AN ACOUSTIC ANALYSIS OF HMONG ("KAIJUE MIAO") TONE[1]

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1. Introduction

Languages use pitch in a variety of ways to encode linguistic meaning. Most familiar to English speakers is the intonational use of pitch, in which phrase-level patterns signal a variety of interactional meanings (semantic information) and the affective state of the speaker. Languages may also utilize pitch tonally. In these languages, pitch patterns, or "tones," extend over one syllable or word only and convey morphemic information, creating lexical and sometimes grammatical distinctions.

Pitch, whether linguistic or non-linguistic, is distinguished from fundamental frequency (Rose 1988). Pitch is perceptual, referring to the auditory sensation of ordering sound from high to low. Fundamental frequency is acoustic, referring to the physical reality underlying this ordering, specifically the number of complete variations in air pressure per second produced by the vocal folds opening and closing. Higher fundamental frequency values correlate to a large extent with higher perceived pitch, but they lack a one-to-one mapping due to other factors involved in the perception of pitch, such as vowel quality and amplitude (Couper-Kuhlen 1986:6; Durrant and Lovrinic 1995:278). Fundamental frequency and pitch are thus distinct, though related, concepts.

In a linguistic context, fundamental frequency (and pitch) plays a primary role in distinguishing between the different tones of a language. However, linguistic tone is not limited to fundamental frequency (and pitch), as the term would have one believe, but may encompass other features as well, such as duration, amplitude, and phonation type. In some languages, these features demonstrate distinctive patternings as well, supplying secondary or even primary phonetic information for tonal discrimination (Whalen and Yi 1992; Ratliff 1992:12).

Rigorous acoustic research is needed to determine the roles of fundamental frequency and other features in discriminating between tones in various tonal languages. Researchers such as Tseng (1990) and Howie (1976) have investigated the acoustic basis of tonal categories, particularly for Mandarin and dialects of Mandarin, providing much-needed insights and an empirical basis for subsequent studies. Many questions into the complex acoustic correlates of tone remain, pending further empirical research, particularly in non-Mandarin languages.

The language of focus in the research presented here is a previously unresearched Hmongic variety of southern China which I refer to as Kaijue

Miao.[1] The Hmongic languages, hereafter referred to as Miao,[2] are noted for their large tone inventories, often exhibiting six to eight lexical tones (*Zhongyang Minzu Yanjiusuo* 1987:2-4). Within the Eastern Guizhou branch, the branch to which Kaijue Miao belongs, eight lexical tones are common. My analysis of Kaijue Miao confirmed the presence of an eight-tone system in this variety as well. Sets of eight words composed of identical segmental sequencing of consonant and vowel but which nevertheless expressed eight distinctive meanings were found (see below). These distinctive meanings corresponded to eight distinctive tones, demonstrating the presence of eight lexical tones.

While Kaijue Miao clearly has eight distinct lexical tones, they could be distinctive for a number of different reasons acoustically. The objective of this present research was to examine the acoustic signal of each of the eight tones of Kaijue Miao in order to determine the distinctive acoustic features which are correlated with each tone. Specific research questions were as follows:

1. What are the duration and fundamental frequency patterns of Kaijue Miao tones?
2. Are there eight distinct duration patterns associated with the eight tones of Kaijue Miao?
3. Are there eight distinct fundamental frequency patterns associated with the eight tones of Kaijue Miao?

Eight distinct fundamental frequency patterns emerged, associated with the eight tones. Eight distinct duration patterns were not found. This study therefore concluded that fundamental frequency, but not duration, serves as a primary acoustic correlate of the eight lexical tones of Kaijue Miao. Phonation type,[3] while relevant to Miao, was beyond the scope of this present study, as was amplitude and the combined contribution of some or all of these features.

2. Data and Methodology

Data for this research were collected in Guizhou, China in 1993. The speaker was a well-educated Miao man from Kaijue village who was employed in the provincial capital. Gathering data from multiple speakers was not possible.

Two minimal sets of words were recorded which demonstrate the eight tones of Kaijue Miao. Tone Set 1 is based on the segmental sequence [tɔ] whereas Tone Set 2 is based on [tʃuo]. Tone Set 1 in isolation as well as in a frame, with all its tonal variations, provided the basis for this analysis. Tone Set 2 supplemented the findings. For Tone Set 1, twelve tokens in isolation and nineteen in a frame were analyzed. For Tone Set 2, six tokens in isolation were analyzed.

Orthographic representation, category number, and shape representation follow conventions used by Chinese researchers of Miao. Orthographically, Miao tones are indicated by choice of word-final consonant. These consonants correlate with tone category numbers, which represent historical similarity between different Miao varieties but not actual shape. The actual shape of each tone in a given variety is represented schematically by the five-point time-pitch graph system developed by Chao (1968).

The tone shapes presented below are similar to those given for the Yanghao variety of Miao, the chosen standard for the Eastern Guizhou branch (Zhang and Xu 1989), with modifications made to capture the unique shapes of Kaijue Miao tones. Kaijue Miao's chief departure from the standard is a switch in the shapes of Tones 3 and 5 (Jing Ping Li, personal communication). In addition, Tone 4 is heard as a mid-low level rather than a low level and Tone 7 as a high-low fall rather than a high-mid fall. Whether the Kaijue Miao shapes of these latter two tones represent an actual linguistic departure from the standard or simply a difference in notation is not known. The basic shapes of Tones 1 and 6 in Kaijue Miao are somewhat unclear based on fundamental frequency patterns observed in the data (to be discussed later) as well as inherent difficulties in determining "basicness" (Chan 1986), They are thus marked with a question mark.

Tones 4, 6, 7, and 8 are accompanied by distinct phonation.

TONE SET 1

Tone 1: ˧?	[tɔ]	dob[4]	'girl's name'
Tone 2: ˥	[tɔ]	dox	'to be hunchbacked'
Tone 3: ˦	[tɔ]	dod	'to cut, to chop'
Tone 4: ˨	[tɔ]	dol	'to bump against'
Tone 5: ˧˥	[tɔ]	dot	'man's name'
Tone 6: ˩˧?	[tɔ]	dos	'with'
Tone 7: ˥˩	[tɔ]	dok	'to take, hold, grasp'
Tone 8: ˧˩	[tɔ]	dof	'a small bench for one'

FRAME

˥	˦		˥	˧? ˧		
[moŋ]	[fʰɑɪ]	__________	[tʃiɪ]	[xʊ] [tʲʊ]		
Mongx	hfaid		jiix	hveb diel.		
You	translate		become	language		Chinese.

Please translate ____________ into Chinese.

TONE SET 2

Tone 1: ˧?	[tʃuo]	job	'to teach'
Tone 2: ˥	[tʃuo]	jox	'root'
Tone 3: ˦	[tʃuo]	jod	'back of the knee'
Tone 4: ˧	[tʃuo]	jol	'a treadle-operated tilt hammer for hulling rice'
Tone 5: ˧˥	[tʃuo]	jot	'tight'
Tone 6: ˩˧?	[tʃuo]	jos	'to pry something open or raise something up, using a lever'
Tone 7: ˥˧	[tʃuo]	jok	'to tie, fasten'
Tone 8: ˧˩	[tʃuo]	jof	'twisted, misshapen'

The voice data were recorded on a Sony WM-60 professional quality cassette tape recorder using a Crown PZM Sound Grabber microphone. The recordings were digitized using WaveLite digitizing software and analyzed on a Sun computer using Waves acoustic analysis software.

Waveforms and fundamental frequency (F_0) files were created for each tone and its tokens. Each token was then marked for the beginning and endpoints of the tone using the waveform and by listening to selected portions of the word. Fundamental frequency and duration measurements were collected, using a computer program developed for these purposes (Kibre 1996). The duration of each token was measured from the points marked and the average duration for each tone was determined. Fundamental frequency was measured by sampling every 5% along the length of the tone, beginning at 15% and ending at 85%. Percentage intervals rather than time intervals were used in the sampling of