

# TONES OF A TRIDIALECTAL: ACOUSTIC AND PERCEPTUAL DATA ON TEN LINGUISTIC TONETIC CONTRASTS BETWEEN LAO 1Aw NYO y"q AND STANDARD THAI

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## ABSTRACT

The tonal acoustics are described of a Nyo speaker fluent in 3 tonally distinct varieties of Tai: Standard Thai with 5 tonemes, Lao with 7, and Nyo with 4 tonemes. Mean fundamental frequency and duration values are presented for the allotones of these tonemes on syllables with unstopped Rhymes. A perceptual experiment is described to determine how many of the 16 allotones are identifiable by Nyo tridialectal listeners. The acoustic and perceptual data are used to demonstrate the existence of 10 linguistic-tonetically distinct tones.

## 1. INTRODUCTION

How do tone languages and dialects differ with respect to their tonal phonetics? One way of investigating this linguistic tonetic question has been to use the acoustics of bilingual speakers (e.g. Maddieson 1979), or bidialectal speakers (Rose 1994, Heywood 1997). The assumption is that observed differences between varieties are not due to individual differences in vocal tract anatomy - since output from the same individual is involved - but realise bona-fide linguistic-phonetic differences. However, there is still no obvious way to distinguish from the acoustics alone differences that realise the bona-fide linguistic-phonetic differences from any equally consistent differences that may reflect other variables. In this paper, a perceptual solution to this problem is tested by examining to what extent observed acoustic differences are used as cues by native listeners to discriminate different dialects. This approach enables us in a sense to see through the ears of both native speaker and native listener.

An additional novelty of this paper is that the tones of a speaker who has excellent command of not just 2, but 3 varieties of tone language are investigated acoustically and perceptually. The 3 varieties are Standard Thai (Sd), Lao, and Nyo, all of which belong to the South-western Thai subgroup of Tai. Standard Thai represents a separate Central sub-group within SW Thai. The Nyo and Lao varieties appear to be more closely related, and probably belong to the NE Thai sub-group, but the details are not yet known. These 3 varieties differ in their tonal inventory. Standard Thai, as is well known, has 5 tonemes. The Nyo and Lao varieties spoken appear to have 4 and 7 tonemes respectively. Space permits only discussion of the allotones on syllables with unstopped Rhymes.

## 2. PROCEDURE

The speaker is a tertiary educated 40 year old male from Sakhon Nakhon in Nakhon Phanom province in Laos. His First Language is Nyo, with the locally current variety of Lao as Second Language. Like most well-educated local

professionals, the speaker belongs to the sociolinguistic class who is also typically fluent in Standard Thai. He was recorded in the Phonetics Laboratory studio in the Department of Linguistics at A.N.U. There were two recording sessions, separated by a week. Only forms elicited in the first session will be described here. In this session, he read out forms from Gedney's (1972) checklist of 64 monosyllabic words designed as a 'short-cut' to discover the tonal system of any Tai dialect. The list contains common words that can be expected to occur in most Tai varieties, and that are reflexes of all the separate categories that are known to condition the differential development of tones in Tai varieties. The words from the Gedney list were written in Thai script on prompt cards, which were given in a block to the informant. He was instructed to pick up each prompt card, and read each word twice, separated by a fairly long pause so as to avoid introduction of intonation associated with the given/new distinction. This procedure worked well, and there was no obvious evidence of such intonation. He chose to read the list in Standard Thai first, followed by Nyo and then Lao.

The data were transcribed phonetically, and a hypothesis made as to their tonemic structure. (It should be noted that it is not possible to do a phonemic analysis on phonetic transcriptions alone: for that, extensive interaction with the speaker is required to find out exactly what phonetic differences are distinctive, what differences constitute free variation etc.) The results of the initial tonemic analysis were that the speaker's Nyo had 4 tonemes, his Lao 7, and his Standard Thai 5. The toneme of each token was thus identified, and tokens further divided for acoustic analysis into unstopped, long stopped, and short stopped groups.

All acoustic analysis was done with Kay's CSL. The same procedure was used as in Heywood's (1997) study of Lao and Standard Thai tone, which involved sampling F0 in the Rhyme at a high enough rate to resolve the details of its time course. Both repeats of a token were measured. Arithmetical mean and standard deviation values for tonal duration and F0 in the 3 varieties were then calculated.

In order to test to what extent the 3 varieties could be identified on the basis of the recorded items, an open identification test was conducted in Sakhon Nakhon in Laos. The original speaker was used, together with 4 other tridialectal speakers (two females and two males), from the same speech community, chosen as suitable by the original speaker. A pseudo-randomised test tape was constructed of the first repeat of all 64 items recorded by the speaker from the Gedney list. Each item was repeated, the repeats separated by a ca. 2 sec. pause. The experiment was conducted in Thai, except for the numbering, in English, of the tokens on the test tape. The aim of the experiment was explained by the supervisor, and subjects were instructed to mark on a

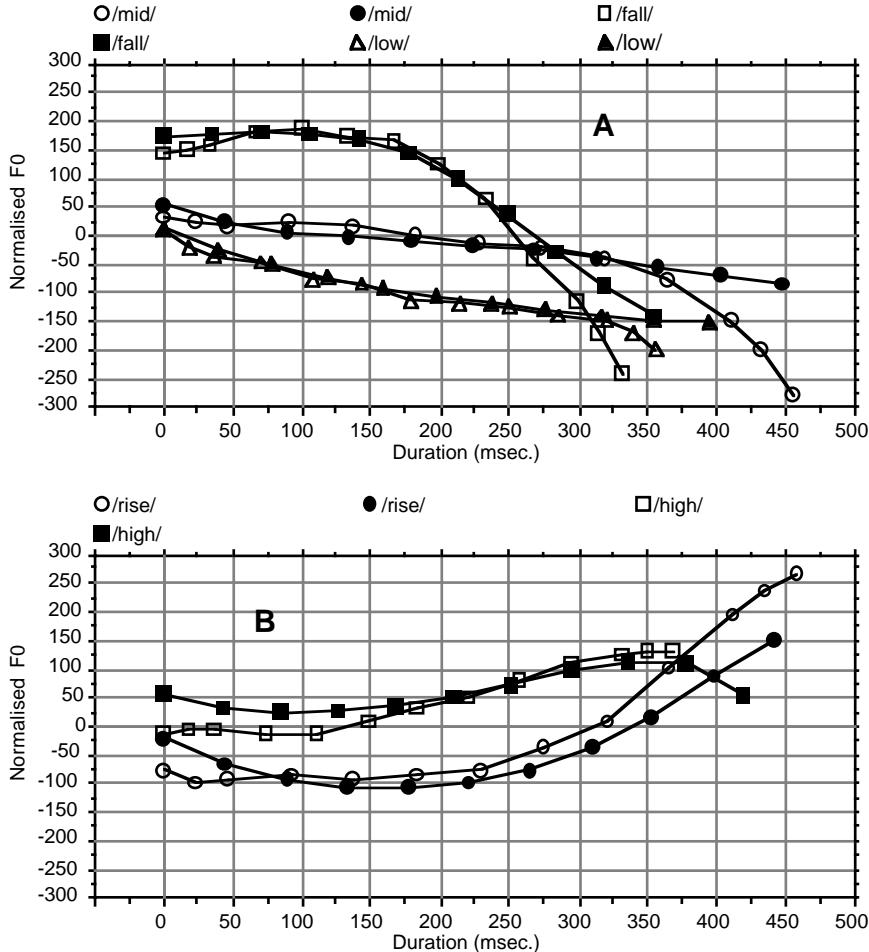


Figure 1: Mean normalised F0 shapes for the speaker's Standard Thai tonemes on unstopped syllables compared with values from 10 Male Bangkok speakers (solid symbols). A shows alltones of /Fall/ /Mid/ and /Low/, B shows alltones of /High/ and /Rise/.

response sheet the identity of the word they heard as Standard Thai, Lao, or Nyo, or any combination of these three as appropriate (i.e. a total of 6 possible responses). They were also asked to write the meaning(s) of the word(s) they heard, so that its/their identity was perfectly clear. The test, which took about 3 hours, was run separately with each subject.

It might be imagined that having to make a 6-way decision of this nature is also rather cognitively demanding. However, the responses of the two females were both largely in agreement and made sense from the point of view of the historical development and phonetic similarity of the tones involved. Moreover they both seemed to be able to make a decision with minimum hesitation, especially one who was a teacher of Thai. The 3 male subjects' responses, on the other hand, appeared on initial inspection not to show the same degree of coherence. Since we were concerned with finding out to what extent any cues present in the acoustic signal could be perceived, only the 2 female responses were evaluated.

### 3. RESULTS

#### 3.1 Standard Thai

The pitch of our tridialectal's Standard Thai tones on unstopped syllables was as follows. He contrasted, as expected, 5 different pitches. The /Mid/ toneme was level in the mid pitch range, with a slight drop off in pitch at the very end: [332]. /Low/ also had level pitch, just above the bottom of the range: [22]. The pitch on /Fall/ fell from the upper third of the pitch range into the lower third, after an initial level or slightly rising component [441, 341]. The rising vs. level difference in onset did not appear to have any obvious conditioning. /High/ had a level pitch in the mid pitch range, followed by a slight rise: [334]. The pitch on /Rise/ was level in the lower third of the pitch range, rising into the upper third: [224]. A small amount of obvious segmental influence from Lao/Nyo was noted in the speaker's Standard readings: he did not pronounce a lateral in the word *klaa* rice seedling, and his /u/ and /a/ vowels had nasalised allophones after /h/.

It is of course of interest to see how the speaker's Standard Thai F0 compares with that of Bangkok speakers, on whom Standard Thai is based. His F0 values were

z-score normalised (Rose 1987) and compared with normalised values of the tonal F0 of 10 young educated Bangkok males (Gandour et al. 1991). The normalised F0 values are shown in figures 1A & B. The vertical scale shows units of standard deviation ( $\times 100$ ) away from mean. The duration values of both sets of data were very similar and required neither normalisation nor equalisation. It can be seen from figure 1 that the speaker's normalised Standard Thai F0 is remarkably close to the mean normalised Bangkok data, with the offset of the /Rise/ tone and the onset of the /High/ tone showing the greatest differences. The speaker's /Fall/, /Mid/, and to a lesser extent /Low/ also decay more drastically at offset than the Bangkok data. Apart from these differences, the speaker's normalised F0 lies within 1 standard deviation of the mean normalised Bangkok F0.

#### 3.2 Nyo

The Nyo variety spoken by our tridialectal contrasts 4 tonemes on unstopped syllables. Naming them after their pitch features they are: /Mid Level/, /High Fall/, /Low Fall/, and /Low Rise/. The /Mid Level/ toneme has level pitch in the mid pitch range [33]. The /High Fall/ falls from the upper third of the pitch range to low. It is preceded by a level or, more commonly, slightly rising pitch component, thus [441,

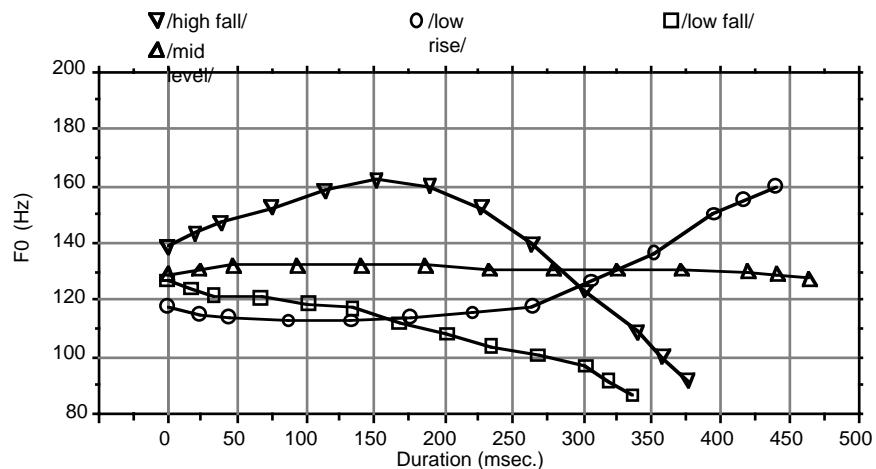


Figure 2: Mean fundamental frequency shapes for the 4 Nyo tonemes on syllables with unstopped rhymes.

341]. The difference between the level and rising onset does not appear to be conditioned by the initial consonant. The pitch of the /Low Fall/ falls through the lower third of the pitch range after an initial level component: [221]. The /Low

speaker's pitch range. Pitch on /High Level/ is level in the upper third of the pitch range: [44]. Pitch on /Mid Level/ is in the middle of pitch range: [33]. Pitch on /Low Level/ is in the lower third of the pitch range: [22]. Some morphemes with /low level/ also have a syllable-final glottal-stop, the significance of which is not clear. The /Low Rise/ toneme has a level pitch in the lowest third of the pitch range, rising into the upper third: [224]. There is some evidence for segmental conditioning of pitch offset height, with syllable-final nasals and -w evincing higher [225] pitch. The mean F0 shapes of these 7 Lao allotones are plotted as functions of absolute duration in figure 3.

#### 4. DISCUSSION

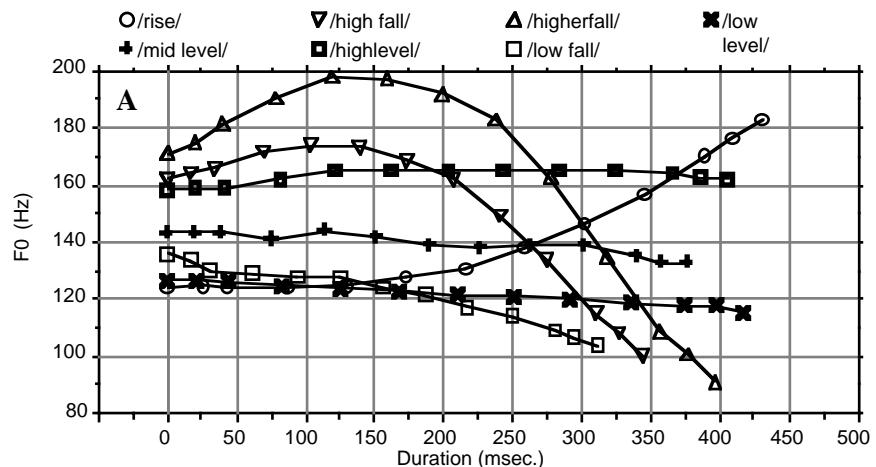


Figure 3: Mean fundamental frequency shapes for the 7 Lao tonemes on syllables with unstopped rhymes.

Rise/ toneme has a level pitch in the lowest third of the pitch range, rising into the upper third: [224]. The mean F0 shapes of these unstopped allotones are plotted as functions of absolute duration in figure 2.

### 3.3 Lao

The speaker appeared to contrast 7 tonemes on unstopped syllables: /High Fall/, /Higher Fall/, /Low Fall/, /High Level/, /Mid Level/, Low Level/, and /Low Rise/. Pitch on the /High Fall/ toneme falls from the upper third of the pitch range to low, with an initial level component: [441]. The /Higher Fall/ has a convex pitch contour, rising slightly within the upper third of the pitch range, then falling into the low: [451]. The pitch of /Low Fall/ falls through the lower third of the pitch range after a short initial level component: [221]. The allotones of the three level tonemes are not maximally dispersed, but are concentrated in the middle of the

The Linguistic Tonic (LT) status of the 16 allotones of the different tonemes described above (5 for Standard, 4 for Nyo and 7 for Lao) will be evaluated in terms of groups with similar pitch features. Of the 4 allotones with rising pitch, Sd /Rise/ and Nyo /Low Rise/ do not differ significantly in their tonal acoustics (i.e. F0 and duration). The Lao /Low Rise/ F0 is significantly higher than in Sd~Nyo, and at the same height, but significantly longer than the Sd /High/. The identification test shows no perceptual difference between allotones with low rising pitch and thus does not support separate LT status for the Lao /Low Rise/: of the 3 A1 morphemes, which have low rising pitch in all 3 varieties, nearly all (6/6 Lao; 5/6 Sd, Nyo) were identified as 'All' (i.e. Nyo, Sd, or Lao). Interestingly, nearly all the 6 remaining (A2, A3) Lao and Nyo low rising pitch morphemes were identified (11/12 Nyo; 10/12 Lao) as Nyo. All 4 morphemes of Sd /High/ were correctly identified (8/8), but its separate LT status from low rising tones is already guaranteed by its tonemic status within Standard.

There are 4 allotones in the data with level pitch: Lao /High Level/ and /Low Level/, and Lao and Nyo /Mid level/. All 5 Lao /High Level/ morphemes (10/10) were correctly identified. Lao and Nyo /Mid Level/ do not differ acoustically, or perceptually. All 3 Nyo /Mid Level/ morphemes (6/6) were correctly identified, and the single Lao token identified as N or N-L. Sd /Mid/, with its slightly falling pitch, was not confused with the Nyo~Lao mid-level tones, and therefore represents a distinct mid-falling LT shape. (Ten out of the 18 occurrences of the 9 Sd /Mid/ morphemes were correctly identified, with 2 of the remaining

morphemes identified as Lao /Low Level/ or Nyo /Low Fall/.)

Interestingly, although Lao /Low Level/ and Sd /Low/ do not differ in F0 or duration, they are clearly identified differently: of the 5 B1, B2 and B3 Lao /Low Level/ morphemes shared with Sd /Low/, 7/10 occurrences were correctly identified, whereas none of the 9 Sd /Low/ morphemes was uniquely identified as Lao.

All 4 alltones with high falling pitch (Lao /Higher Fall/; Lao, Nyo, Sd /High Fall/) differ significantly in tonal acoustics. Lao /High Fall/ lies about 15-20 Hz higher than Sd, but with the same contour. Nyo /High Fall/ lies at about the same height as Sd, but differs in its rising onset profile which results in an 11 Hz significantly lower onset, and a 9 Hz significantly higher peak than Sd. All 3 varieties share /High Fall/ morphemes in C2 and C3 categories; Nyo and Lao also share /High Fall/ morphemes in the C4 category. Differences between C2/C3 /High Fall/ morphemes do not appear to be perceptually significant. For the 6 C2/C3 morphemes, there were only 6/36 correct identifications (2 Nyo; 4 Sd; 0 Lao), and ca. half the identifications (16/36) were as All (8 Nyo; 6 Lao; 2 Sd). Of the rest, 9 identifications were either/or, and 5 as unique and incorrect. In rather sharp contrast to these results, however, differences between the 4 Nyo and Lao /High Fall/ C4 morphemes were perceptually significant: 10/16 occurrences (6/8 Nyo; 4/8 Lao) were correctly identified. The identification of one morpheme (may wood) as the Sd may /Fall/ negative particle might have been influenced by the high frequency status of the latter morpheme, in which case the correct rate would be higher. It is probable that the presence of the syllable-initial sonorant in these C4 morphemes aids the perception of the differences between level F0 (Lao) and rising F0 (Nyo) over the first half of their duration, which means that LT differences may be sensitive to segmental differences. It appears then that two LT distinct shapes have to be recognised for the /High Fall/, to which the Lao /Higher Fall/ makes a third by virtue of its contrast with Lao /High Fall/. (Of the 4 Lao /Higher Fall/ morphemes, 2 were correctly identified, and 2 were confused with the /High Fall/ in Sd or Nyo, or Sd or Lao.)

Of the low falling pitched tones, the Lao /Low Fall/ lies about 10 Hz significantly higher than Nyo, but with the same contour. However, there is not enough evidence that they represent linguistic-tonetically distinct shapes, since there were only 2 shared /Low Fall/ morphemes (sua shirt and khaa to kill) between Nyo and Lao. Of the 14 Nyo /Low fall/ morphemes, 21 out of 28 occurrences were correctly identified, including the 2 C1 morphemes shared with Lao. Of these 2 Lao /Low Fall/ morphemes, one was correctly identified and the other identified as All.

Results of the acoustical investigation and identification test thus support the following 10 Linguistic-tonetically distinct shapes: Higher Rise-Fall (Lao /Higher Fall/); High Rise-Fall (Nyo /High Fall/); High Fall (Sd~Lao); High Rise (Sd/High/); Low Rise (Sd~Nyo~Lao); High Level (Lao); Mid Level (Nyo~Lao); Mid Fall; (Sd /Mid/); Low Level (Lao); and Low Fall (Nyo~Sd(~Lao?)). It is interesting to note that 10 was also the maximum number of clearly different tones found for the Southern Thai bidialectal in Rose (1994). Future investigations of multidialectals' tones will determine

if this represents an upper limit on the number of tonetically different forms a multidialectal can produce.

It is also of interest to note that, as hoped, the identification test has proved successful in demonstrating that some of the statistically significant acoustic differences do not carry identifying potential, and do not therefore represent linguistic-tonetically distinct shapes. Thus Lao /High Fall, Low Fall, Low Rise/ were all 10 - 20 Hz significantly higher than corresponding Sd and Nyo shapes, but were not identifiable as Lao. For some reason, the speaker presumably adjusted his range slightly upwards for his Lao forms.

One final observation is that the recognition patterns in the identification test suggest that some words were better representatives of a given dialect than others. An even clearer idea of the relationship between the tones of the 3 varieties might therefore come, not from overall means, but from means of those individual words that were identified the best.

## 5. ACKNOWLEDGEMENTS

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