The Phonetic Plausibility of the Segmentation of Tones in Thai Phonology*

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ABSTRACT

In such Southeast Asian tonal languages as Central Thai, the domain of a tone is ordinarily taken to be the syllable, but some linguists have claimed that a segmental representation of the tones best fits the grammar. Thus, the five-way tonal contrast present in the Thai lexicon would be handled by various arrangements of three level tones, underlying which are two binary features. The question is raised as to what kind of phonetic evidence, either in the form of fundamental-frequency contours or perceptual data, would support such a claim. The resulting criteria applied to productions of isolated Thai words and words embedded in sentences fail to provide any direct support for a segmental representation of the tones. In addition, listening tests with controlled variants of fundamental-frequency contours made with a speech synthesizer also fail short of the goal. It is concluded that the phonological arguments for segmentation are weak, that the phonetic data render it implausible, and that the concept is psychologically unconvincing.

INTRODUCTION

The specification of each morpheme in a tone language includes not only a sequence of consonantal and vocalic features, but also a distinctive pitch pattern that is manifested physically in the fundamental frequency of the voice. Linguists have generally analyzed Central Thai (Siamese) as having a five-way tonal contrast, with the syllable as the domain of the tone. There are said to be three level or static tones—mid, low and high—as well as two gliding or dynamic tones—rising and falling.

Some phonologists (for example, Trager, 1957; Leben, 1973; Gandour, 1974) have argued that the holistic treatment of tones in Thai is inherently wrong and should be replaced by a segmental treatment with various sequences of single vowels, double vowels, and final sonorants as the proper domain. While such arguments on the part of Trager (1957) may be a matter of personal taste


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in the manipulation of symbols for the writing of an efficient grammar, the generative treatments must be taken more seriously, since claims are made in this school of thought that the grammar should reflect the speaker's internalized knowledge of his language. By this reasoning, we must suppose that the speaker of Thai stores a lexical item with a dynamic tone as a properly ordered sequence of high and low tones or tonal features.

Linguists with the holistic view of Thai tones have never felt obliged to defend their position. They knew the language well, and it seemed intuitively correct not to segment the tones. This feeling was supported by the native Thai grammatical tradition reflected in the orthography that provides for the correct reading of the tones. Although there is scant literature on children's acquisition of Thai, my own observations and those of others suggest that children learn their basic vocabulary with a tonal contour as an integral part of each item. In fact, children may learn the dynamic tones before the static ones (Sarawit, 1976).

SEGMEmENEmTATION OF TONES

The segmentalists argue that consonantal constraints upon the freedom of occurrence of the tones indicate a mapping of each tone onto a segmental base at the level of the underlying form. All five tones may occur contrastively only on syllables that end in a long vowel, or a short or long vowel followed by a sonorant. Except for a few loan words and onomatopoeic terms, a syllable with a short vowel followed by a final stop may take only the high or low tone, while a long vowel followed by a final stop may take only the low or falling tone. In addition, the lexicon includes practically no high or rising tones after certain initial consonants. It is also claimed that tone alterations in compound words are stated in a better formalism with a segmental approach. The general argument rests on the controversial premise that long vowels are sequences of two short vowels.

My thesis here is that a segmental analysis of the tone of Thai is unreasonable and unrealistic. I am not, however, arguing that such an analysis is not appropriate to any language. The most convincing case is one in which all contour tones are obviously derived from underlying sequences, as when vowels undergo sandhi across a morpheme boundary, bringing about a merger of the final static tone of the first morpheme and the beginning static tone of the second morpheme to yield a contour.

Some African languages are said to have a rule of tone copying (Leben, 1973). An inherently toneless syllable takes on the immediately preceding tone. Thus, a toneless element will become high after a high tone and low after a low tone. If, however, the preceding syllable bears a contour tone, the toneless element copies only the final "tone" of the alleged sequence in the contour. The tone-copying rule taken alone as an argument for segmentation succumbs to a natural explanation, which is simply that the pitch movement of the preceding syllable persists in its course through any following element that does not carry a distinctive tone of its own. Even if the latter arguments are accepted, the sandhi feature could lead to a segmental analysis of the tones of those languages anyway, although among these African languages there seem to be some that can be shown to have underlying contour tones (Elimelech, 1974).
If, as it seems, the speaker of Thai learns every morpheme with its tone contour, why must a grammar include complicated rules to express the few consonantal limitations on freedom of occurrence of the tones? These facts are simple and may be seen as part of the speaker's knowledge without letting them force us into an improbable view of lexical entries. In fact, this knowledge has not kept Thai from breaking these "rules" in the tonal treatment of loan words. As for tone alternations and neutralizations in compound words, Gandour (1974) has shown instrumentally that the kinds of examples given by Leben (1973) are by and large untenable.

**PHONETIC EVIDENCE**

If we believe that the phonology of a language should lead very directly to correct phonetic outputs and auditory percepts, what phonetic evidence would help settle the argument? Would a phonologically disinterested phonetics point to a segmental organization of the tones? A good basis would be acoustic data showing that each of the static tones normally appeared as a level with, perhaps, slight contextually induced perturbations. If each dynamic tone normally appeared as a sequence of these levels with a rapid glide between them, the phonetic evidence would be even more consistent with a segmental analysis. Instrumental investigation of the physiological mechanisms underlying the tones might show segmentation in laryngeal maneuvers or aerodynamic forces. Perceptual evidence might be that static tones are more acceptable when produced as absolute levels rather than movements of fundamental frequency. Also, dynamic tones produced segmentally ought to be more acceptable than mere glides without end-point levels. One more phonetic question is the plausibility of the segmentation of long vowels into two short vowels onto which the tonal segments are mapped. There should be evidence of rearticulation halfway through a long vowel.

Fundamental-frequency contours of Thai tones (Abramson, 1962, 1975; Erickson, 1974) give no acoustic support to the segmental analysis. Although a criterion of relative movement seems to justify the dichotomy between static and dynamic tones (Abramson, 1976), it is nevertheless true that all five tones show much movement. There are no true levels, and the dynamic tones are specified by their direction of movement and not by their end points.

Among the static tones, the fundamental frequency pattern that comes closest to being a true level is that of the mid tone, but even so, it moves upward or downward at both ends or throughout its extent through tonal coarticulation. The low tone starts near the beginning of the mid tone, drops quickly at first, and then falls slowly to the bottom of the voice range. Its early fall distinguishes the low tone from the mid tone. The high tone starts just above the middle of the voice range and, often after a dip, slowly rises. The dynamic tones are exaggerations of the static tones. The falling tone starts just above the middle of the voice range, rises, and then falls abruptly to the middle or bottom of the range. It may thus be better named the high falling tone as contrasted with the low tone, which is a low falling tone. The rising tone starts near the beginning of the mid tone, drops quickly to the bottom of the voice range, then moves abruptly upward. The rising tone is thus really a low rising tone, while the high tone is a high rising tone.
The patterns of laryngeal-muscle activity underlying the contours of the tones of Thai might seem to support a segmental analysis. Such has been Erickson's interpretation of the data in her important dissertation (1976). Using electromyography, she found the activity patterns of a number of laryngeal muscles during the production of the five tones. Two muscles best represent her data. One of them, the cricothyroid, is the principal agent in the control of fundamental frequency. Its contraction stretches and stiffens the vocal folds causing the frequency to rise; when it relaxes, the frequency falls. The other is the thyrohyoid, one of the strap muscles, whose role in the control of fundamental frequency is moot. They contract in association with sharp falls in frequency, but no causal relationship has been demonstrated.

Erickson finds distinctive muscle patterns for the five tones. It is in the dynamic tones that she most readily finds support for segmentation. The rising tone shows a thyrohyoid peak for its initial drop, followed by a cricothyroid peak for its sharp rise, while the falling tone shows a cricothyroid peak first, for its initial rise, followed by a thyrohyoid peak for its sharp fall. The static tones, even when occurring on long vowels, are not obviously to be divided temporally into segments of contraction and relaxation nor, for that matter, do they show uniform patterns throughout, as might be expected in true geminate tones. If one reads support of a segmental view into the complicated muscle data, one is then obliged to reconsider the phonetic integrity of a number of conventionally accepted vocalic and consonantal segments with their temporally resolvable peaks of muscle activity, as in aspirated stops and semi-vowels.

As for perception, some observers hear the static tones as levels, and it is possible that in some instances of these tones auditory averaging of small movements will indeed give the impression of levels; however, it is easy to hear pitch changes most of the time. Indeed, many foreigners have trouble distinguishing between the mid and low tones on the one hand and the mid and falling tones on the other. That is, although experiments in speech perception (Abramson, 1976) do support a dichotomy between tones with large pitch shifts and those without, the term static for the latter is an exaggeration. Although other experiments show that fundamental-frequency levels can be heard as the three static tones by Thai subjects, their acceptability is enhanced when they are synthesized as glides (Abramson, 1975). One can synthesize very acceptable dynamic tones by using continuously changing contours (Abramson, 1962, 1975, 1976), but preliminary work suggests that rapid movements between low and high levels will not yield equally acceptable dynamic tones.

Acoustic data do not enable us to show that the long vowels of Thai are segmentable into sequences of two occurrences of the same vowel (Abramson, 1962, 1974), nor do I know of any electromyographic evidence of rearticulation in long vowels.

CONCLUSION

The arguments for segmentation based on interactions between tones and consonants are too devious and weak to be convincing, and when we turn to phonetic data, the argument becomes even less plausible. I conclude that the traditionally espoused unitary status of the tones of Thai is unshaken.
REFERENCES


