

A NEW LOOK ON DIPHTHONGS IN THAI

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1 Introduction

Thai has three phonemic diphthongs /ia/, /ua/, 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/, /ua/, 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.

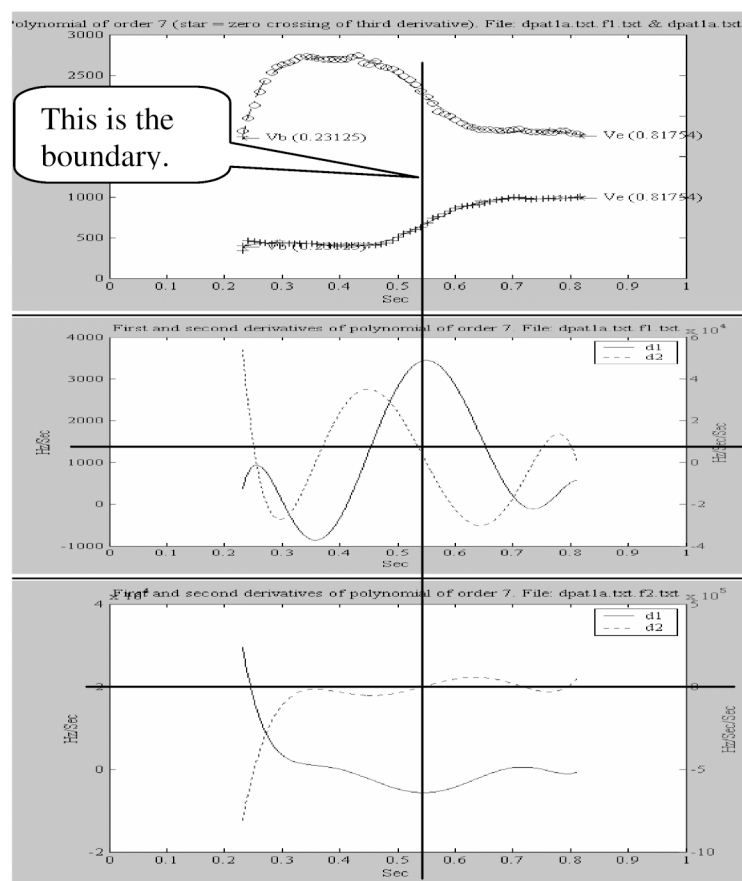


Figure 1: An example of how to mark the boundary between the first and the second vocalic element of a diphthong /ia/.

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	1 st formant (1 st > 2 nd vocalic elements)	2 nd formant (1 st > 2 nd vocalic elements)
/ia/	<u>lower > higher</u> (Use negative ongoing zero-crossing of 2 nd derivative)	<u>higher > lower</u> (Use positive ongoing zero-crossing of 2 nd derivative)
/ua/	<u>lower > higher</u> (Use negative ongoing zero-crossing of 2 nd derivative)	<u>mid level > lower</u> (Consult the derivatives of F1 values)
/ua/	<u>lower > higher</u> (Use negative ongoing zero-crossing of 2 nd derivative)	<u>lower > higher</u> (Use negative ongoing zero-crossing of 2 nd 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/, /ua/, and /ua/, respectively.

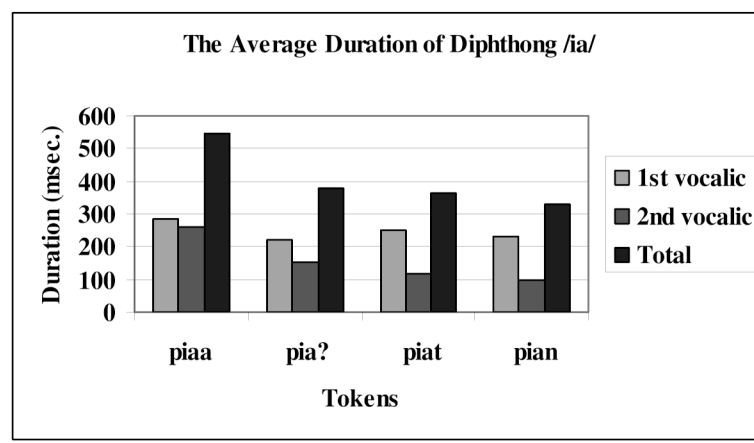


Figure 2: *The duration of diphthong /ia/.*

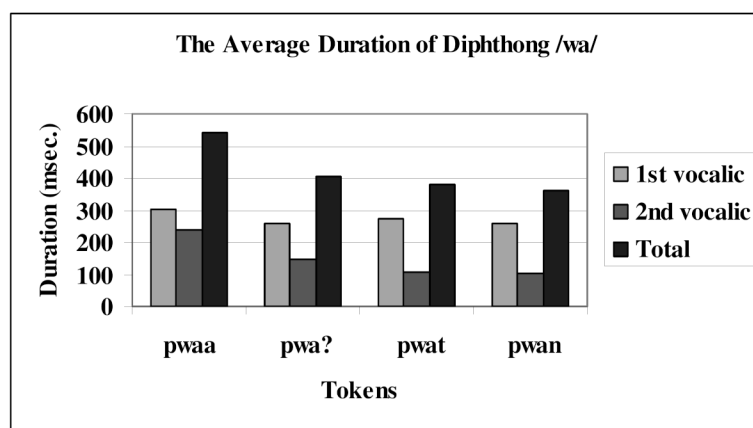


Figure 3: *The duration of diphthong /wa/.*

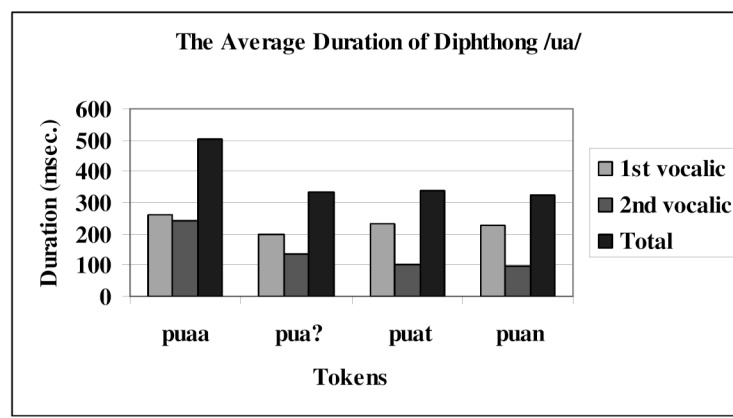


Figure 4: *The duration of diphthong /ua/.*

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

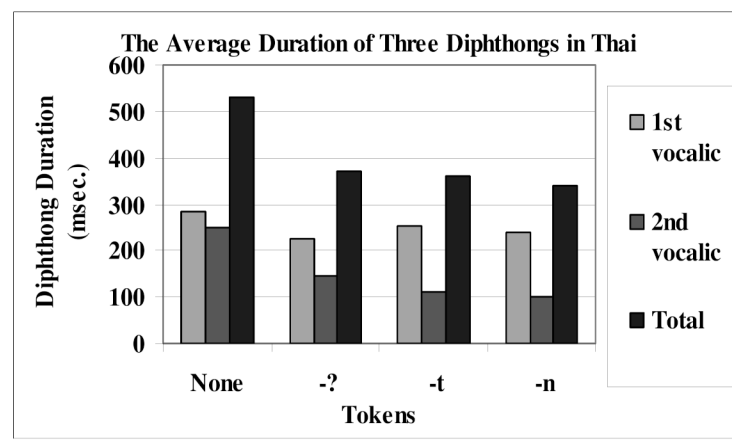


Figure 5: *The average duration of all three diphthongs: /ia/, /ua/, and /ua/ in four conditions.*

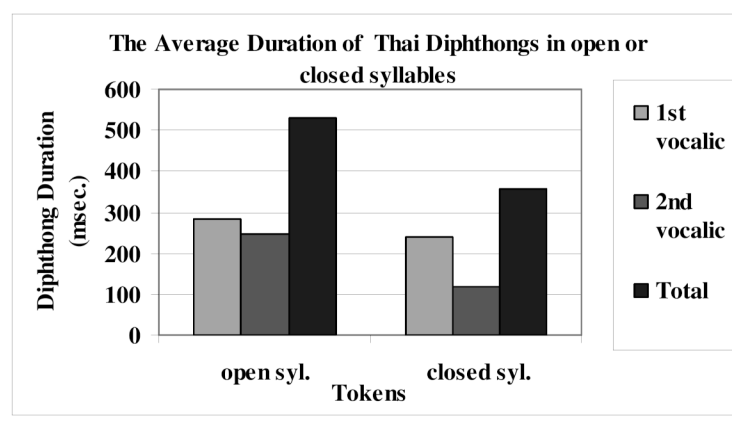


Figure 6: *The average duration of diphthongs in open and closed syllables.*

From Figures 2-4 above, it can be seen that the durations of the two vocalic elements among the three diphthongs in each condition (without any final, with final glottal stop, with a final alveolar stop, and with a final alveolar nasal) are in the same range.

Figures 5-6 above summarize the average of the duration of the two vocalic elements of all three diphthongs in each condition, as stated above. The results show that it can be clearly seen that in all conditions the first vocalic element is longer than the second vocalic element. This result correlates with the previous finding in Roengpitya (2001 and 2002) that the first vocalic component is a prominent part in distinguishing the three phonemic diphthongs in Thai.

The results of this paper, as seen in Figure 6, further reveal that the difference between the durations of the first and the second vocalic elements are greater for the tokens in closed syllables (the first vocalic element is 34% longer than the second vocalic element) than for the tokens in open syllables (the first vocalic element is only 7% longer than the second vocalic element).

The next result agrees with the previous study in the same previous literature that the total duration of diphthongs in open syllables is longer (about 174 msec.) than the total duration of diphthongs in closed syllables.

Further details report that both the first and the second vocalic elements of diphthongs in open syllables are longer than both vocalic elements of diphthongs in closed syllables. The main cue to distinguish the total durations of longer allodiphthongs (in open syllables) and of shorter allodiphthongs (in closed syllables) is the duration of the second vocalic element. The second vocalic element of longer allodiphthongs is about 130 msec. (in average) longer than the one of shorter allodiphthongs; whereas, the first vocalic element of longer allodiphthongs is only about 44 msec. (in average) longer than that of shorter allodiphthongs.

4 Conclusion

Previously (Roengpitya 2001 and 2002), diphthongs were measured for three main components: the first vocalic element duration, the duration of the transition between the first and the second vocalic elements, and the second vocalic element duration.

The aim of the present study, however, has been to apply a new method of diphthong measurement, using the second derivatives of the first two formants to demarcate the offset of the first vocalic element and the onset of the second vocalic element, before measuring the durations of the two main diphthong components without the duration of the transition between the two vocalic elements.

The results from the acoustic study of Thai diphthongs presented here follow the same direction as the results in previous findings on shorter and longer diphthongs in Thai. First, the first vocalic element of all diphthongs is significantly longer than the second vocalic element. The prominent element of a diphthong falls on the first vocalic element rather than on the second vocalic element. The study in this paper has additionally given more details that the difference between the duration of the two vocalic elements is greater for diphthongs in closed syllables than for those in open syllables.

Furthermore, longer allodiphthongs in open syllables have a longer total duration than those of shorter allodiphthongs in closed syllables. The main cue in distinguishing longer allodiphthongs from shorter ones is the duration of the second vocalic element. Shorter allodiphthongs have a shorter second vocalic element than longer diphthongs do. To conclude, though the results of diphthong durations obtained in this study via the use of a new method of measurement, confirmed the main results of the findings in previous literature (Roengpitya, 2001 and 2002), the present study has also provided more details and support for the main findings of previous studies.

In the near future, I aim to apply this method to an investigation of the status of the so-called rising diphthongs in Thai /ai/ and /au/, or /aj/ and /aw/, and examine whether they are diphthongs or a vowel-consonant combination.

From the diphthong study of the present paper, I also hope that the new method of measuring diphthongs introduced in the paper will be another useful option for other researchers to study diphthongs not only in Thai, but also in other languages of the World.

Notes

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