phonological unit, phonological contrast, and his rules 2 and 3 for the differentiation of phonemes and variants (Trubetzkoy 1968:7, 1969:48-49), the following phonological tones can be assigned to the phoneme inventory of Burmese phonology.

Four tones:

- | | | |
|----------|---------------------|----------------------------------|
| Tone I | /tɕá/ | 'lotus', 'to take a long time' |
| Tone II | /tɕâ/ | 'to hear' |
| Tone III | /tɕà/ | 'to fall down' |
| Tone IV | /tɕa [?] / | 'to be stringent', 'to be tight' |

The Burmese phonological tones, however, are classified differently by various writers. Taylor (1920) and Firth (1933) classify the Burmese tones into three. Firth (1936) and McDavid (1945) suggest that there are five tones in Burmese. Cornyn (1944), Burling (1967), Stewart (1955) and Becker (1964) agree in classifying the Burmese tones into four.

If the CVC phonological syllable pattern is recognised, as in present-day written Burmese and old epigraphic Burmese, it is true that /tɕa[?]/ (written tɕap), (Tone IV in the above example) could be treated as belonging to the CVC pattern, and thus there would be only three tones in Burmese. In present-day spoken Burmese, however, the final stops of the written CVC pattern are replaced by a final stop, which is a glottal stop in isolation. If the CVC pattern is regarded as one phonological syllable pattern, then this characteristic will be the sole representation of the final C of the CVC pattern. Therefore it is more acceptable to analyse the Burmese phonological syllable pattern as V and CV and to treat the final stop as a tonal feature.

Firth (1936) and McDavid (1945) classify the Burmese tones into five because they treat the neutral vowel [ə] as a separate tone. The neutral vowel [ə] appears as a non-final **neutral** syllable in words consisting of two or more syllables, but never in monosyllabic words. Burmese is basically a monosyllabic language and any non-monosyllabic word in Burmese with a neutral vowel [ə] is either a borrowing or a lexical compound or the result of a derivational process. Therefore, in this analysis, the Burmese phonological tones are classified into four. [Note that Tones I, II and II in this analysis are generally described as even or level tone, heavy or breathy tone and creaky tone respectively in the literature. The cardinal order and symbols of the tones in this analysis are somewhat different from Okell (1969) but same as Cornyn (1944) and Cornyn and Roop (1968).]

2. EXPERIMENT 1

There are altogether fifty vocalic nuclei in Burmese apart from the neutral vowel [ə].

Basic symbol	non-nasalsed				nasalsed			
	Tone I	Tone II	Tone III	Tone IV	Tone I	Tone II	Tone III	Tone IV
i	1. í	2. î	3. ÿ	4. i [?]	5. í	6. î	7. ÿ	X
e	8. é	9. ê	10. è	11. ei [?]	12. éí	13. êí	14. èí	X
ε	15. é	16. ê	17. è	18. ε [?]				X
ai				19. ai [?]	20. áí	21. âí	22. ãí	X
a	23. á	24. â	25. ã	26. a [?]	27. á	28. â	29. ã	X
o	30. ó	31. ô	32. õ	33. au [?]	34. áú	35. âú	36. ãú	X
o	37. ó	38. ô	39. õ	40. ou [?]	41. óú	42. ôú	43. õú	X
u	44. ú	45. û	46. ù	47. u [?]	48. ú	49. û	50. ù	X

([ei], [au] and [ou] can be regarded as the different realisations of /e/, /o/, and /o/ in the environment of nasalisation or a final stop and [ãí] could be the allophone of /ai/ in the nasalised environment.)

All these fifty vocalic nuclei of two male native speakers and two female native speakers were recorded in [hVdǎ] (/hVdǎ/) frame for the monophthongal nuclei and in [hVndǎ] (/hVndǎ/) and [hvv[?]dǎ] (/hvv[?]dǎ/) frames for the diphthongal nuclei. The initial consonant [h] was chosen in the frames because it is the weakest consonant to bring forth any co-articulation effect on the following vowel; the medial

[d] was chosen to make the segmentation easy; and the final [á] was chosen to make the utterances natural for the Burmese speakers as this is a frequent vowel.

Some of the utterances in these frames are nonsense words whether the last syllable [dá] is eliminated or not. These nonsense words however have to be tolerated because the purpose of the experiment is to analyse the phonetic qualities of the vocalic nuclei of the utterances and they are not foreign for the Burmese speakers to pronounce. The established writing system enables the subjects to pronounce them easily and naturally whether they are meaningful or not.

Every speaker uttered every sound twice and both utterances were recorded. All the recorded sounds were processed with a Frokjaer-Jensen intensity and fundamental frequency meters, using the linear intensity output and the duplex oscillogram and fundamental frequency output. The outputs were displayed by a mingograph. The necessary precautions were observed both in recording and processing. When the fundamental frequency of every utterance was measured, a slight difference between the first and the second utterances of the same sound sometimes occurred. In such a case the average value of the two was taken.

Of the three outputs observed on the mingograph (i.e. intensity display trace, duplex oscillogram trace and the fundamental frequency trace), the intensity display trace of the tones does not show any consistency or any common factor by which the contrastive features of the tones can be distinguished. It is tempting to say that in the null context that these fifty utterances are in, the intensities of the tones do not behave regularly as they do in sentences. The duplex oscillogram trace also enables us only to distinguish the vowel segments from the adjacent consonants along the fundamental frequency trace. Therefore, of the three parameters, only the fundamental frequency trace of the tones is dealt with in this present analysis.

The fundamental frequency as shown in the mingograms of all the four subjects, rises gradually from Tone I to Tone IV. The fundamental frequency for Tone I starts at a relatively level range and tends to go down slightly; the fundamental frequency for Tone II starts at a relatively level range, goes up, and then falls down relatively low; the fundamental frequency for Tone III starts at a relatively high range, usually higher than or as high as the peak of Tone II, and falls down relatively low; the fundamental frequency for Tone IV starts at a high range, frequently higher or as high as the peak of Tone II and falls low, but not as low as Tone III because it stops very suddenly before it can drop lower. The general contrastive features of the four phonological tones offered by the analysis of their fundamental frequency

can be described as:

- I level, low
- II high, rising, falling
- III high, falling
- IV high, falling, abrupt end.

For the detailed contrastive characteristics of the tones, in terms of their fundamental frequencies, there is no special point to be observed for Tones I and II because Tone I simply starts at a level range and falls slightly in the end and Tone II starts at a level range, goes up and falls down to the level range. However there are some detailed contrastive features to be observed for Tones III and IV in comparison with Tone II.

The fundamental frequency of all the utterances in Tone III by the two female speakers starts with a high range, higher than the peak of Tone II with one exception. For the one exception also, the starting range is the same as the peak of Tone II. The fundamental frequency of the utterances of the first male subject in Tone III starts with a relatively high range, usually as high as the peak of Tone II. Of the fourteen utterances of the first male subject in Tone III, the fundamental frequency for nine he starts with the high range equal to the peak of Tone II, the fundamental frequency for three starts with the high range higher than the peak of Tone II; and the fundamental frequency for the remaining two starts at a range slightly lower than the peak of Tone II. The fundamental frequency for all the utterances in Tone III by the second male subject starts at the high range, higher than the peak of Tone II.

For the two female subjects, the commencing high range of Tone IV is generally either higher than or as high as the peak of Tone III. However, in one case for one female subject and in three cases for the other, the commencing range of Tone IV is either equal to or slightly lower than the peak of Tone III. Of the eight utterances in Tone IV of one male subject, four are equal to and four are slightly lower than the peak of Tone III; of the eight utterances in Tone IV of the other male subject, three are equal to and five are slightly lower than the peak of Tone III.

The following table summarises the average fundamental frequencies of the four tones for the four subjects, out of their 200 utterances i.e. 50 each (14 in Tone I, II and III and eight in IV) among the four subjects i.e. out of 56 utterances in each of the first three tones and 32 utterances in Tone IV.