A NEW LOOK ON DIPHTHONGS IN THAI

Rungpat Roengpitya
Chulalongkorn University, Thailand
<runphatr@hotmail.com>

1 Introduction

Thai has three phonemic diphthongs /ia/, /ɯa/, and /ua/. Short and long diphthongs in Thai are not phonemically distinctive (Abramson 1962 and Naksakul 1998). Previous literature noted that diphthongs are shorter in unstressed positions but longer in stressed positions, and that diphthongs are always short when followed by a final glottal stop (Naksakul, 1998). Roengpitya (2001, 2002) found that shorter diphthongs occur in closed syllables; whereas, longer diphthongs occur in open syllables.

Roengpitya (2001) measured the diphthong duration in three major components: (1) the duration of the first vocalic element, (2) the duration of the transition between the first and the second vocalic elements, and (3) the duration of the second vocalic element. I found that diphthongs in open syllables are longer than the ones in closed syllables (for 61 msec. of the duration of the first vocalic element, for 11 msec. of the transition duration, and for 112 msec. of the second vocalic duration). I concluded that the main cue to distinguish the phonetic shorter-longer diphthongs was the shorter or longer duration of the second vocalic element.

However, the previous study of diphthongs in Thai did not demarcate the offset of the first vocalic element and the onset of the second vocalic element of diphthongs. In the present paper, I have attempted to present a plausible method to mark where the first vocalic element ends and where the second vocalic element of each diphthong starts. My aim is to find out whether the duration of the second vocalic element of diphthongs is still the main cue to distinguish between shorter and longer allodiphthongs in Thai.

2 An Acoustic Study of Thai Diphthongs

2.1 *Aim*

The aim of this paper is to demarcate the offset of the first vocalic element and the onset of the second vocalic element of diphthongs, and to find out whether the duration of the second vocalic element of diphthongs is the main cue to distinguish shorter and longer allodiphthongs in Thai.

2.2 *Tokens*

The tokens, used in this study, had the structure of C1V(C2)T, where C1 was a voiceless unaspirated stop /p-/; V was /ia/, /ɯa/, or /ua/; C2 was a glottal stop /-ʔ/, a voiceless unreleased alveolar stop /-t/, or a dental nasal /-n/; and T was a low tone. Some tokens were meaningful but some were nonsense words. All the tokens were in citation forms.

2.3 *Speakers*

The speakers for this study were three native Standard-Thai speakers: three females (the author, Speaker 2, and Speaker 3). The first speaker was a lecturer, and Speakers 2 and 3

were graduate students at Chulalongkorn University, Bangkok, Thailand. All of the speakers had normal speech and hearing.

2.4. *Procedure*

The three speakers read all the tokens ten times. The tokens were recorded digitally in Praat sound program at a sample rate of 16 kHz. with 16 bits per sample. All the tokens were extracted for the first and the second formant values of diphthongs. All the tokens were transferred to the Matlab Program for the first two formant analysis. There were a total of 360 tokens in this study: 3 diphthongs * 4 conditions * 10 times * 3 speakers.

To measure the durations of the first and the second vocalic elements, we computed the values of the first and second derivatives of the first and second formants. We used the zero-crossings of the derivatives (positive or negative, depending on the direction of the formant movement) to demarcate where the first vocalic element of a diphthong ends and where the second vocalic element of a diphthong starts. The figures below show an example of how to mark the boundary of the first and second vocalic elements of a diphthong.
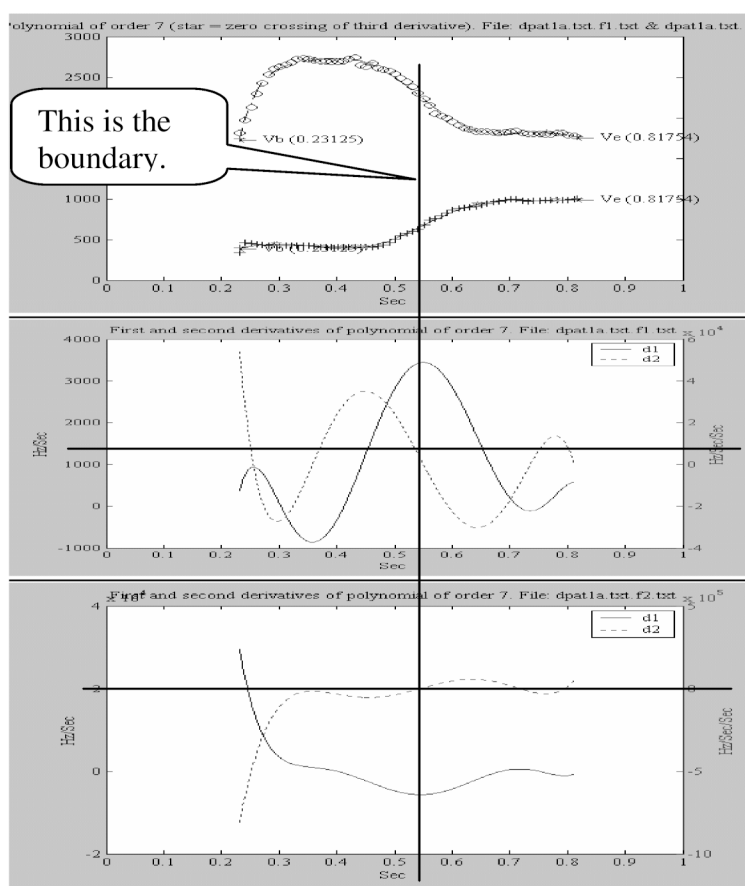

Figure 1: *An example of how to mark the boundary between the first and the second vocalic element of a diphthong /ia/.*

It can be noted that the formants of each diphthong have their own direction of movement. The way to find the boundary of each diphthong is applied, as in Table 1.

Table 1: *The principles for finding the boundary between 2 vocalic elements of diphthongs.*

diphthongs	1st formant (1st > 2nd vocalic elements)	2nd formant (1st > 2nd vocalic elements)
/ia/	**lower > higher** *(Use negative ongoing zero-crossing of 2nd derivative)*	**higher > lower** *(Use positive ongoing zero-crossing of 2nd derivative)*
/ɯa/	**lower > higher** *(Use negative ongoing zero-crossing of 2nd derivative)*	**mid level > lower** *(Consult the derivatives of F1 values)*
/ua/	**lower > higher** *(Use negative ongoing zero-crossing of 2nd derivative)*	**lower > higher** *(Use negative ongoing zero-crossing of 2nd derivative.)* (NOTE: Sometimes, the rate of change and its phase are different from the F1 values. To be consistent, use the derivative of F1 values.)

After the boundary between the first and the second vocalic elements of diphthongs was marked, I measured the durations of the first and the second vocalic elements of diphthongs. The results are presented in the next section.

3 Results

Figures 2, 3, and 4 show the durations of the first and the second vocalic elements of diphthongs /ia/, /ɯa/, and /ua/, respectively.
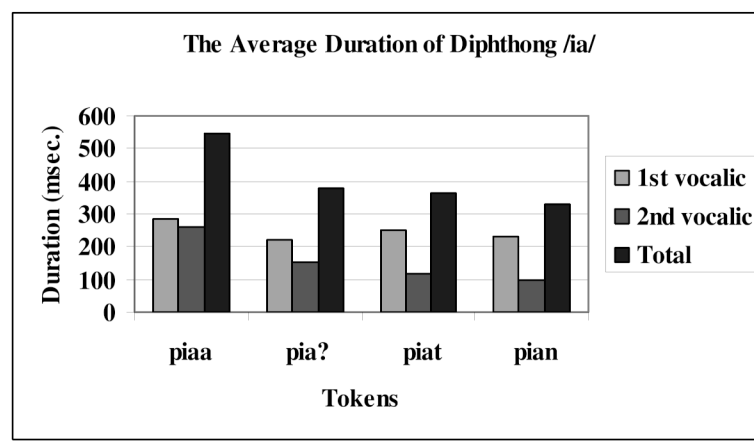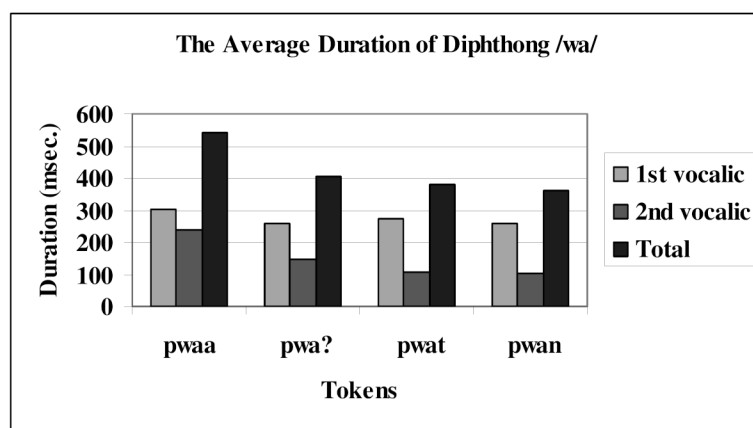

Figure 2: *The duration of diphthong /ia/.*

The Average Duration of Diphthong /wa/

Figure 3: *The duration of diphthong /ɯa/.*

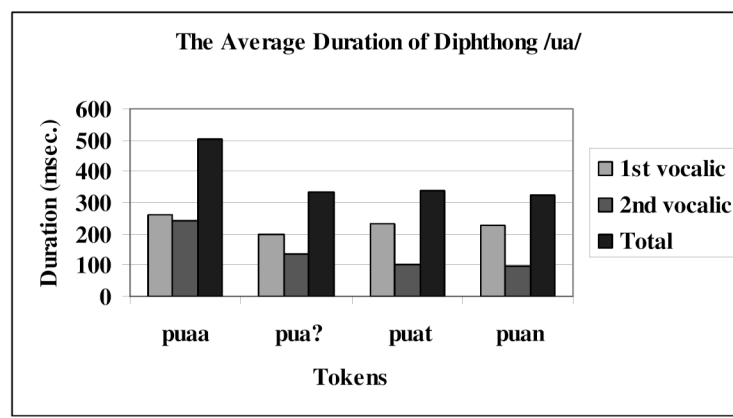**The Average Duration of Diphthong /ua/**

Figure 4: *The duration of diphthong /ɯa/.*

Figure 5 presents the average duration of all three diphthongs: /ia/, /ɯa/, and /ua/ in four conditions. Figure 6 shows the average duration of diphthongs in open and closed syllables.