PHONETIC VARIATION IN ANONG VOWELS

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ABSTRACT

The study presents an acoustic analysis of Anong vowels, a language on the edge of extinction, investigating how language death affects their range, distribution, and degree of variability. Three processes, raising, nasalization, and laryngealization, operating on Anong vowels are discussed.

Keywords: Vowel variation, endangered language.

1. INTRODUCTION

The purpose of this study is to present an acoustic analysis of Anong vowels and to investigate how the language death affects their range, distribution, and degree of variability. The study deals with the general principles underlying the patterns of contextual and non-contextual variability of the vowels as a contribution to the relatively small cross-linguistically phonetic database on vowel systems in extremely endangered languages. The acoustic structure of the Anong vowel system is examined from three angles: First, the vowels are located in acoustic space. Second, the acoustic patterns of raised vowels and nasalized vowels are examined in detail. And, third, vowel tenseness (laryngealization) is analyzed.

Anong is a tonal Tibeto-Burman language spoken in Fugong County in the Yunnan Province in China. It is a language on the edge of extinction with 62 fluent speakers and about 300 semi-fluent speakers remaining [1,2]. The fluent speakers are all over 60. They are also fluent in Lisu, specifically the northern dialect of Lisu [6]. Among these older speakers only few of them know the local Chinese dialect [1,2]. Anong is an endangered language, something evident from the usage patterns in bilingual contact situations. In the village of Mugujia, where the only fluent speakers of Anong live, Anong is only used when all the speakers are fluent in Anong, otherwise Lisu is the language of communication. Thus the prospects of anyone else learning the language are virtually non-existent.

1.1. Anong data

Sun collected the Anong data during six field trips, in the '60s, '80s and '90s. The present analysis is based on the data recorded in 1999.

1.2. Anong vowels

Sun [3] distinguishes eight main vowels, with [y] a ninth one restricted to a handful of Chinese borrowings. The notational system used by Sun in 1988 differs slightly from the ones used in 2000, with the difference in the symbols for the low back vowels (Fig. 1). The apical vowel /ʅ/ is actually pronounced as [jɨ] (Sun [4]).

Figure 1: Anong vowels.

1988 [3:30]			2000 [4:69]		
i (y)		ɯ u	i (y)		ɯ u
e		o	e		o
ɛ		ɔ	ɛ	a	ɑ
	ɑ				

2. AN ACOUSTIC ANALYSIS OF VOWELS

The recordings are of words produced in isolation, and thus they represent vowel qualities in clear citation forms. The number of tokens measured for each vowel is given in Table 1. The vowels [y] and [e] are not included in the analysis, because no examples were available in the recorded data. The recorded words were first sampled at 10 kHz, and then the measurements of formant frequencies were taken in the middle portion of the vowel, using the spectrographic displays and FFT and LPC spectra on the Macquirer program. The mean formant frequencies are shown in Table 1. The positions of the Anong vowels in a two-formant space are plotted in Fig. 2, with ellipses drawn around each cluster of points representing a single vowel type.

Fig. 2 shows that high vowels are characterized by a strong tendency to centralize. Of special interest is the vowel transcribed by Sun as the back unrounded vowel [ɯ]; in his work, Sun [1] observes that [ɯ] is more central than the symbol [ɯ] would lead one to expect, and, as the acoustic analysis shows, a more appropriate IPA symbol for [ɯ] would, in fact, be [ɨ]. A different back vowel, [u], shows a similar, though not as radical, centralizing tendency (F2=967). It becomes more peripheral only when it follows a bilabial stop, as in, for example, [kɑ^{55}pu^{31}] 'cuckoo' or [pʰu^{31}] 'blow air on fire'. When after a bilabial, the F2 lowers by ca 200 Hz (mean F2=675 Hz); these tokens of [u] are included in Fig. 2. Another vowel that is centralized is [ʅ]. It is a central vowel [ɨ] (mean F2=1740 Hz (s.d.=32 Hz). The F2 values for [ʅ] were compared with the F2 values for [ɯ]. A one-way ANOVA shows the differences in F2 to be highly significant ($F(1,11)=44.4$, $p<0.001$) indicating that, even though centralized, [ʅ] is different from [ɯ].

Table 1: Mean frequencies of Anong vowels.

	n	F1	F2	F3
i	5	356	2096	3500
ʅ = ɨ	7	387	1740	2913
ɛ	3	452	1846	3336
ɑ	6	600	1044	2739
o	7	416	753	2743
u	8	379	967	2854
ɯ = ɨ	6	380	1849	2912

The low vowel [ɑ] becomes the most open and central vowel when it functions as the prefix [a^{31}], as in, for example, [a^{31}sɑ^{53}] 'earth'. In this case, the F2 increases by ca. 200 Hz (based on 8 tokens, mean F2=1217). In Fig. 2, the scatter for [a] is included.

2.1. Vowel raising

Vowel raising occurs when /ɛ ɑ o/ follow a palatal. Measured in the middle, the three non-high vowels are raised to what in IPA would be [i ɐ u], respectively. Formant values of the main vowels /ɛ ɑ o/ and their raised counterparts are given in Table 2; their formant frequencies are plotted in Fig. 2.

Table 2: Formant frequencies for /ɛ ɑ o/

	F1	F2	F3
[ɛ]	465	1831	3563
	390	2032	2885
[ɑ]	600	1044	2739
	472	1062	2681
[o]	416	753	2743
	345	979	2293

Vowels following palatal consonants show a lowering of the F1. The influence of a palatal consonant is greater for the low vowel /ɑ/ (the F1 is lowered by ca. 130 Hz) than for the mid vowels /ɛ/ and /o/ (their F1 is lowered by ca. 70 Hz). Mid vowels also show an increase in F2 vis-à-vis their neutral counterparts. In the case of /ɛ/, the F2 is increased by ca. 200 Hz, in the case of /o/ it is increased by ca. 220 Hz. As a result, when raised, /ɛ/ overlaps with /i/ and /o/ overlaps partially with /u/. The vowel /ɑ/, on the other hand, occupies a new vowel space.

When the apical vowel /ʅ/ follows a palatal, it becomes a peripheral vowel. The mean F2 is increased by ca. 400 Hz (F1=378; F2=2157; F3=3976). For comparison, the two scatters, both of them marked with the symbol [ʅ], are presented in Fig. 2.

2.2. Nasal vowels and nasalization

According to Sun [4], in Anong there are nasal vowels. As an example, Sun contrasts the following three words: [lɑ^{33}] 'to look, seek', [lɑ̃^{31}] 'to swim', [lɑ̃ŋ^{55}] 'piece (of stone)'. However, nasal vowels are now retained somewhat randomly. For example, [lɑ̃^{31}] 'to swim' is now pronounced as [lɑ^{31}], making the difference between [lɑ^{31}] 'to swim' and [lɑ^{33}] 'to look, seek' just tonal.

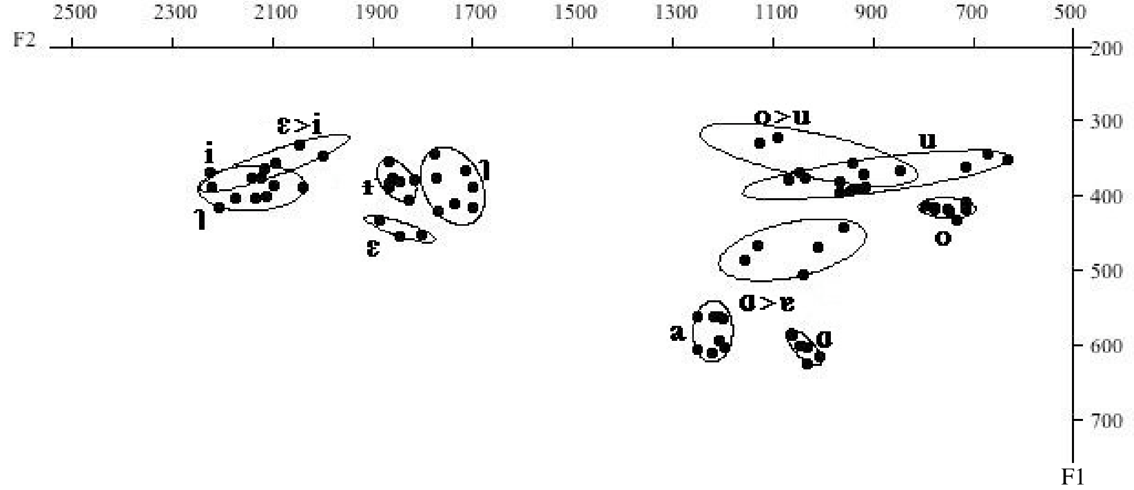
Vowels are nasalized when they are followed by a nasal. An acoustic analysis was conducted to see how the nasalized /ɑ/ fits into the patterns of the oral /ɑ/. The values of the first three formants of the nasalized [ɑ] were measured, using the same procedure outlined above for the oral vowels. LPC analysis involved cross-checking with FFT spectra [5]. The results are given in Table 3. For comparison, the formant frequencies for the oral [ɑ] and its raised counterpart are also given.

Table 3: Three allophones of /ɑ/.

	F1	F2	F3
[ɑ]	600	1044	2739
[ɐ]	472	1062	2681
[ɑ̃]	405	1015	3237

The values for the nasalized [ɑ̃] and the raised [ɐ] are very similar. The only consistent and robust difference between [ɑ̃] and [ɐ] is in F3. For [ɑ̃], F3 is by ca. 550 Hz higher than for [ɐ]. In some words, the nasal is no longer pronounced. For example, in [pʰɑ̃ŋ^{31}] 'five', [ŋ] is no longer pronounced, but nasalization on the vowel is preserved. The word is now pronounced as [pʰɑ̃^{31}].

Figure 2: Anong F1/F2 vowel space.



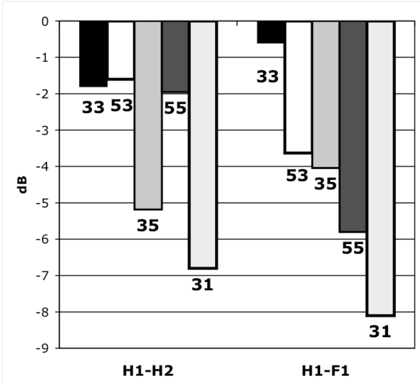
3. TENSE VOWELS

Anong vowels have been described as tense, a new feature first recorded only in 1983 [1]. Tense, referring primarily to laryngeal settings, is a characteristic of vowels in many Southeast Asian languages. In their analyses of Jingpo, Hani, Nasu, and Wa, Maddieson and Ladefoged [8] found that the most consistent acoustic feature of tense vowels was energy increase in higher formants and energy reduction in fundamental frequency (first harmonic). Tense (laryngealized) vowels often correlate with particular tones.

3.1. Tense vowels in Anong

The voice quality effects induced by laryngealization were analyzed on the FFT spectra computed over a window starting at the 46th millisecond and lasting for another 46 milliseconds. For each vowel token, the amplitude values that were measured were those of the first harmonic (H1) of the fundamental frequency, the second harmonic (H2), and the first formant (F1). The acoustic parameters of Anong vowels were measured for every tone to see whether there is a correlation between tenseness and a tone pitch. Anong has five tones: two level tones, 55 and 33, and three contour tones, the rising 35 tone, and two falling tones: 53 and 31. For each tone, except for tone 35, five tokens were measured. For tone 35 only one token was available. All the vowels occurred in open syllables.

Figure 3: Differences in H1-H2 and H1-F1 amplitude.



The H1-H2 and H1-F1 amplitude differences found in Anong (Fig. 3) are consistent with amplitude differences found in other languages with laryngealized vowels. The amplitude of higher formants is bigger than the amplitude of fundamental frequency (first harmonic). What is different in Anong, however, is that all the tones show some degree of laryngealization. The mean H1-H2 amplitude differences show that H2 is 5.18 dB above H1 for tone 35 and 6.8 dB for tone 31. This difference is smaller for tones 33, 55, and 53. For these tones, H2 is from 1.6 to 1.95 dB above H1. Measurements of the amplitude difference in H1-F1 show this difference to be the biggest for tone 31, 8.1 dB. Tones 53, 35, and 55 have an F1 from 3.63 to 5.8 dB above H1. Tone 33 has the smallest difference; the F1 is only 0.6 dB above H1.

4. DISCUSSION

In Fig. 4, Sun's [4] vowel configuration is compared and contrasted with the one based on this acoustic study. The difference is in the representation of the vowel [ɯ], now marked as [ɨ], and in the lack of [a], now analyzed as an allophonic variant of [ɑ]. The vowels [y] and [e] are put in parenthesis to mark the fact that their acoustic values have not been checked due to the lack of tokens. It is quite possible that [ɛ] and [e] constitute allophones of the same phoneme.

Figure 4: Anong vowels.

2000 [4:69]			2007 (this study)		
i (y)	ɯ	u	i (y)	ɨ	u
e		o	(e)		o
ɛ	a	ɑ	ɛ		ɑ

The data reveal that in Anong vowels following palatals are systematically altered. Moreover, this change is shown to be robust. The allophonic variation of /ɛ ɑ o/ is manifested as shifts predominantly along the high/low dimension, but the front/back dimension is also altered. The data also reveal that the vowel /ɿ/ shifts along the front/back dimension.

Nasalization has been shown to trigger [ɑ̃] raising. A tendency to drop the final nasal but to keep the vowel nasalized has also been observed. A tendency to denasalize vowels has been observed. These two tendencies could be presented as the following chain: [ɑŋ > ɑ̃ > ɑ].

The analysis shows that Anong vowels are systematically laryngealized. On the FFT spectra, H2 and F1 are more intense than H1. Across the six tones, vowels are least laryngealized when they co-occur with tone 33. This is a new tone that developed between 1988 (not recorded by Sun [3]) and 2000 (recorded by Sun [4]). Considering tone33 as different from the point of view of its co-occurrence with less laryngealized vowels, it is possible to suggest that Anong contrasts a tense phonation with a more modal phonation type.

4.1. Possible Lisu influence

The three processes, raising, nasalization, and laryngealization, are also found in Lisu, however, the directionality of change and end results are different. Raising has been reported to occur in Southern Lisu but the results are different: the mid vowels /e ø ɤ o/ are variably raised to /i y ɯ u/ [7]. Nasalization has also been found in Lisu, but unlike the variable nasalization in Anong, it occurs in syllables beginning with a vowel or with h- [8]. Finally, while there are laryngealized vowels in Lisu, they do not occur with every tone, but rather occur regularly in two of the six tones [5,6]. Here, however, it is certainly possible that Anong laryngealization may have developed partially due to Lisu influence.

5. FINAL REMARKS

This study, of course, is intended as a study of Anong itself, but it also aims to contribute to the relatively small cross-linguistically phonetic database on vowel systems, particularly those in languages on the edge of extinction. In terms of contact, only the possible development of laryngealization seems to suggest that Lisu has affected Anong, and even here, there is no hard evidence.

It is clear that the speaker for which we have recordings is a fluent, accomplished speaker of Anong. It is also clear both that Anong will be gone when the 62 current speakers are gone and that Lisu is the dominant language for all but five of the oldest fluent speakers of Anong. Nonetheless, despite these two strong potential sources of influence on it, the Anong system seems to have kept its integrity. That is, neither language death nor contact seems to have affected the directionality, distribution, and degree of vowel variability. Further, once the variation attributable to palatals is factored out, the scatter of points for each vowel is quite compact.

6. REFERENCES

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ACKNOWLEDGMENTS

This work was supported by NSF Grant #606232 *Endangered Languages in China*. The author would like to thank Sun Hongkai, David Bradley and Graham Thurgood for their help.