

# **TONAL OVERLAPPING: AN INSTRUMENTAL STUDY OF SUPHANBURI THAI**

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The Thai language spoken in Thailand consists of four dialects: Central Thai, Northern Thai, Northeastern Thai, and Southern Thai. As the names indicate, these dialects are spoken in the four regions of the country: the central region, the northern region, the north-eastern region, and the southern region respectively. The main characteristics that differentiate these dialects are the phonological system and lexical items. In addition, each dialect is further divided into many sub-dialects. These sub-dialects are differentiated mainly by tones. Tonal variation among the Thai dialects and sub-dialects cover the whole range of possibilities: phonetic realization, phonotactic distribution, phonemic systems, and lexical distribution (Wells 1982).

As far as Central Thai is concerned, its sub-dialects are also differentiated almost exclusively by tones. There are three main sub-dialects of Central Thai: western Central Thai, central Central Thai, and eastern Central Thai (Tingsabadh 1985). Western Central Thai is spoken in the provinces to the northwest and southwest of Bangkok, central Central Thai in the provinces around Bangkok, and eastern Central Thai in the provinces along the eastern seaboard. In this study<sup>(1)</sup> the variety investigated is an accent<sup>(2)</sup> of western Central Thai spoken in Siprachan--a district in Suphanburi province<sup>(3)</sup>.

Two wordlists were used in this study. The first consists of about six hundred simple everyday monosyllabic and polysyllabic words. These words appear on the list in semantic groups (e.g. body parts, kinship terms, animals, and plants). To minimize interference from Standard Thai--the interviewer's dialect--the repetition method was avoided. Instead, pictures and/or questions were used to elicit the words on the list from the informant.

The second wordlist--which will be referred to from now on as 'the tone set'--consists of the words /ka<sup>1</sup> kha<sup>2</sup> kha<sup>3</sup> kha<sup>4</sup> kha<sup>5</sup> kha<sup>6</sup>/. These words are minimally distinctive by tones except for the word carrying tone 1. This discrepancy is necessary since in this accent tone 1 does not occur with a syllable with an initial aspirated stop. The tone set was prepared after a preliminary analysis was carried out by auditory judgement on the first wordlist. When it was found that this accent has six tones, the tone set was constructed representing all of the tones. Ten tokens of each of the six words were included at random in the wordlist. The words in this list were elicited by a special method. First of all, the informant was taught to recognize a sign for each of the words. The interviewer then showed him a sign at a time according to the order on the prepared wordlist. The informant then said all of the sixty words as prompted. The whole interview including the first and the second wordlists was recorded on tape.

The recording was analyzed at the Linguistics Research Unit in Bangkok. All of the words in the tone set were analyzed together with some of the words in the first wordlist. From the first list, ten syllables were chosen to represent each tone in each of the following six contexts: (a) monosyllabic words; (b) the unstressed syllable of disyllabic words; (c) the prominent-stressed syllable of disyllabic words; (d) the unstressed syllable of three-and-four-syllable words; (e) the stressed syllable of three-and-four-syllable words; and (f) the prominent-stressed syllable of three-and-four-syllable words. In all three hundred and sixty syllables were analyzed<sup>(5)</sup>.

The instrument used in the analysis was the DSP Sona-Graph Model 5500. The fundamental frequency (F<sub>0</sub>) value of each syllable was measured using the stored setup number 05 which presents a wideband spectrogram and a combination display of pitch, amplitude envelope, zero crossing, and waveform<sup>(6)</sup>. In this study only the

pitch trace was measured. The syllable duration was normalized. Measurement was done at every 10% point of the duration of each syllable. Results were then recorded on the Macintosh computer using the programme EXCEL1.05T. After that a graph was produced for each tone in each context showing both the actual  $F_0$  curves of the ten syllables as well as the average  $F_0$  curve of each tone in each context. Graphs showing just the average  $F_0$  contours of the six tones in all of the contexts (i.e. the tone set and contexts (a)-(f) above) were also produced separately.

The six tones of this accent are as follows (see Figures 1 and 2): tone 1 mid-level, tone 2 upper mid-falling, tone 3 upper mid-rising-falling, tone 4 mid-rising, tone 5 high-delayed falling, and tone 6 mid-falling<sup>(7)</sup>.

Considering just the average  $F_0$  contours (see Figures 1-7), one finds a certain amount of variation among the realizations of the six tones.

Firstly, variation due to the different contexts studied is evident. The six tones are shown to have different realizations in the tone set (see Figure 1), the ordinary monosyllabic words (see Figure 2), the unstressed syllable of disyllabic words (see Figure 3), the prominent-stressed syllable of disyllabic words (see Figure 4), the unstressed syllable of three-and-four syllable words (see Figure 5), the stressed syllable of three-and-four syllable words (see Figure 6), and the prominent-stressed syllable of three-and-four syllable words (see Figure 7). The graphs show that the shapes of the tonal realizations are influenced by the degree of stress. The weaker the stress, the narrower the rise and the fall in the  $F_0$  contours. It is interesting to note that the realizations of the six tones in the tone set and the ordinary monosyllabic words are quite different from those in the prominent-stressed syllable of disyllabic and three-and-four-syllable words.

Secondly, the pitch range--the interval between the highest pitch and the lowest pitch--of the six tones varies from one context to another. The range is widest (100-160 Hertz) in the monosyllabic words (see Figures 1 and 2) and the prominent-stressed syllable of both disyllabic and three-and-four-syllable words (see Figures 4 and 7). In the unstressed syllable of disyllabic words and the stressed syllable of three-and-four-syllable words (see Figures 3 and 6), the range is between 120 and 155 Hertz. In the unstressed syllable of three-and-four-syllable words (see Figure 5), the range

is the narrowest (125-150 Hertz). Thus, the weaker the stress, the narrower the pitch range. It is noticeable that the high point of the range is not very different among the contexts while the low point of the range clearly differs.

Thirdly, it was found that tonal distinction can vary from one context to another. The tones in question are tone 1 and tone 4, and tone 1 and tone 2. This informant's tone 1 and tone 4 are distinct in the tone set (see Figure 1), the ordinary monosyllabic words (see Figure 2), and the stressed syllable of three-and-four-syllable words (see Figure 6). These two tones are not distinct in the unstressed syllable of disyllabic words (see Figure 3), the prominent-stressed syllable of disyllabic words (see Figure 4), and the prominent-stressed syllable of three-and-four-syllable words (see Figure 7). In the case of tone 1 and tone 2, they are distinct in all of the contexts except in the unstressed syllable of three-and-four-syllable words (see Figure 5).

Up to this point only the average  $F_0$  contours were considered. In this study graphs showing the  $F_0$  contours of every syllable analyzed as well as the average  $F_0$  contour were produced for each tone in each context (i.e. the tone set and the contexts (a)-(f) mentioned above). In this paper only the graphs of tone 3 in all of the contexts are shown (see Figures 8-13). The graphs showing the  $F_0$  contours of every syllable analyzed--which will be called from now on 'the detailed graphs'--give us some interesting insights into the nature of tonal realizations.

Firstly, the detailed graphs show that the average  $F_0$  contours leave out information known in auditory studies as 'allophones'. It is shown in the detailed graphs that each of the tones is realized differently even within the same context. In Figure 9, for example, tone 3 has four allophones: the one with a distinct rise and a distinct fall, the one with a moderate rise and a moderate fall, the one with a moderate rise and a distinct fall, and the one which is relatively level.

Secondly, in the two types of monosyllabic words used in this study--the tone set and the ordinary monosyllabic words--the tones are often realized differently. In the tone set, there is considerable uniformity in the realizations of tones (see Figure 8). On the other hand, in the ordinary monosyllabic words, a variety of patterns appear (see Figure 9). This shows that elicitation techniques have a great deal of influence on the way tones are realized.

Thirdly, the detailed graphs show that a fair amount of tonal overlapping occurs in the data.

The first two points will not be discussed any further in this paper while the third will be considered in detail.

A few remarks are needed at this point concerning the data used in this paper. The term 'overlapping' is normally used in connection with the results of auditory analyses. In this study it is used with the results of an instrumental analysis and solely that of the fundamental frequency value. Other concomitant features--like intensity--were not included in the analysis. Nevertheless, the results of this study even in the present form suggest that tonal overlapping occurs in the speech of the informant. As the informant is a typical speaker of Suphanburi Thai. It will be generalized that the phenomenon also occurs in Suphanburi Thai.

An objection to this study may come from those who hold the view that tones must be analyzed in terms of relative pitch rather than absolute pitch (Pike 1948). In this study all of the data used are absolute in the sense that they are the results of instrumental analysis and studied without reference to the pitch of neighbouring syllables. Since the average  $F_0$  contours resulted from the instrumental analysis in this study (see Figures 1-7) do portray the tone system of Suphanburi Thai, it is believed that absolute pitch can be used in a tonal study and the results of such a study can give us useful information on tones. This has been shown to be the case also in Standard Thai (Abramson 1962, 1975).

To investigate the extent of tonal overlapping that occurs in the data in this study, the detailed graphs of the six tones in all of the seven contexts (i.e. the tone set, ordinary monosyllabic words, the first and unstressed syllable of disyllabic words, the prominent-stressed syllable of disyllabic words, the unstressed syllable of three-and-four-syllable words, the stressed syllable of three-and-four-syllable words, and the prominent-stressed syllable of three-and-four-syllable words) were copied onto transparencies. After that the graphs of the six tones in each context were compared a pair at a time and any overlapping found was noted down.

The comparison shows that in the context of the tone set no overlapping occurs. All of the sixty words--ten tokens for each tone--are clearly distinct. However, in the context of ordinary monosyllabic words, tonal overlapping was found between some words carrying tone 1 and tone 4, and between some words carrying tone 2 and tone 6.

In disyllabic words, the graphs of the unstressed syllables and the prominent-stressed syllables were compared separately. In the prominent-stressed syllables, tonal overlapping was found between many syllables carrying tone 1 and tone 4 resulting in the overlapping of the average  $F_0$  contours of the two tones as mentioned above. In the unstressed syllables, a considerable amount of tonal overlapping was found between tone 1 and tone 4, and between tone 2 and tone 6. It is interesting to note that the average  $F_0$  contours of tone 1 and tone 4 overlap but not those of tone 2 and tone 6 (see Figure 3). Some overlapping was also found between the following pairs of tones: tone 1 and tone 3, tone 2 and tone 5, tone 3 and tone 4, tone 5 and tone 6. Consequently, the six tones may be divided into two sets according to the overlapping pattern: tones 1, 3 and 4 as one set, and tones 2, 5 and 6 as the other set.

In three-and-four-syllable words, a comparison was made separately for the following three groups of graphs: those of the prominent-stressed syllables, those of the stressed syllables, and those of the unstressed syllables.

In the prominent-stressed syllable, the  $F_0$  contours of the syllables carrying two pairs of tones i.e. tones 1 and 4, and tones 2 and 6 overlap considerably. In this context the  $F_0$  contours of the syllables carrying tone 3 and tone 5 do not overlap with each other or with the other tones.

In the stressed syllable, the two pairs of tones that overlap in the prominent-stressed syllable also overlap in this context. In addition, there is some overlapping between tone 2 and tone 5.

It is in the last context studied--the unstressed syllable of three-and-four-syllable words--that 'total' overlapping occurs. In this context the  $F_0$  contours of a large number of syllables carrying the six tones overlap (see Figures 12 and 15-19).

As already mentioned earlier, there may be some objection to the suggestion that tonal overlapping exists on the ground that concomitant features may be

the factors that distinguish the tones that have overlapping  $F_0$  contours. This may be the case in some of the other contexts. However, in the unstressed syllable of three-and-four-syllable words the extent of overlapping makes it seem impossible for the tones to be separated by those features.

The data presented in this study show that tones are fully distinctive only in the context of the tone set. The reason for this is clear. In the tone set, tone is the only characteristic that differentiates the words from one another. There are neither segmental clues nor contexts.

In the ordinary monosyllabic words and the prominent-stressed syllable of polysyllabic words, the realizations of some of the tones begin to overlap especially those of tone 1 and tone 4, and those of tone 2 and tone 6.

In the other types of syllables, tonal distinction is reduced further depending on the degree of stress. In the least stressed syllables, tonal distinction is almost nonexistent.

This study shows that the overlapping of tonal realizations depends mainly on degrees of stress. In the least stressed syllables tones overlap completely. The notion of neutralization can be used to refer to this phenomenon. When tones are neutralized, their distinction is not relevant in that context. So in Suphanburi Thai tone 1 and tone 4 are neutralized in both the unstressed syllable and the prominent-stressed syllable of disyllabic words, for example.

The considerable amount of overlapping in the data of this study--especially in the more weakly stressed syllables--makes us wonder whether tones are redundant in some phonetic contexts. This question is particularly relevant to the study of tones in connected speech where unstressed syllables regularly occur. Is it possible that tones have a relatively minor role to play in conveying meaning in connected speech? To the authors, it seems more acceptable to say that tones are always distinctive in the utterance at an abstract level and that the phonetic realizations of these tones can have many shapes in the different phonetic contexts. Overlapping or neutralization can occur at this concrete level but that does not interfere with the native speaker's knowledge of the tones of the words at the abstract level.

## NOTES

- 1) The research on which this paper is based was sponsored by the Research Division, Chulalongkorn University through the Linguistics Research Unit, Faculty of Arts, Chulalongkorn University.
- 2) The term 'accent' is used here to refer to a variety which is distinguished solely by the phonological system (Chambers 1980).
- 3) An auditory and instrumental study of tones in Suphanburi Thai was carried out in a previous study (Tingsabadh 1980). This study differs from that one in several aspects. In particular, polysyllabic words are analyzed in this study whereas only monosyllabic words were analyzed in the previous study.
- 4) In the original research of this study (Tingsabadh 1990), the data analyzed came from three male informants. In this paper the data from only one of them are presented.
- 5) In the original research (Tingsabadh 1990), the data were also separated into tones on 'live' syllables (the open syllables and those ending in nasals), on 'short checked' syllables (the syllables ending in stops containing short vowels) and on 'long checked' syllables (the syllables ending in stops containing long vowels). In this paper, however, only the tones on the 'live' syllables will be discussed.
- 6) The following information is given in the operating manual of the DSP Sona-Graph: "The pitch (fundamental frequency of the voice) trace is derived from the short time real cepstrum of the speech signal. This was obtained using 1024 point forward and inverse FFT's and 600/1024 zero-padded ratio. The pitch is estimated over an interval of about 60 milliseconds and the time between successive estimates is 1/160 of the time on the screen....The estimate generated by the algorithm is limited to the range 78 Hertz to 350 Hertz."
- 7) The tone system of this accent of Suphanburi Thai corresponds to that of Standard Thai (Abramson 1962) as follows:

<u>Suphanburi Thai</u>	<u>Standard Thai</u>
Tone 1: Mid-level	Tone 1: Mid
Tone 2: Upper mid-falling	Tone 2: Low
Tone 3: Upper mid-rising-falling	Tone 3: Falling
Tone 4: Mid-rising	Tone 4: High
Tone 5: High-delayed falling	Tone 5: Rising
Tone 6: Mid-falling	Tone 1: Mid



## REFERENCES

- Abramson, A.S. (1962) 'The Vowels and Tones of Standard Thai: Acoustical Measurements and Experiments'. *IJAL* 28.2, Part II.
- \_\_\_\_\_. (1975) 'The Tones of Central Thai: Some Perceptual Experiments.' In Jimmy G. Harris and James R. Chamberlain (eds.) **Studies in Tai Linguistics in Honor of William J. Gedney**. Bangkok: Central Institute of English Language
- Chambers, J.K. and Trudgill, P. (1980) **Dialectology**. Cambridge: Cambridge University Press.
- Pike, K.L. (1948) **Tone Languages**. Ann Arbor: The University of Michigan Press
- Tingsabadh, M.R.K. (1980) **A Phonological Study of the Thai language of Suphanburi Province**. PhD dissertation. University of London.
- \_\_\_\_\_. (1985) 'Some Accents of Central Thai, A Tonal Study'. Paper presented at the 18th International Conference on Sino-Tibetan Languages and Linguistics, August 27-29, 1985, Bangkok.
- \_\_\_\_\_. (1990) 'Tones in Suphanburi Thai: a Comparative Study between Tones in Monosyllabic Words and Tones in Polysyllabic Words'. Unpublished Manuscript.
- Wells, J.C. (1982) **Accents of English 1, An Introduction**. Cambridge: Cambridge University Press.

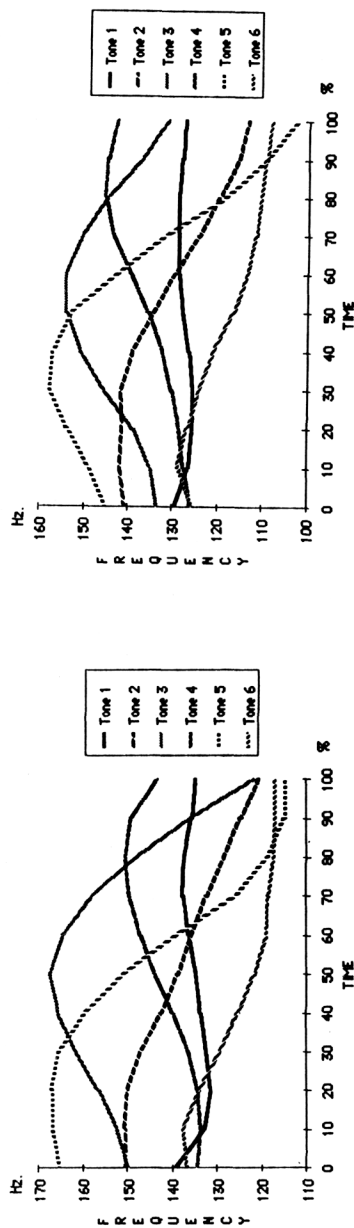


Figure 1 Average F<sub>0</sub> contours of the six tones in the tone set

Figure 2 Average F<sub>0</sub> contours of the six tones in ordinary monosyllabic words

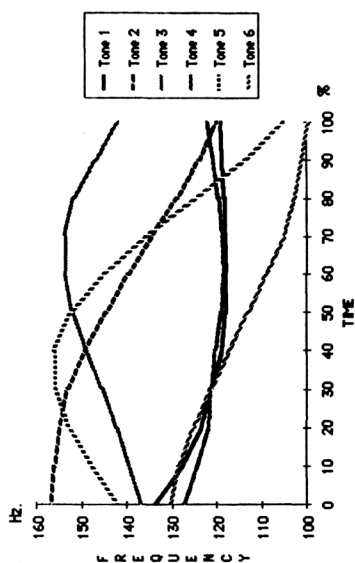


Figure 4 Average F<sub>0</sub> contours of the six tones in the prominent-stressed syllable of disyllabic words

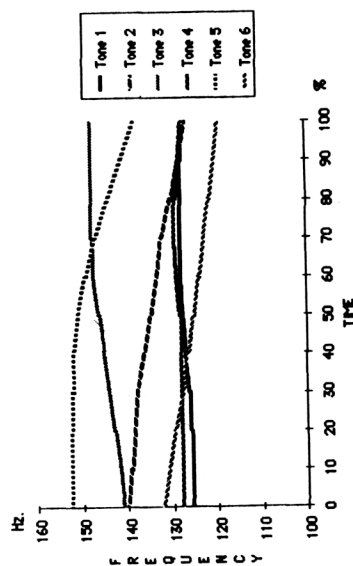


Figure 3 Average F<sub>0</sub> contours of the six tones in the unstressed syllable of disyllabic words

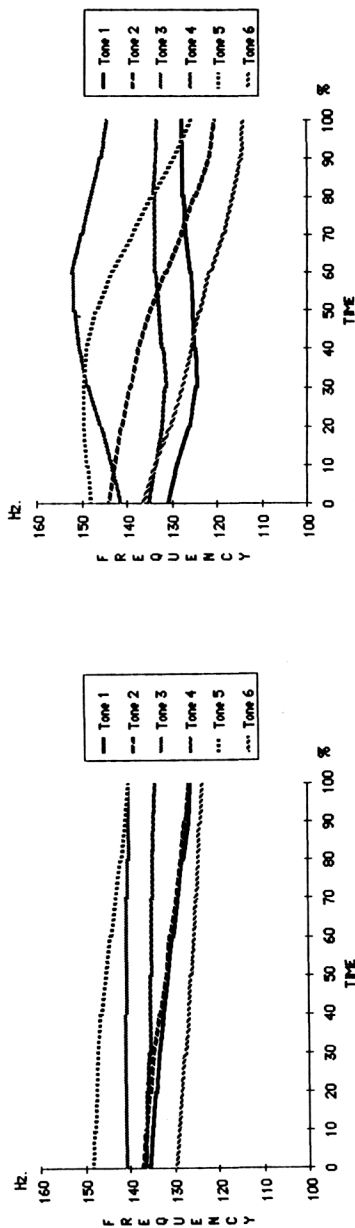


Figure 5 Average F<sub>0</sub> contours of the six tones in the unstressed syllable of three-and-four-syllable words

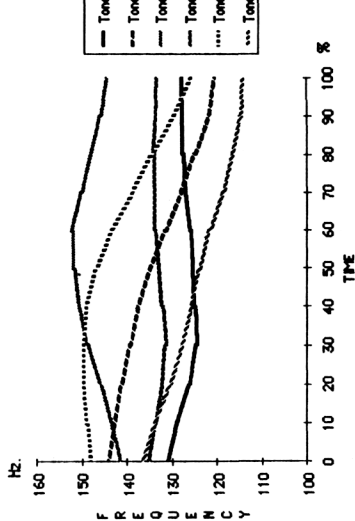


Figure 6 Average F<sub>0</sub> contours of the six tones in the stressed syllable of three-and-four-syllable words

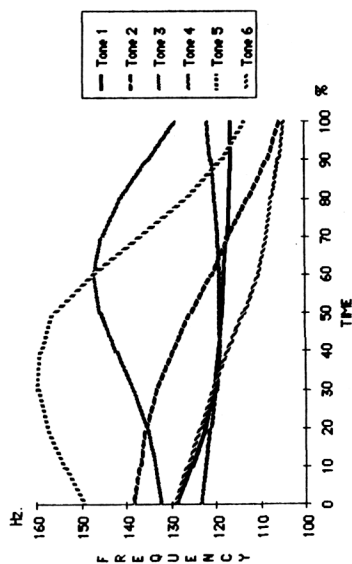


Figure 7 Average F<sub>0</sub> contours of the six tones in the prominent-stressed syllable of three-and-four-syllable words

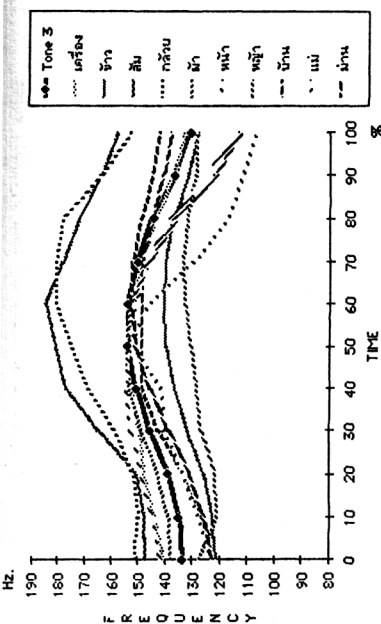


Figure 9 Average and actual  $F_0$  contours of tone 3 in ordinary monosyllabic words

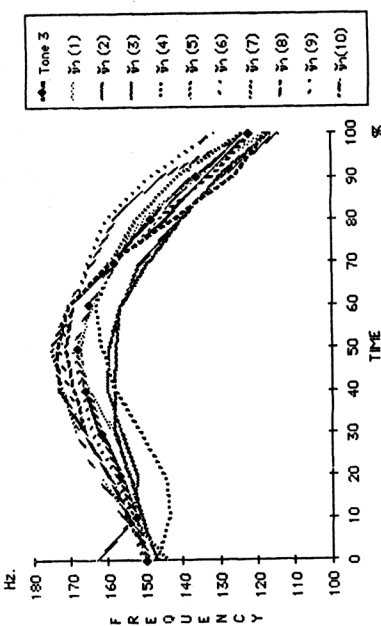


Figure 8 Average and actual  $F_0$  contours of tone 3 in the tone set

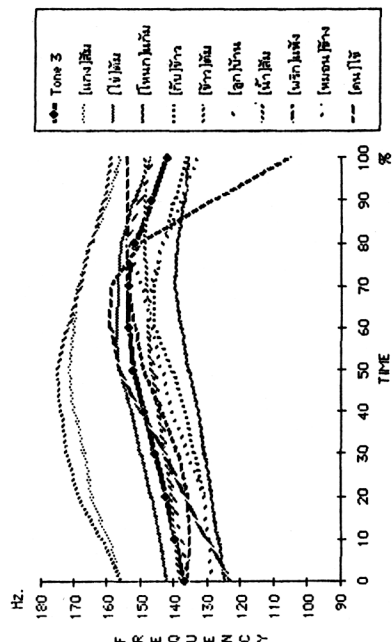


Figure 11 Average and actual  $F_0$  contours of tone 3 in the prominent-stressed syllable of disyllabic words

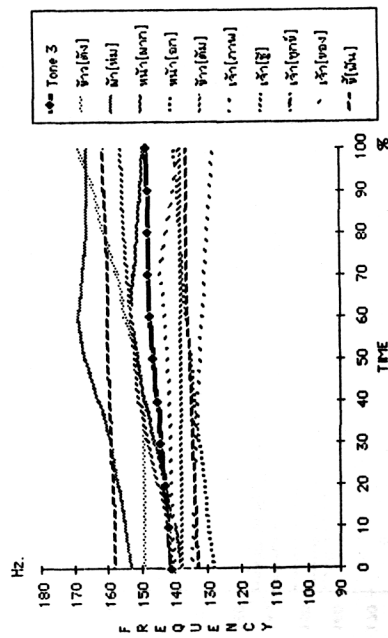


Figure 10 Average and actual  $F_0$  contours of tone 3 in the unstressed syllable of disyllabic words

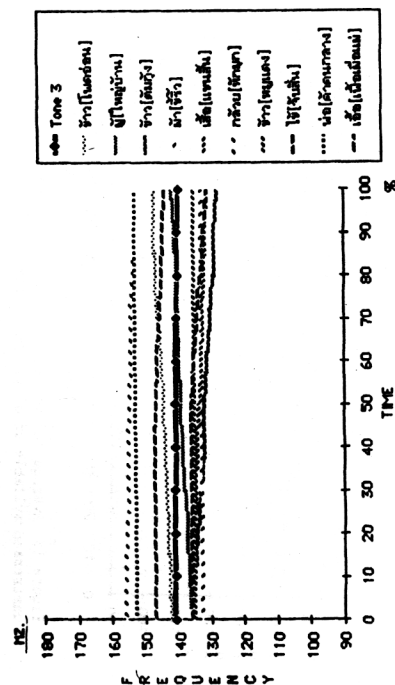


Figure 12 Average and actual  $F_0$  contours of tone 3 in the unstressed syllable of three-and-four-syllable words

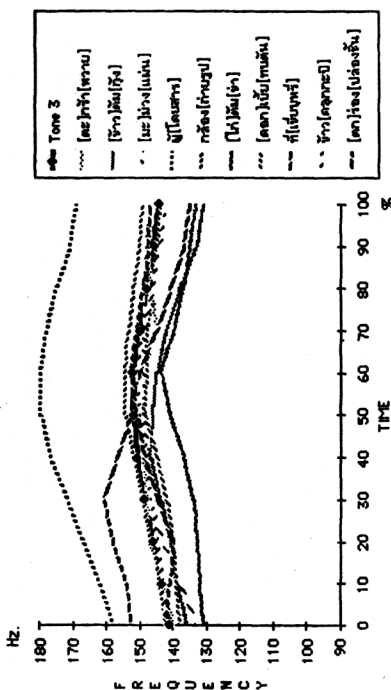
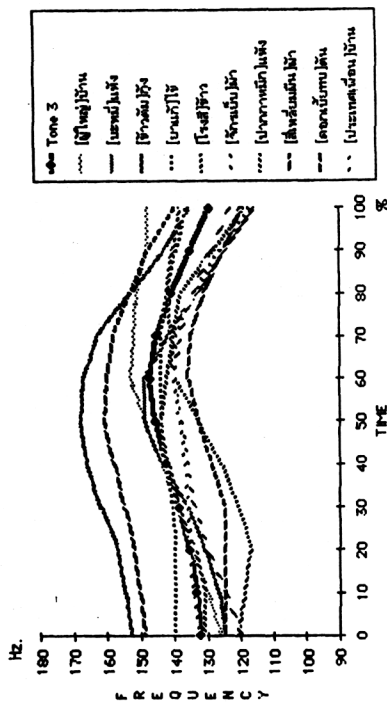
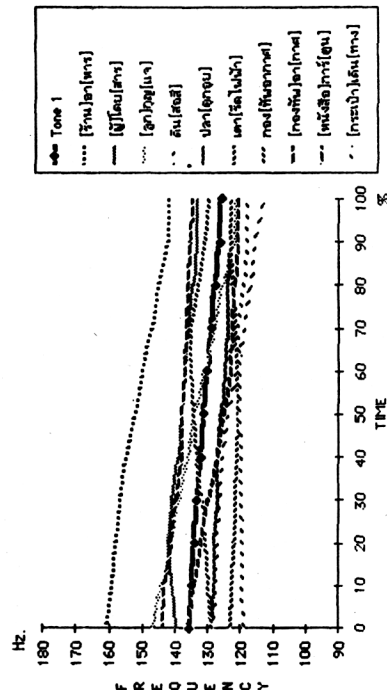


Figure 13 Average and actual  $F_0$  contours of tone 3 in the stressed syllable of three-and-four-syllable words



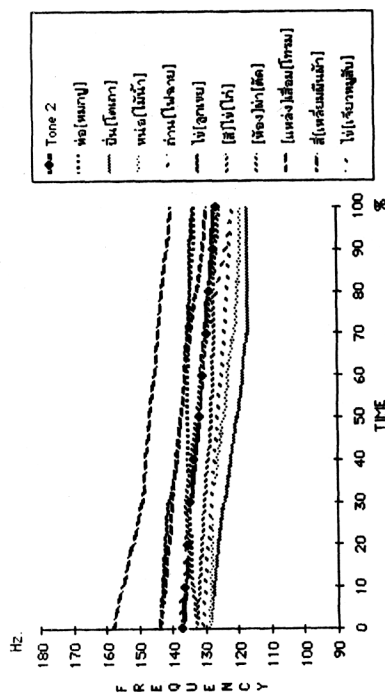


Figure 16 Average and actual  $F_0$  contours of tone 2 in the unstressed syllable of three-and-four-syllable words

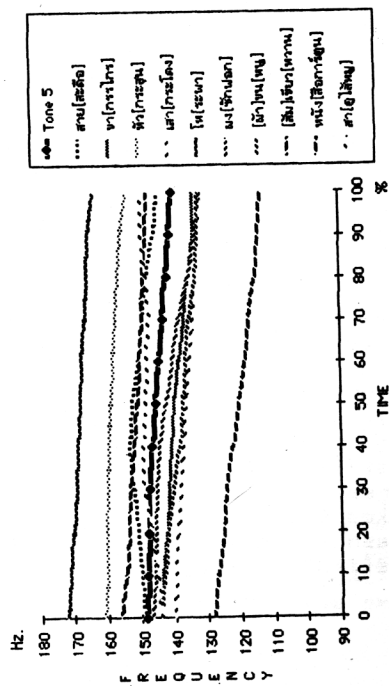


Figure 18 Average and actual  $F_0$  contours of tone 5 in the unstressed syllable of three-and-four-syllable words

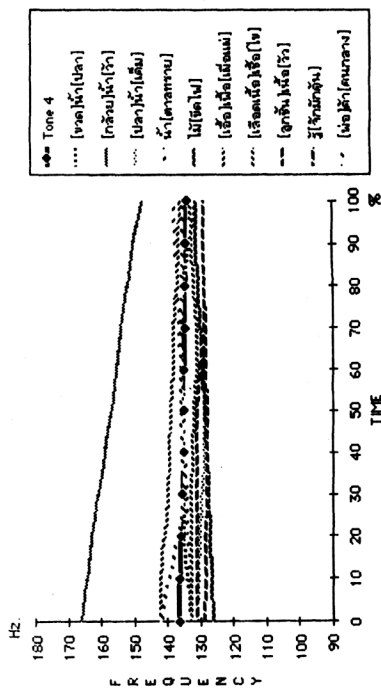


Figure 17 Average and actual  $F_0$  contours of tone 4 in the unstressed syllable of three-and-four-syllable words

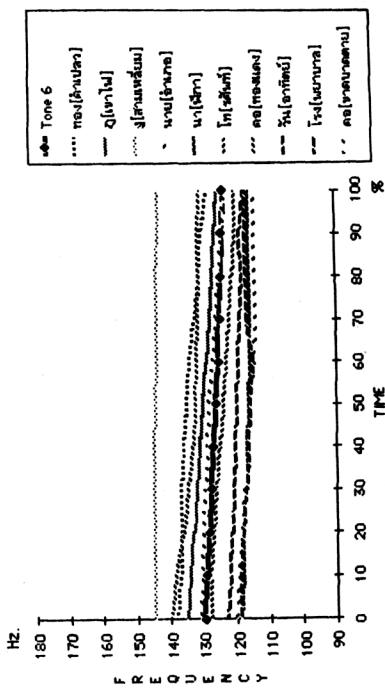


Figure 19 Average and actual  $F_0$  contours of tone 6 in the unstressed syllable of three-and-four-syllable words