TONES IN NORTHERN KAMMU: A PHONETIC INVESTIGATION*

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Kammu is a Mon-Khmer language spoken in Northern Laos, Vietnam and Thailand and in Southern China.[1]

Table 1 shows an analysis of the segmental phonemes of five northern (Khwɛɛn, Yuan, Krɔɔŋ, Rɔ́ɔk and Lɨɨ) and one southern (ʔUu) sub-dialect of Kammu.[2] In the northern dialects, the feature voice plays a minor role in the consonant system. These dialects have been analysed as having two tones, called high and low (Lindell 1974). The non-tonal southern dialects, on the other hand, use the feature voice contrastively throughout the consonant system.[3]

In view of these facts it has been suggested (Ferlus, 1974; Lindell, Svantesson & Tayanin, 1976) that the southern dialects are closer to the non-tonal Proto-Kammu stage than the northern dialects, which are in the process of developing tones. The relationship between consonant types and tone in these dialects has a direct bearing on the origin and development of tone (Haudricourt, 1961; Matisoff, 1973; Maran, 1973; For a summary of theories on this subject, see Matisoff, 1973).

As a complement to the phonological analysis (Table 1) it is our aim here to present a preliminary acoustic and perceptual study of the "tones" of Northern Kammu. A male native speaker of the Yuan sub-dialect, about 40 years old, participated in the experiment.

The acoustic analyses and perceptual tests will be described under the headings Production and Perception, respectively.

Production

Table 2, p. 21, shows the speech material selected for investigation. The four pairs of words have been analysed as being minimally distinguished by tone, the three unpaired words as 'neutral' with respect to tone (Lindell et al., 1976). These words will hereafter be referred to as high-tone words, low-tone words and neutral words. Care was taken to find words the meaning of which could be illustrated by drawings. The drawings were used to elicit natural productions of the test words in two different contexts.

* Also in Acta Orientalia 38.

Table 1

Kammu phonology

Initial consonants

Northern Kammu

p	t	c	k	ʔ
–	–	–	–	
ph	th	ch	kh	
ʔb	ʔd[1]			
–	–		–	
m	n	ñ	ŋ	
	–			
	r			
	–			
	l			
	s			h
–				
w		y		

Southern Kammu

p	t	c	k	ʔ
b	d	j	g	
ph	th	ch	kh	
ʔm	ʔn			
m̥	n̥		ŋ̊	
m	n	ñ	ŋ	
	r̥			
	r			
	l̥			
	l			
	s			h
w̥				
w		y		

Final consonants[2]

p	t	c	k	ʔ
m	n	ñ	ŋ	
	s			h
	r			
	l			
w		y		

Vowels[2]

i	ɨ		u	ii	ɨɨ		uu	ia	ɨa	ua
e	ə		o	ee	əə		oo		əa	
ɛ	a	ɑ	ɔ	ɛɛ	aa	ɑɑ	ɔɔ			

(After Lindell, Svantesson & Tayanin, 1976)

1 The phonetic characteristics remain to be investigated.

2 The same systems for both dialects.

Table 2

Test items

[ŋɔ́ʔ] 'rice in husk'	[ŋɔ̀ʔ] 'to fear'
[prnɔ́ʔ] 'broom'	[prnɔ̀ʔ] 'sling to carry baby'
[klá:ŋ] 'kite'	[klà:ŋ] 'stone'
[rá:ŋ] 'tooth'	[rà:ŋ] 'flower'

[si:m] 'bird'

[chuk¹] '(kind of) bamboo'

[mat¹] 'eye'

In the first context, the subject was asked to give the word illustrated by the drawing, in aswer to the question What is that? The question was asked in Kammu by one of the experimenters (KL), who pointed to the drawing. In the second context, the subject was asked to give the word embedded in the frame [ki: màh . . . kə:] 'this is his . . . ' and for the word (ŋɔ̀ʔ) 'fear' in the frame [kə: . . . kə:] 'he . . . him'.

The words were elicited in four different orders. The recordings, made in a sound-proof room (Phonetics Laboratory, Lund University), yielded eight productions of each test item.

This material was analysed by means of a Frøkjaer-Jensen pitch extractor. The fundamental frequency (f_o) curves, four for each test item, were superimposed on tracing paper with the beginning of the vocalic segment as a common time reference for each sentence. Figure 1 is an example of these tracings. The four curves follow each other closely, indicating little variation in the productions of the test items.

Figure 2 shows the average f_o curve of each member of the four minimal pairs in phrase-final position. The tracings of the f_o curves of the embedded words were similar, except for a slight rise over those words ending in a nasal.

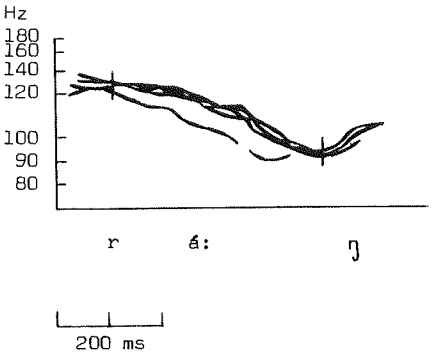

Figure 1. Superimposed f_0 tracings from four productions of [rá:ŋ].

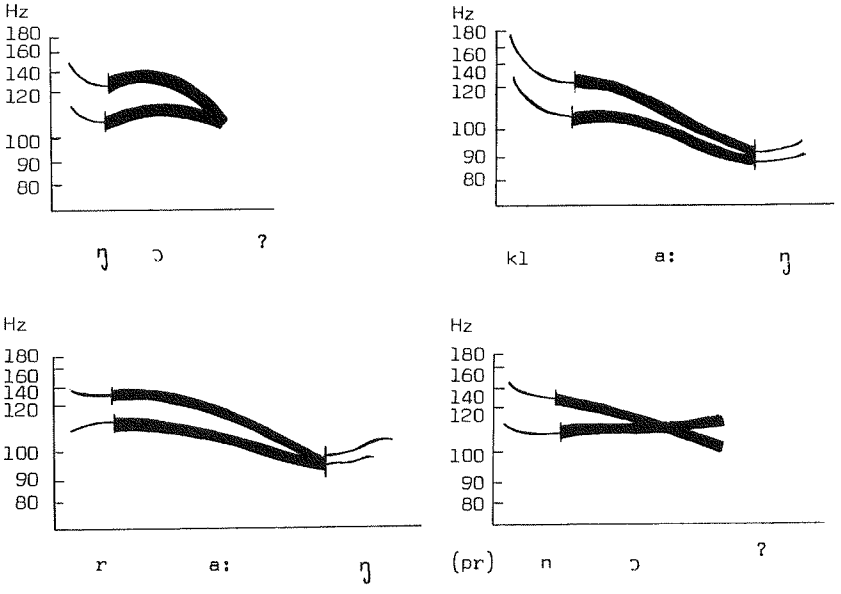

Figure 2. Average f_0 curves of four productions of minimal pairs. The upper curve in each pair is derived from a high-tone word,

The high-tone words have a higher average f_0 value than the low-tone words. The largest difference, 30 Hz, is to be found at or near the beginning of the f_0 tracing. Towards the end of the vocalic segment the curves converge.

There is some variation in the configuration of the curves that can be associated with the different segmental composition of the syllables. For the sequences [kla:ŋ] and [ra:ŋ] both the high- and the low-tone words have falling curves, for the sequences [ŋɔ$^{?}$] and [ŋɔ$^{?}$] the high-tone word is falling and the low-tone word is close to level. There are higher f_0 values in all the sequences ending in [$^{?}$]. This may be a consequence of the glottal stop which involves a contraction of the vocalis muscle. The pitch-raising effect of [$^{?}$] has been noted in other languages (e.g. for Arabic, Hombert, 1975; for Swedish, Gårding et al., 1975).

Figure 3 shows the f_0 curves of the neutral words. The tracings of the four productions of each test word follow each other as closely as the words minimally distinguished by tone. The words beginning with a voiceless fricative have an f_0 configuration similar to that of the high-tone words, whereas the word beginning with a sonorant has an f_0 curve similar to that of the low-tone words.

The fact that the neutral words have two tonal configurations depending on consonant type calls for an investigation of the spectral composition of the minimal pairs, notably the initial consonants. Are they really as alike as the phonological analysis would imply? One remark made by the informant suggests a possible difference in their articulation. In the high-tone words he "spits out the vowels", in the low-tone words he "sucks them in".

A spectrographic analysis of the minimal pairs showed that in three of four pairs the initial consonants had essentially the same spectral patterns. Only in the pair [ra:ŋ] is the initial consonant different. In the low-tone word, /r/ is trilled with two to four trills, in the high-tone word it has no trills but an initial phase of weak friction preceding the voiced part of the /r/. Figure 4 shows typical examples of spectrograms for [ra:ŋ] and [kla:ŋ].

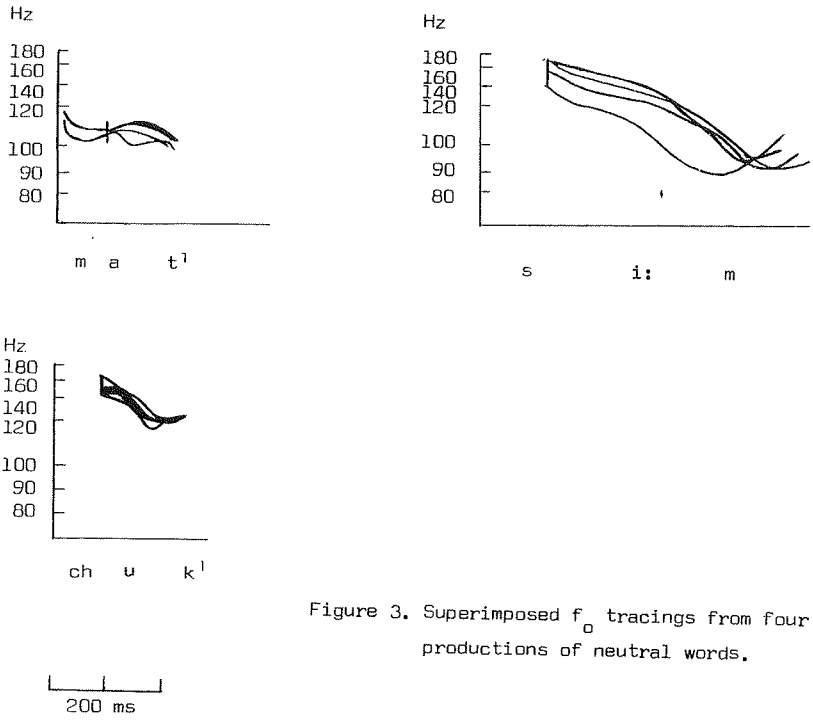

Figure 3. Superimposed f_0 tracings from four productions of neutral words.

Perception

A test was run one week after the recording to check if the informant could identify his own productions. The words were presented four times, each time in a different order. The subject was asked to point to the picture that corresponded to the word he had heard. In this task he made no errors.

A test on the role of the initial consonants for the identification of the minimal pairs was also performed. Stimuli were prepared by removing the initial consonants from three productions of the four minimal pairs using an electronic gating technique. This procedure gave us 24 stimuli.

The informant was asked to listen to the stimuli and identify the words from which the stimuli had been derived. He was to answer by pointing to the appropriate drawing.

The informant gave correct answers for all stimuli except [klá:ŋ] and [prnś$^{?}$] which were judged incorrectly one third of the time. It is also of interest that the informant soon discovered that a stimulus like [á:ŋ]

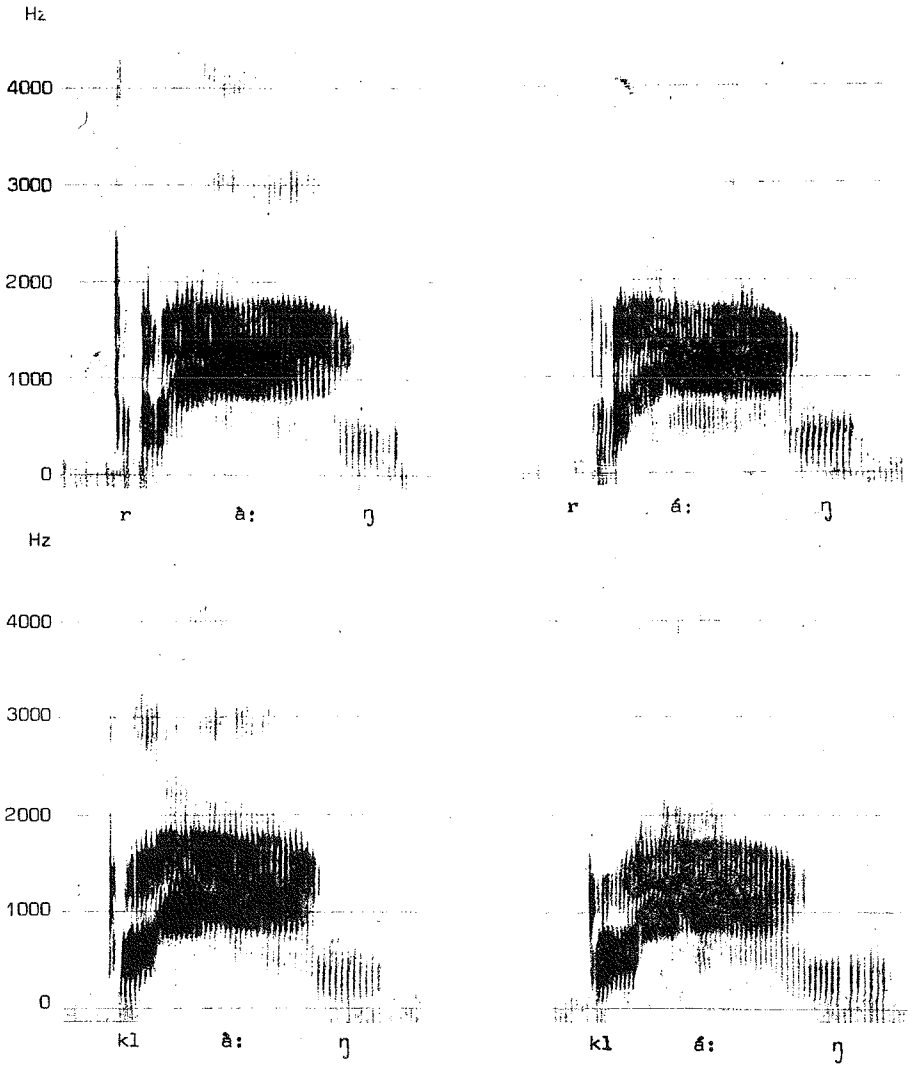

Figure 4. Wide-band spectrograms of [ra:ŋ] and [kla:ŋ]. Notice difference in initial /r/ in the first pair.

could come from both [rá:ŋ] and [klá:ŋ] and similarly for the other stimuli. His reaction to the truncated stimuli was that they sounded like children's speech.

This remark may suggest that children belonging to this speech community acquire tone earlier than certain types of syllable-initial consonants and clusters which would be in agreement with the results of an investigation of tone acquisition in Mandarin Chinese (Li & Thompson, 1976).

Discussion

Our results lend support to the phonological analysis proposed by Lindell et al. High- and low-tone words were found to have higher and lower f_0 curves, respectively.

There is also confirmation of the phonological analysis on the perceptual side. Stimuli in which the initial consonants had been deleted could still be identified correctly.

Although the vocalic segments of a pair have similar formant patterns - as indicated by the spectrograms - it is still possible that spectral information other than fundamental frequency could possibly distinguish these words. In order to establish that f_0 is a sufficient cue, we plan to present stimuli for identification in which the fundamental frequency pattern associated with the high-tone words is superimposed on a low-tone word, and vice versa.

The fact that the three neutral words showed fundamental frequency patterns similar to the high- and low-tone words, with "high" curves after voiceless consonants and "low" curves after voiced ones, suggests that all words in this dialect have "tone". It also seems likely that only in cases where the dialect has developed minimal pairs is the informant's judgement of the tonal quality of a word consistent. These hypotheses remain to be tested in follow-up experiments.

The difference in f_0 associated with consonant type in the neutral words (about 25 Hz) is somewhat larger than what is found in other languages (Lehiste, 1961; Lea, 1973; Hombert, 1975; Gandour, 1974). Figure 5 gives f_0 values of vowels after voiced and voiceless aspirated stops in American English.

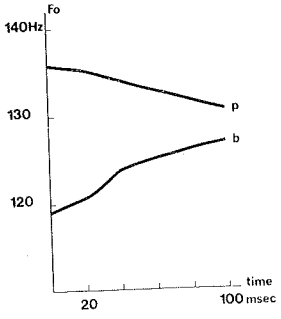

Figure 5. Fundamental frequency values of vowels after voiced and voiceless aspirated stops - [p] and [b] represent the voiceless aspirated and the voiced series respectively. Fundamental frequency (vertical axis) is measured as a function of time (horizontal axis) - (5 subjects).

(After Hombert, 1975)

Since this phonetic study has supported the tonal analysis of Northern Kammu, it is of interest to examine the dialectal differences between Northern and Southern Kammu.

A list of cognates reveals the following correspondences (Lindell et al., 1976) between consonant types and tone.[4]

Southern Kammu	Northern Kammu
pV	pV́
bV	pV̀
tV	tV́
dV	tV̀
jV	cV̀
blV	plV̀
drV	trV̀
klV	klV́
glV	klV̀
hmV	mV́
mV	mV̀
hŋV	ŋV́
ŋV	ŋV̀
hwV	wV́
wV	wV̀

One possible interpretation of these correspondences is that Northern Kammu replaced the distinctive value of voice with tone.

Thus the northern and southern dialects of Kammu seem to confirm a

widely accepted theory of the origin of tone. According to this theory (e.g. Haudricourt, 1961), tones arose when redundant f_0 features connected with the consonant types became primary, and consonantal oppositions disappeared in the beginning and/or the end of syllables.

Acknowledgements

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2. We are indebted to Jack Gandour for discussions which led to improvements in the form and substance of this paper.

Notes

1. For a general description of the Kammu see LeBar et al., 1964. For the Kammu in Vietnam, China and Thailand see also Dang, 1976; Davies, 1909; LeBar, 1967.
2. The phonemic system of the southern ?Uu dialect is in close agreement with that described by Smalley, 1961; Delcros, 1966; and Maspero, 1955. Although 'n is not represented in our material we have completed the table using Smalley's analysis.
3. In Ferlus, 1974, the southern dialects are designated 09-1, the northern 09-2. We have no representation of Ferlus' 09-3, where the voiced plosives have become unvoiced and aspirated.
4. Not all possibilities are found in the material on which that paper is based.

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