

AN ACOUSTIC STUDY OF NORTHERN KHMER VOWELS

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1. Northern Khmer phonology

Northern Khmer is spoken in northeastern Thailand in the provinces of Buriram, Surin, and Sisaket by perhaps 1,000,000 people. It is closely related to Central Khmer of Cambodia, 80-85% cognate on a 270-word basic list. This study is based on the speech of Mr. Kheuan Singkhanipa of Ban Khokkrapeu, 5 km. south of Surin City.

Northern Khmer has typical Mon-Khmer consonant and syllable structure, with /p, t, c, k, ʔ; b, d; ph, th, ch, kh; m, n, ɲ, ŋ; w, l, r, y; s, h/ as initial and medial consonants, and /p, t, c, ʔ; m, n, ɲ, ŋ; w, l, r, y; h/ as final consonants. Final -ʔ sometimes varies to -k.

The vowel system contains 14 pure vowels and 3 offglided vowels (Chart 1), as has been described by Smalley (1976) and Dhanan and Chartchai (1978). Each of these 17 vowels has contrasting long and short varieties. All 17 long vowels can occur in closed syllables. All but uua have been found in open syllables, and uua is sure to appear soon in loanwords from Thai. All 17 short counterparts are pronounceable and distinguishable by native speakers, though i, ɯ, u are in nearly free variation with ɨ, ɯ, u.

No phonation distinctions have been recorded by any of the linguists who have worked on Northern Khmer, and if any traces exist they are clearly not phonemically significant. There is presumably some correlation between the Northern Khmer vowel heights and Central Khmer registers, but the correspondences do not appear to be simple.

ia	ua	ua
i	ɯ	u
ɨ	ɤ	ʊ
e	ə	o
ɛ	ʌ	ɔ
	a	a

Chart 1. Northern Khmer Vowel System

These vowel contrasts may be exemplified in:

liia	'leave'	liiat	'open package'
lii	'carry on shoulder'	riit	'to iron'
tanlɯ	'sea'	chəlɯt	'squeeze through'
ʔanree	'pestle'	pleet	'bad girl'
panlɛɛ	'vegetables for curry'	khɫɛt	'crosseyed'
--		kuɯaʔ	'shoes'
luɯ	'hear'	luɯʔ	'raise'
lɣ	'above'	məlɣt	'oily'
leeləə	'puzzled'	krəət	'sound of tieing'
klɛ	'close friend'	kanlɛt	'uvula'
panlaa	'thorns'	kanlaat	'cockroach'
luua	'hit at'	ləluuaʔ	'waves'
luu	'howl'	ləluut	'abort'
kruv	'kitchen'	lɯt	'jump'
leeloo	'babble'	səloot	'kindly'
lɔɔ	'oxcart'	cəlɔɔt	'fall off'
sanlaa	'soup'	kaŋhaat	'nasal talk'

In terms of universals of vowel systems (Crothers 1978), Northern Khmer is atypical in both the number of basic vowels and their positions. By Crothers' typology Northern Khmer would be classified as 14:4, that is 14 basic vowel positions and 4 interior vowels (excluding a). The highest inventory in his sampling is Pacoh 12:3, which, not surprisingly, is also a Mon-Khmer language. (The Northern Khmer short vowel system, with neutralization of 3 contrasts, would be rated 11:3.) Standard Cambodian Khmer (Henderson 1952, Huffman 1967:245) can be considered to have 9 basic vowel positions, so would have a 9:2 rating.

Crothers' universal no. 12 states that the number of height distinctions in front vowels is equal to or greater than the number of distinctions in back vowels. But Northern Khmer has fewer front vowels (4) than back vowels (5). (In Crothers' counting a is usually reckoned as a central vowel.)

2. The experiment

Using a Kay Sonograph model 7029A at Mahidol University we made spectrograms over a period of about a week in late 1982 using a single informant.²

We made several spectrograms of each utterance (usually only one utterance per vowel), varying between logarithmic and linear settings, wide and narrow bands, sections vs. bands, and with or without contour envelopes. Occasionally we superimposed one on top of another. The majority were done at 80-8,000 Hz

range, but some, especially back vowels, were done at 40-4,000 Hz.

The data consisted of the informant pronouncing monosyllables with the 17 vowels in the environments pVV, pVVp, pVp. Some of these monosyllables were meaningful morphemes, others were hypothetical but phonologically correct. The informant had no hesitation reading any of them, using a writing system adapted from Smalley (1976). We decided to include the open syllable puua, though that is presently a vacant hole in the phonological system. And we included the short pu, pu, pu, as they are phonetically distinct, though their phonemic status is marginal. We decided to keep the environments identical to facilitate comparison, and chose p as the consonant before and after the vowel.

In reading the spectrograms we estimated the middle of a formant band, then using the calibration markings on the spectrogram estimated the frequency to the nearest 50 cycles.

The results cited in section 3 are estimates based on the spectrogram readings as described above, adjusted for the clarity of the various spectrograms. They may be assumed to be accurate within 50 Hz. (But because most of these were single tokens of the vowel, in some cases they may not represent the center of the vowel range.)

3. Results

The resultant readings for F_1 and F_2 in open syllables (pVV) are given below and plotted on Chart 2.

	F_1	F_2		F_1	F_2		F_1	F_2
iia	{ 350	2400	uuua	{ 425	1400	uua	{ 400	725(?)
	{ 750	1625		{ 725	1400		{ 700	1200
ii	275	2375	uuu	350	1500	uu	300	725
ɿɿ	400	2300	ɿɿ	450	1450	uu	400	800
ee	525	2175	əə	550	1350	oo	500	825
εε	650	1950	ʌʌ	725	1400	ɔɔ	575	875
			aa	825	1400	ɔɔ	725	1050

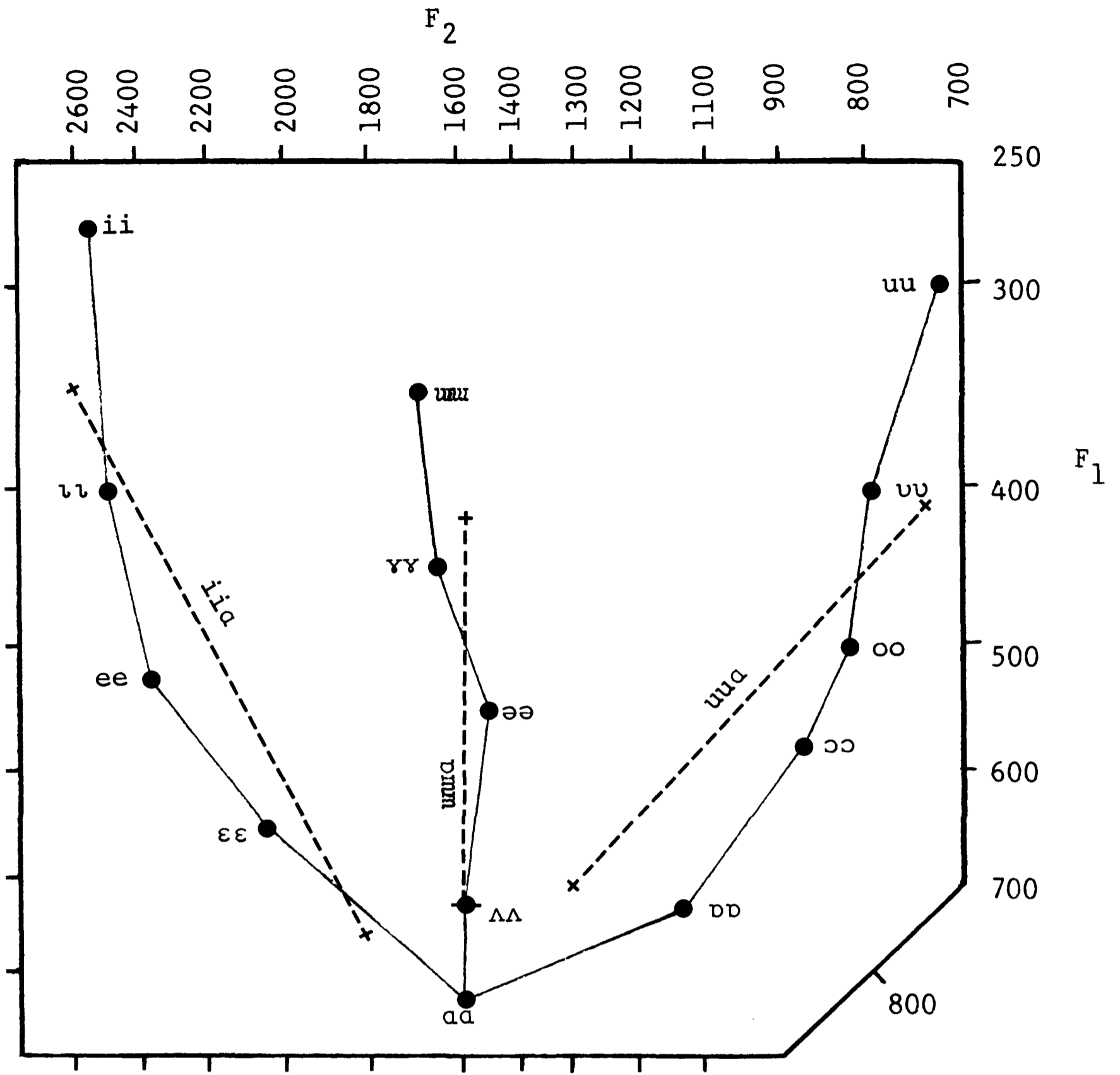


Chart 2. F₁ and F₂ in Open Syllables

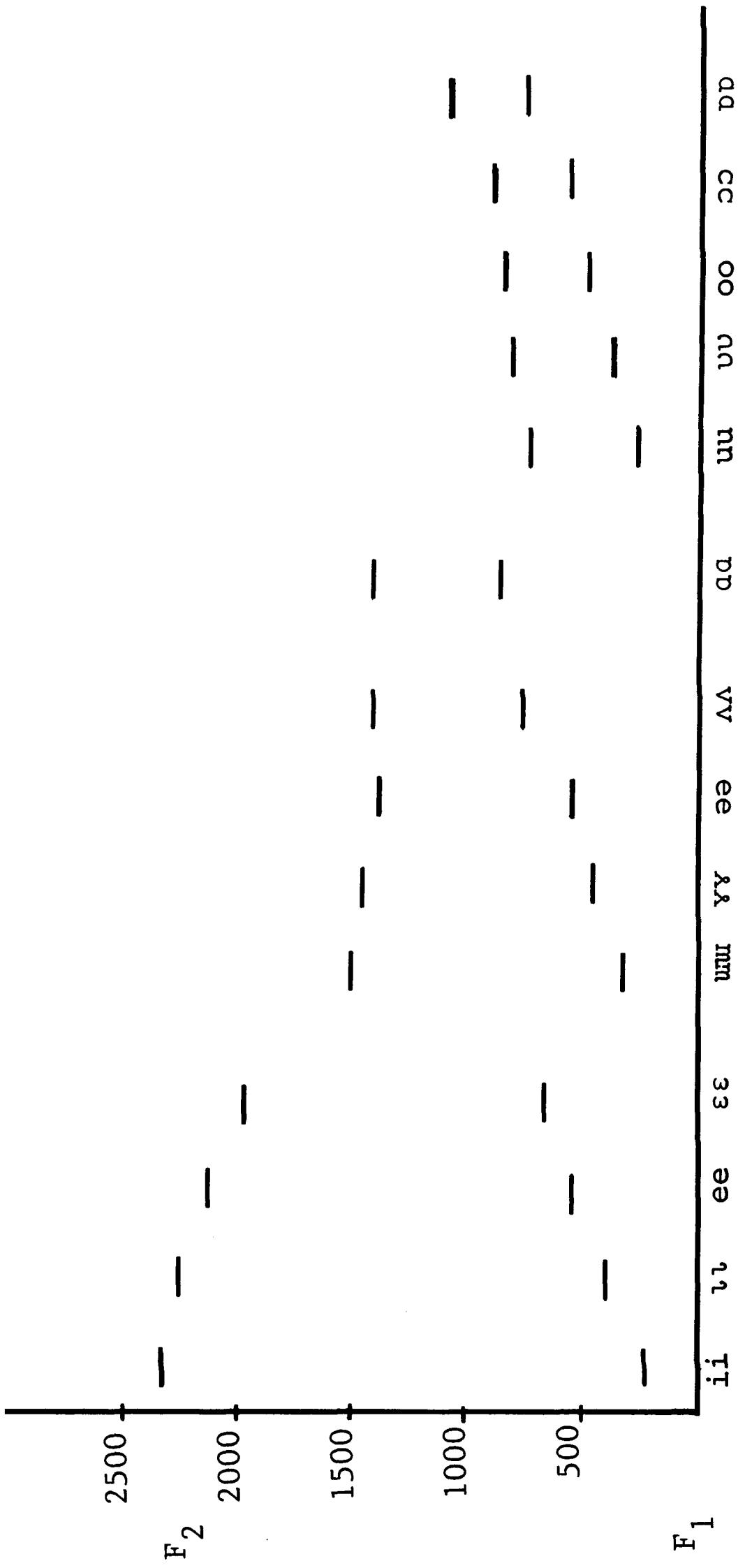


Chart 3. F₁ and F₂ in Open Syllables

The readings for long vowels in closed syllables (pVV) are:

	F ₁	F ₂		F ₁	F ₂		F ₁	F ₂
ia	{ 325	2400	ua	{ 425	1400	ua	{ 425	675
	{ 625	19-1600		{ 650	1375		{ 625	1000
ii	300	2400	ui	325	?	uu	275	650
ɨ	350	2300	ɥ	475	1450	uɨ	400	675
ee	500	2100	ə	600	1400	oo	500	800
εε	650	1900	ʌ	750	1350	ɔ	625	875
			aa	850	1375	ɒ	725	975

The readings for short vowels in closed syllables (pVp) are:

	F ₁	F ₂		F ₁	F ₂		F ₁	F ₂
ia	{ 400	2300	ua	{ 425	1450	ua	{ 450	750
	{ 650	18-1600		{ 675	1300		{ 550	950
i	300	2300	u	425	1500	u	325	650
ɨ	425	2200	ɥ	(480	1400) ³	u	425	725
e	550	2100	ə	625	1400	o	525	800
ε	650	1850	ʌ	750	1350	ɔ	600	850
			a	775	1400	ɒ	700	1000

4. Comments

The high front offglide /ia/ has two clear steady states in open syllables. But in closed syllables F₁ of the [a] is a long downward glide, not a steady state. This contrasts with Brou (Miller 1967:165) in which /iaq/ has two clear steady states. F₂ of the [a] moves upward a little, but is more like a steady state.

The front vowels in general show F₁ and F₂ far apart. But F₂ and F₃ are close together and parallel. F₁ is very heavy and often difficult to separate from the voice bar. F₂ and F₃ are lighter with the higher vowels and darker with the lower vowels.

The close high central vowel⁴ /u/ has a very faint F₂, so faint that it is completely missing on many of the spectrograms. F₃ is clearly visible, and F₄ is strong. With /ɥ/ F₂ is clearer. With the central offglide /uua/ F₂ also starts very faint, but ends strong (on the [a]).

The central vowels in general have a heavy F₁ with a lighter F₂. F₂ is very light in the high vowels but gets increasingly darker with the lower vowels. F₁, F₂, and F₃ tend

to be about equidistant from each other.

The close high back vowel /u/ has a very strong and wide F_1 , with a weak F_2 ; the two formants are so close that it is often hard to distinguish them. The open high back vowel /ʊ/ also has a weak F_2 , and most of the sectioned spectrograms don't show any F_2 spike for it. The offglide /uua/ shows two clear steady states moving in parallel.

The back vowels in general have very heavy F_1 , with much lighter F_3 and F_4 . There are often many faint bands above F_2 , making it sometimes difficult to decide which one to call F_3 . F_1 and F_2 are fairly close to each other.

The three offglides /iia, unua, uua/ tend toward a low [a] position in open syllables (see Chart 2), but toward a mid [ʌ] or [ə] in stopped syllables.

NOTES

1. The first author is primarily responsible for the Northern Khmer data, the second for the spectrography, and both jointly for the conclusions.
2. A somewhat similar experiment was conducted the year before, with more tokens of each vowel, and the results were presented at the 15th Sino-Tibetan Conference in Beijing, August 1982. Following that the spectrograph machine was readjusted, so the present data may be a little more accurate, but the present conclusions are based on fewer samples. The two sets of conclusions result in the same general picture, though the specific placement of vowels varies a little. The figures in Charts 2 and 3 all fall within or very close to the range of scatter in the first experiment.
3. Through an oversight we didn't get a spectrogram of /pɤp/. So we have given here the /pɤp/ figure from the first experiment. There is only a very weak, if any, phonemic contrast between short /u/ and /ɤ/, so the higher F_1 in /puɤp/ may represent a slipping toward /pɤp/, since he wasn't consciously contrasting the two. When he is being careful, however, the informant makes a phonetic distinction between /u/ and /ɤ/ parallel to that between /uuu/ and /ɤɤ/.
4. There is some debate among phoneticians whether these vowels are articulatorily central or back. But acoustically they are clearly midway between front and back.

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