

# THAI TONES PRODUCED BY TONAL AND NON- TONAL LANGUAGE SPEAKERS: AN ACOUSTIC STUDY<sup>1</sup>

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## บทคัดย่อ

วัตถุประสงค์ของงานวิจัยนี้คือวิเคราะห์ลักษณะทางกลศาสตร์ของวรรณยุกต์ภาษาไทยที่ออกเสียงโดยผู้พูดภาษามีวรรณยุกต์ได้แก่ ภาษาเวียดนามและภาษาพม่า กับผู้พูดภาษาไม่มีวรรณยุกต์ได้แก่ ภาษาเขมรและภาษามลายูในบริบทคำพูดเดี่ยวและคำพูดต่อเนื่อง คำทดสอบสร้างจากวรรณยุกต์ 5 หน่วยเสียง ได้แก่ วรรณยุกต์สามัญ วรรณยุกต์เอก วรรณยุกต์โท วรรณยุกต์ตรี และวรรณยุกต์จัตวา ทั้งที่ปรากฏในพยางค์เป็นและพยางค์ตาย ใช้ทดสอบกับผู้บอกภาษา 24 คน ประกอบด้วยผู้พูดภาษาเวียดนาม ภาษาพม่า ภาษาเขมร และภาษามลายู ที่มี

ประสบการณ์ภาษาไทยมาก (ภาษาละ 3 คน) และที่มีประสบการณ์ภาษาไทยน้อย (ภาษาละ 3 คน) ทั้งนี้ผู้วิจัยบันทึกเสียงรายการคำผ่านคอมพิวเตอร์โดยตรง และวิเคราะห์ ค่าความถี่มูลฐาน (F0) ของวรรณยุกต์ด้วยโปรแกรมพราท เวอร์ชัน 5.1.43 จากนั้นแปลงค่า ความถี่ มูลฐานเป็นค่าเซมิโตน

ผลการวิจัยพบว่าลักษณะทางกลศาสตร์ของวรรณยุกต์ภาษาไทยที่ออกเสียงโดยผู้พูดภาษาเวียดนาม ภาษาพม่า ภาษาเขมร และภาษามลายูมีความแตกต่างกันตามแบบลักษณ์ภาษา ในภาพรวมพบว่าผู้พูดที่มีประสบการณ์ภาษาไทย มากออกเสียงวรรณยุกต์ภาษาไทยได้ดีกว่าผู้พูดที่มีประสบการณ์ภาษาไทยน้อยไม่ว่าจะเป็นวรรณยุกต์ในพยางค์เป็นและวรรณยุกต์ในพยางค์ตายในบริบทคำพูดเดี่ยว อย่างไรก็ตามพบว่า ในคำพูดต่อเนื่องผู้พูดภาษามีวรรณยุกต์ได้แก่ ผู้พูดภาษาเวียดนามและผู้พูดภาษาพม่าที่มีประสบการณ์ภาษาไทยมากออกเสียงวรรณยุกต์ภาษาไทยได้ดีกว่าผู้พูดภาษาเขมรและผู้พูดภาษามลายูที่มีประสบการณ์ภาษาไทยมาก หมายความว่าลักษณะทางกลศาสตร์ของวรรณยุกต์ทั้ง 5 หน่วยเสียง ใกล้เคียงกับของผู้พูดภาษาไทยเป็นภาษาแม่ โดยสรุปแล้ว อาจกล่าวได้ว่าประสบการณ์ภาษาไทย ได้แก่ระยะเวลา ในการเรียน ความถี่ในการใช้ภาษาไทย และจุดมุ่งหมายหรือแรงจูงใจในการเรียนภาษาไทย มีผลต่อความสามารถ ในการเรียนรู้วรรณยุกต์ภาษาไทย นอกจากนี้ การเป็นผู้พูดภาษามีวรรณยุกต์ไม่ได้เอื้อ

<sup>1</sup> วรรณยุกต์ภาษาไทยที่ออกเสียงโดยผู้พูดภาษามีวรรณยุกต์และผู้พูดภาษาไม่มีวรรณยุกต์: การศึกษาทางกลศาสตร์  
This paper is a part of the research project on “Thai vowels and tones produced by Khmer, Vietnamese, Burmese, and Malay speakers: An acoustic and perception study” funded by Thailand Research Fund (TRF) and Naresuan University

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ประโยชน์ต่อการเรียนภาษาที่สอง ที่เป็นภาษามี  
วรรณยุกต์ในช่วงเริ่มเรียน

## Abstract

*The purpose of this paper was to analyze the acoustic characteristics of Thai tones produced by tonal language speakers, namely Vietnamese and Burmese, and non-tonal language speakers, namely Khmer and Malay, in citation form and connected speech. The test words in citation form and connected speech comprised five tones, which were the Mid tone, the Low tone, the Falling tone, the High tone, and the Rising tone occurring in non-checked and checked syllables. The informants were twenty-four Vietnamese, Burmese, Khmer, and Malay native speakers with high experience in Thai (three speakers for each language) and low experience in Thai (three speakers for each language). The informants' speech was recorded directly on to a computer. The fundamental frequencies (F0) of tones were measured using Praat Version 5.1.43 and then converted to semitones.*

*The results show that the acoustic characteristics of Thai tones produced by Vietnamese, Burmese, Khmer, and Malay native speakers are typologically different. The speakers with high experience in Thai seem to produce Thai tones in non-checked syllables and checked syllables better compared to those with low*

*experience in Thai in citation form, regardless of typological difference. However, it is found in connected speech that the native tonal language speakers of Vietnamese and Burmese with high experience in Thai can produce better Thai tones, i.e. the acoustic characteristics of the five tones similar to those produced by Thai native speakers, than the Khmer and Malay speakers with high experience in Thai. It can be concluded that experience measured by years of study, frequency of usage, and the objectives of study all influence the ability of second language speakers to correctly form Thai tones. Moreover, speaking a tonal native language does not benefit a speaker attempting to learn another tonal language at the first stage of learning.*

## Introduction

The diversity of languages spoken in ASEAN countries is a crucial topic arising from the formation of the ASEAN community. Such diversity can be classified by typology. According to Crowley (1997: 130), a typological classification of languages looks for certain features of a language and groups the languages that share the same features. There are seven languages spoken in ASEAN countries, but only four languages were chosen by typology in this research, namely Vietnamese, Burmese, Khmer, and Malay. Classification by tone finds that

Vietnamese and Burmese are in the same group as Thai with regard to being tonal languages, whereas Khmer and Malay are non-tonal languages.

Typologically, Vietnamese is classified in the Vietic sub-group of Mon-Khmer in the Austroasiatic language family. Vietnamese is a tonal language because of tonogenesis. The official dialect of Vietnamese is Northern Vietnamese. There are six tones in Northern Vietnamese (Thompson, 1987), which are High-level (Ngnag), Low-level (Huyền), Low-rising (Hỏi), High-rising with glottalization (Ngã), High-rising (Sắc), and Low-falling with glottalization (Nặng). The other tonal language, Burmese, is in the Lolo-Burmese sub-group of Tibeto-Burman in the Sino-Tibetan language family. Lower Burmese or Yangon dialect is the official language of Myanmar. There are four tones in Lower Burmese according to Niyomtam and Niyomtam (1994), which are Low-level, Mid-falling, High-falling, and Glottal stop.<sup>3</sup> As for the non-tonal language, Khmer, Central Khmer is the official language of Cambodia. It is in the Austroasiatic language family. Huffman, Promchan and Lambert (1970) studied the phonological system of Central Khmer and found that there were eighteen monophthongs and thirteen diphthongs. The fourth language, Malay, is spoken in

Malaysia, Brunei, Singapore and Indonesia. It is grouped in Malayic in the Austronesian language family. Clynes and Deterfing (2011) describe Standard Malay as a non-tonal language, although it does have pitch accent.

Many scholars have studied the Thai tones produced by foreign speakers. Several examples include a comparative study of acoustic characteristics of Thai tones spoken by Vietnamese according to language experiences (Nguyen Thi Van Chi, 2006), a contrastive study of Thai tones between Khmer-Thai students and native Thai students in Prathom 1, Ban Kae Yai School and Mattayom 6, Sriphataisamun School, Surin Province vs. students in Prathom 1 and Mattayom 6, Kasetsart University Laboratory School (Kangwansupapan 2007), the Bangkok Thai tones produced by Japanese speakers: an acoustic and perception study (Sinthawashewa, 2009), the Bangkok Thai tones produced by 6-7 year-old Pattani Malay children: an acoustic and perception study (Wong-ampai, 2009), and a comparison study of Bangkok Thai tones spoken by Thai and Indian speakers: a case study of gender (Phiasuphan, 2014). However, none of the previous studies compared the acoustic characteristics of Thai tones spoken by tonal and non-tonal speakers.

According to Wang (2006) and Hao (2012), speaking a native tonal language

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<sup>3</sup> Glottal stop tone means a tone occurring in the syllable ending with glottal stop.

does not benefit a speaker learning another tonal language because the speaker still has to distinguish the native tone system from the second language tone system. Therefore, this research aims to analyze the acoustic characteristics of Thai tones produced by Vietnamese, Burmese, Khmer, and Malay speakers<sup>4</sup> in citation form and connected speech.

## Methodology

The informants were twenty-four Vietnamese, Burmese, Khmer, and Malay speakers; six speakers for each language, three of speakers were high experience speakers (speaker 1, 2, 3) and three others who were low experience speakers<sup>5</sup> (speaker 4, 5, 6). The wordlist consisted of five Thai tones in non-checked syllables and checked syllables occurring in citation form and connected speech. Three sets of test tokens were composed using the vowels /a, a:/ together with the variety of

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<sup>4</sup> The speakers of each language are native speakers of the official or standard dialect. Malay speakers were from Malaysia and spoke Standard Malay dialect. The speakers are both male and female.

<sup>5</sup> The questionnaire for deciding high and low experience in Thai was developed from Modehiran (2005) and Sinthawashewa (2009). The questions were composed of many aspects, including years of studying Thai, frequency of using Thai in daily life, and relationships with Thai people.

initial consonants which are voiceless aspirated stop (k<sup>h</sup>), nasal stop (m, n), and voiceless fricative (s).<sup>6</sup> The five tones in non-checked syllables are /mid/ (T.1), /low/ (T.2), /falling/ (T.3), /high/ (T.4), and /rising/ (T.5). The tones in checked syllables are /low/ (T.2 short and long), /falling/ (T.3 long), and /high/ (T.4 short).

The wordlist in citation form is shown below:

Set 1	
(lǎŋ)k <sup>h</sup> a:	“roof”
k <sup>h</sup> ā:	“galangal”
k <sup>h</sup> â:	“value”
k <sup>h</sup> á:	“trade”
k <sup>h</sup> ǎ:	“leg”
k <sup>h</sup> àt	“to rub”
k <sup>h</sup> à:t	“to tear”
k <sup>h</sup> át	“to select”
k <sup>h</sup> â:t	“to belt”

Set 2	
na:	“wet rice field”
(nó:j)nà:	“custard apple”
nâ:	“face”
ná:	“aunt, uncle (younger)”
nǎ:	“thick”
màt	“punch”
mà:k	“betel nut”
mát	“to tie”
mâ:k	“very/many”

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<sup>6</sup> The fundamental frequencies of each vowel were measured and this study focuses on tonal patterns and needs to have a variety of vocabulary.

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## Set 3

saj	“fish trap”
sāj	“to put”
sāj	“intestines”
sāj	“to preen”
sāj	“clear”
sàp	“to chop”
sà:t	“to splash”
sák	“to wash”
sâ:k	“remains”

The words in citation form were made into sentences for connected speech, for example:

k<sup>h</sup>a: lǎŋ k<sup>h</sup>a: bâan c<sup>h</sup>ǎn sǐ: ná:m ɲən  
“My house’s roof is blue.”

mát k<sup>h</sup>ǎw c<sup>h</sup>áj c<sup>h</sup>ǎk mát krapǎw wáj  
“He uses a robe to tie a bag.”

sāj wan ní: thó:ŋ fá: cēm sāj mǎi  
mǐ: mē:k  
“Today, the sky is clear (and)  
there are no clouds.”

The informants were asked to pronounce each test-word and test-sentence three times randomly. The total number of test tokens was 3,888 (4 languages x 6 speakers x 27 test-words x 2 contexts x 3 times). The data was recorded directly onto a computer. The fundamental frequencies (F0) were measured using Praat Version 5.1.43. The fundamental frequencies of each vowel were measured at every 10% of normalized duration. The measured fundamental frequencies in Hertz were converted into semitone values. The semitone formula proposed by Jitwiriyant (2012) was  $12 \times 3.32 \times \log(\text{Hz to be translated} / (0.9 \times \text{Hz reference level}))$ . This is to help minimize the variation among the pronunciation between male and female speakers.

After that the acoustic characteristics of Thai tones produced by the Vietnamese, Burmese, Khmer, and Malay speakers were compared to Thai tones in citation form and connected speech produced by native Thai speakers from L-Thongkum and Graduate Students (2011) as shown in Figure 1.

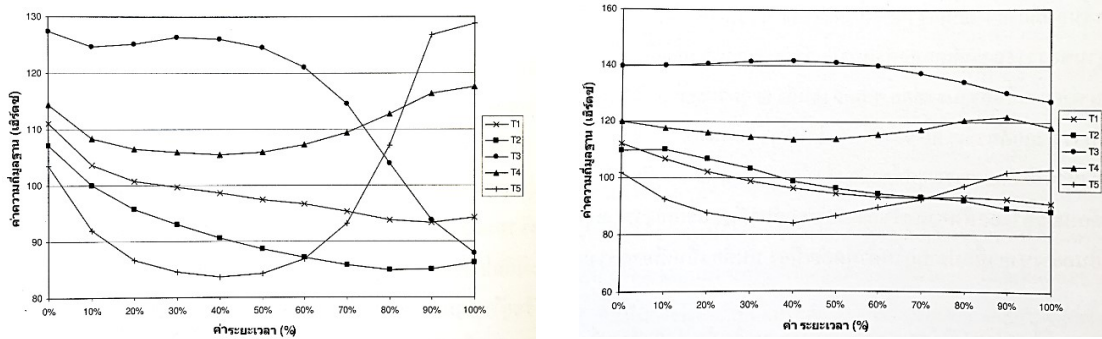


Figure 1 Fundamental frequencies of Thai tones in citation form (left) and in connected speech: stressed syllable (right) (L-Thongkum and Graduate Students, 2011: 140-141)

## **Results**

### **Tones in citation form: non-checked syllables**

The acoustic characteristics of tones in non-checked syllables occurring in citation form, as produced by Vietnamese, Burmese, Khmer, and Malay speakers with high experience in Thai, show that there are five tones relatively.

The acoustic characteristics of the five tones in non-checked syllables spoken by the speakers with high experience in Thai of each language are shown in Figure 2.

Figure 2 shows that, in non-checked syllables, the mid tone (T.1) in almost all of the speakers starts at a mid-pitch and falls slightly, except for Vietnamese Speaker 3 and Khmer Speaker 2, where the mid tone (T.1) starts at a mid-pitch and stays level. The low tone (T.2) starts at a lower pitch and also falls slightly toward the end of the duration. It is noticeable that the pitch height of the mid tone (T.1) and low tone (T.2) spoken by some speakers are very close to each other as shown in Burmese Speaker 1, Khmer Speakers 1 and 3, and Malay Speaker 3, whose mid tone (T.1) and low tone (T.2) are merged.<sup>7</sup>

The falling tone (T.3) in almost all of the speakers begins at a high pitch and falls to a mid-pitch, except for Vietnamese Speaker 1 and Burmese Speaker 3, where the falling tone (T.3) begins at a high pitch and falls slightly and has a pitch contour that is similar to the mid tone (T.1). The high tone (T.4) begins at a mid-pitch and rises to a high pitch, except for Burmese Speakers 2 and 3, where at the 80% point of the duration, the high tone (T.4) falls slightly after rising to a high pitch. Similarly, in Malay Speaker 3, the high tone (T.4) begins at a mid-pitch and rises to a high pitch, and then stays level at the 70% point of the duration. Lastly, the rising tone (T.5) starts at a mid/low or mid-pitch and sharply rises to a high pitch, except for some speakers of Malay, where the rising tone (T.5) rises to a mid/high pitch.

In contrast to the speakers with high experience in Thai, the acoustic characteristics of Thai tones in non-checked syllables in citation form as spoken by the speakers with low experience in Thai seem to vary among the four languages, as shown in Figure 3.

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<sup>7</sup> Malay Speaker 3 produces the mid tone (T.1) at the same pitch height as the low tone (T.2).

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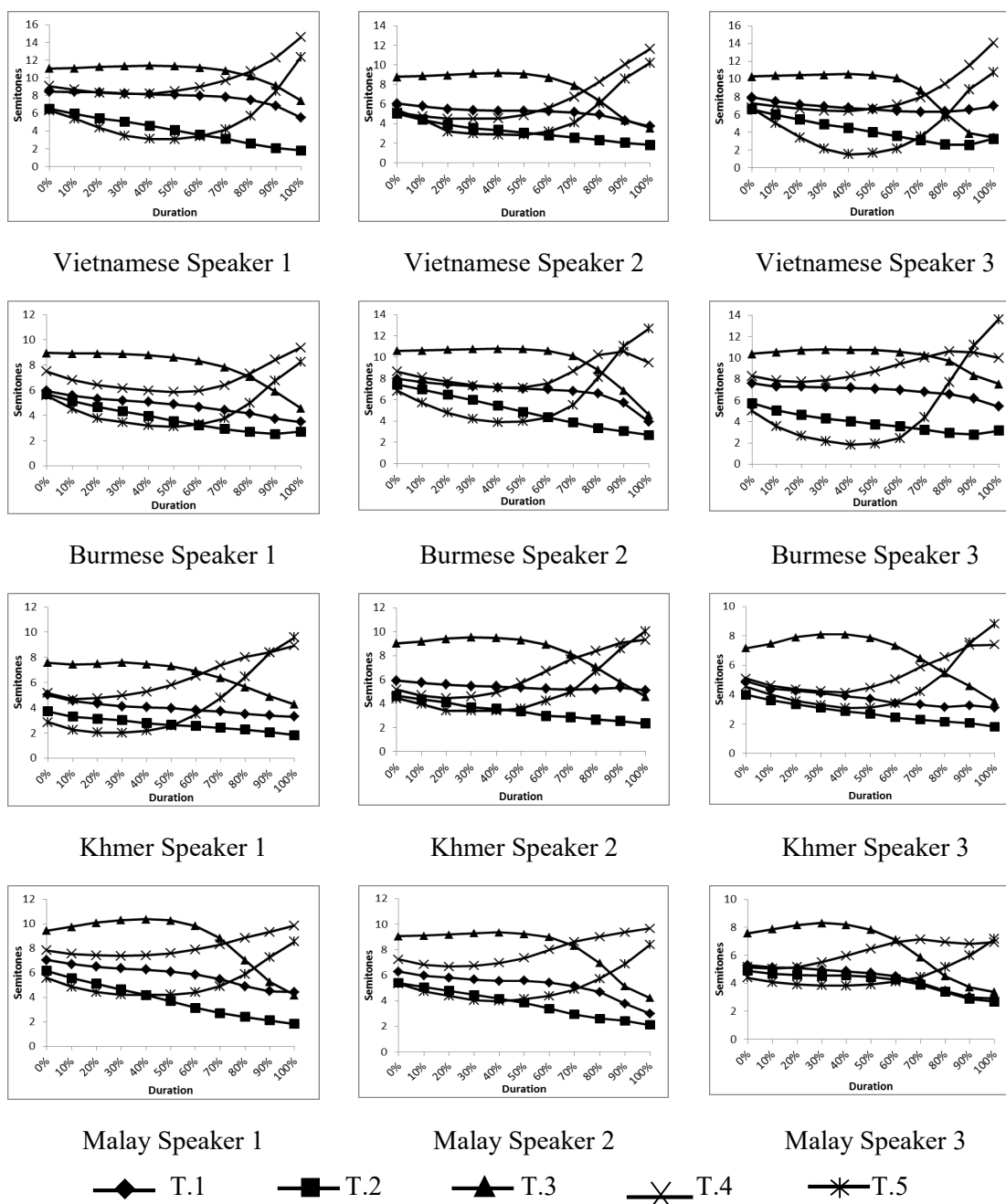


Figure 2 Semitones of Thai tones in non-checked syllables in citation form as spoken by the speakers with high experience in Thai

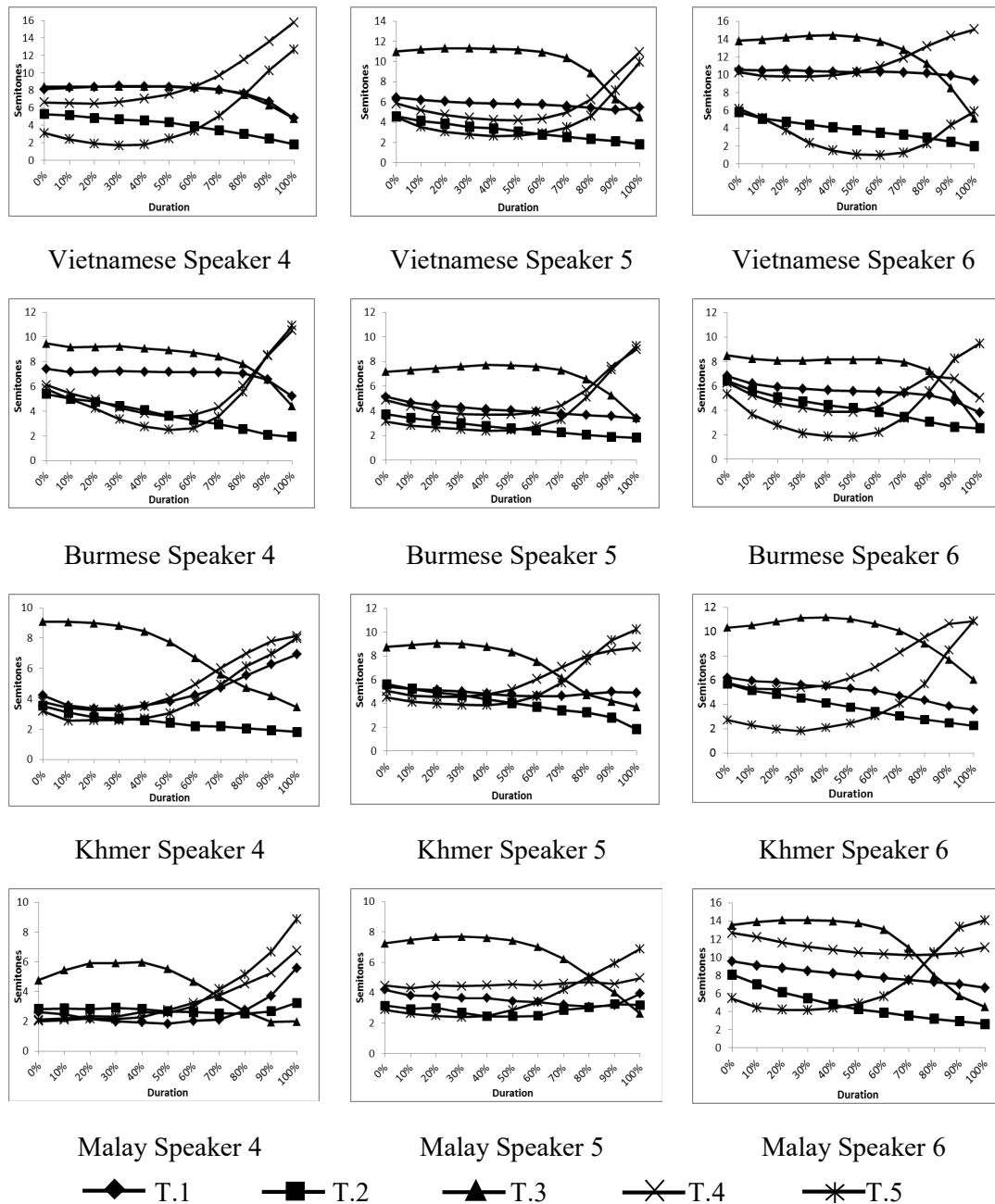


Figure 3 Semitones of Thai tones in non-checked syllables in citation form as spoken by the speakers with low experience in Thai



Figure 3 shows that the Vietnamese, Burmese, Khmer, and Malay speakers with low experience in Thai produce the five tones in non-checked syllables differently. The static tones comprised of the mid tone (T.1) and low tone (T.2) are very close to each other in some speakers, as shown in Khmer Speakers 5 and 6, and Malay Speaker 5. Moreover, the mid tone (T.1) also has a pitch contour that is similar to the falling tone (T.3) in Vietnamese Speaker 4, whereas in Khmer Speaker 4 and Malay Speaker 4, the mid tone (T.1) has a pitch contour that is similar to the high tone (T.4). Meanwhile, the dynamic tones such as the high tone<sup>8</sup> (T.4) and the rising tone (T.5) are almost merged by 50% of the low experience speakers, namely Vietnamese Speaker 2, Burmese Speakers 4 and 5, Khmer Speakers 4 and 5 and Malay Speaker 4. Moreover, the high tone (T.4) produced by Malay Speakers 5 and 6 has a level contour.

### **Tones in citation form: checked syllables**

In checked syllables, the Vietnamese, Burmese, Khmer, and Malay speakers with high experience in Thai can produce all tones occurring in checked syllables, which are the low tone in short vowel (T.2 short), the low tone in long vowel (T.2 long), the

falling tone (T.3 long), and the high tone (T.4 short), as shown in Figure 4.<sup>9</sup>

From Figure 4, it can be seen that the low tone in both the short vowel (T.2 short) and long vowel (T.2 long) starts at a mid-pitch and falls slightly toward the end of the duration, except for Burmese Speaker 3, whose low tone starts at a mid-pitch and stays level until the end. The falling tone (T.3 long) starts at a high or mid/high pitch before falling sharply to a low pitch. except for Burmese Speaker 3, whose falling tone (T.3 long) starts at a mid-pitch and stays level before falling slightly at the 70% point of the duration.

The high tone (T.4 short) begins at a high pitch and rises slightly to the end in almost all of the speakers, whereas the high tone (T.4 short) spoken by Burmese Speaker 3 starts at a mid-pitch and stays level before rising slightly at the 70% point of the duration, and the high tone (T.4 short) spoken by Malay Speaker 3 starts at a high pitch and rises slightly before falling at the 80% point of the duration.

For the speakers with low experience in Thai, almost all of the speakers can produce the tones in checked syllables, e.g. Vietnamese Speakers 5 and 6, Burmese Speakers 4, 5 and 6, Khmer Speakers 5 and 6 and Malay Speaker 6. However, there are

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<sup>8</sup> The high tone is analyzed as a dynamic tone having a high rising contour (Teeranon, 2007).

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<sup>9</sup> The scale of the vertical axis in a checked syllable is the same as in non-checked syllable.

tones merged by some speakers as well, as shown in Figure 5.

Figure 5 shows that the falling tone (T.3 long) and high tone (T.4 short) merge for Vietnamese Speaker 4. The low tone in the long vowel (T.2 long) almost merges with the high tone (T.4 short) for Khmer Speaker 4. For Malay Speaker 4, all four tones almost merge, especially between the low tone with long vowel (T.2 long) and the high tone (T.4 short), the low tone with short vowel (T.2 short) and the falling tone (T.3 long), whereas the high tone (T.4 short) of Malay Speaker 5 starts close to the low tone (T.2 long) and stays level toward the end of the duration.

#### **Tones in connected speech: non-checked syllables**

In connected speech, the acoustic characteristics of the five Thai tones in non-checked syllables are different from those in citation form, as shown in Figure 6.

In Figure 6, the acoustic characteristics of the five tones in non-checked syllables in connected speech show that the Vietnamese and Burmese speakers with high experience in Thai produce the five tones better than the Khmer and Malay speakers. For Khmer Speaker 2, the mid tone (T.1), falling tone (T.3), and high tone (T.4) merge. As well, the low tone (T.2) merges with the rising tone (T.5). Meanwhile, for Khmer Speaker 3, the mid tone (T.1), low tone (T.2), and high tone (T.4) merge. Moreover, the rising

tone (T.5) merges with those three tones near the 80% point of the duration. Likewise, the falling tone (T.3) and high tone (T.4) by all Malay speakers have similar pitch level and contour. As for the Vietnamese and Burmese speakers, the acoustic characteristics show that there are five tones. However, the pitch contour of the dynamic tones in connected speech are flatter than those in the citation form (see Figure 2).

For the speakers with low experience in Thai, the acoustic characteristics of the five tones in non-checked syllables in connected speech show that the Vietnamese and Burmese speakers with low experience in Thai also produce the five tones better than the Khmer and Malay speakers, even though some tones merge as shown in Figure 7.

Figure 7 shows that for Vietnamese Speaker 5, the mid tone (T.1) almost merges with the high tone (T.4), whereas for Vietnamese Speaker 6, the mid tone (T.1) merges with the falling tone (T.3), having a high falling pitch. The high tone (T.4) and rising tone (T.5) have similar pitch height for the Burmese speaker. The Khmer and Malay speakers have acoustic characteristics of almost all of the five tones that are flat. For Khmer Speaker 4, the falling tone (T.3), high tone (T.4) and rising tone (T.5) merge, whereas the low tone (T.2) merges with the rising tone (T.5), having a low pitch for Khmer Speaker 6. The mid tone (T.1) merges with the low tone (T.2) for Malay

Speakers 4 and 5, whereas the low tone (T.2) merges with the high tone (T.4), having a low pitch, for Malay Speaker 6.

### **Tones in connected speech: checked syllables**

In checked syllables, the acoustic characteristics show that some speakers with high experience in Thai can produce the tones in checked syllables in connected speech, e.g. Vietnamese Speaker 3, Khmer Speaker 1, and Malay Speaker 1. However, there are also tone merges by some speakers, as shown in Figure 8.

In Figure 8, the falling tone (T.3 long) and high tone (T.4 short) have similar pitch height and contour for Vietnamese Speakers 1 and 2, Burmese Speakers 1 and 2, Malay Speakers 2 and 3. Moreover, all four tones occurring in connected speech almost merge, as seen by Burmese Speaker 3 and Khmer Speakers 2 and 3.

For the tones in checked syllables in connected speech produced by the speakers with low experience in Thai, the acoustic characteristics show variation among the speakers more than those produced by the speakers with high experience in Thai, despite being in the same language. Moreover, the dynamic tones, e.g. the falling tone (T.3 long) and high tone (T.4 short), have a level contour for almost all of the speakers.

Figure 9 shows that the falling tone (T.3 long) and high tone (T.4 short) take on a level contour for almost of all the speakers. Moreover, the high tone (T.4 short) has the same pitch height as the low tone (T2 short and T2 long) for Vietnamese Speakers 4 and 5, and all Khmer speakers, and has lower pitch height than the low tone for Malay Speaker

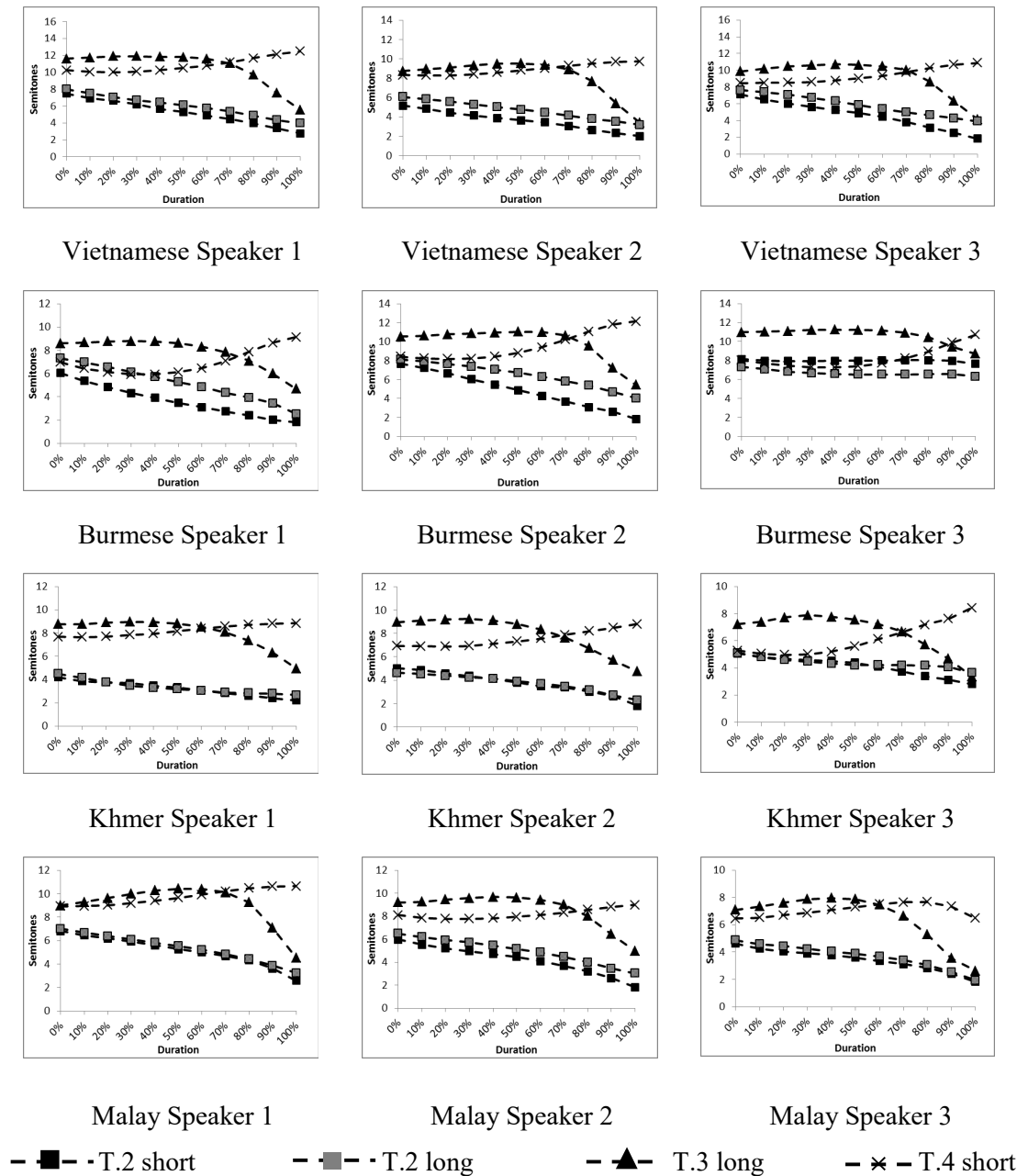


Figure 4 Semitones of Thai tones in checked syllables in citation form as spoken by the speakers with high experience in Thai

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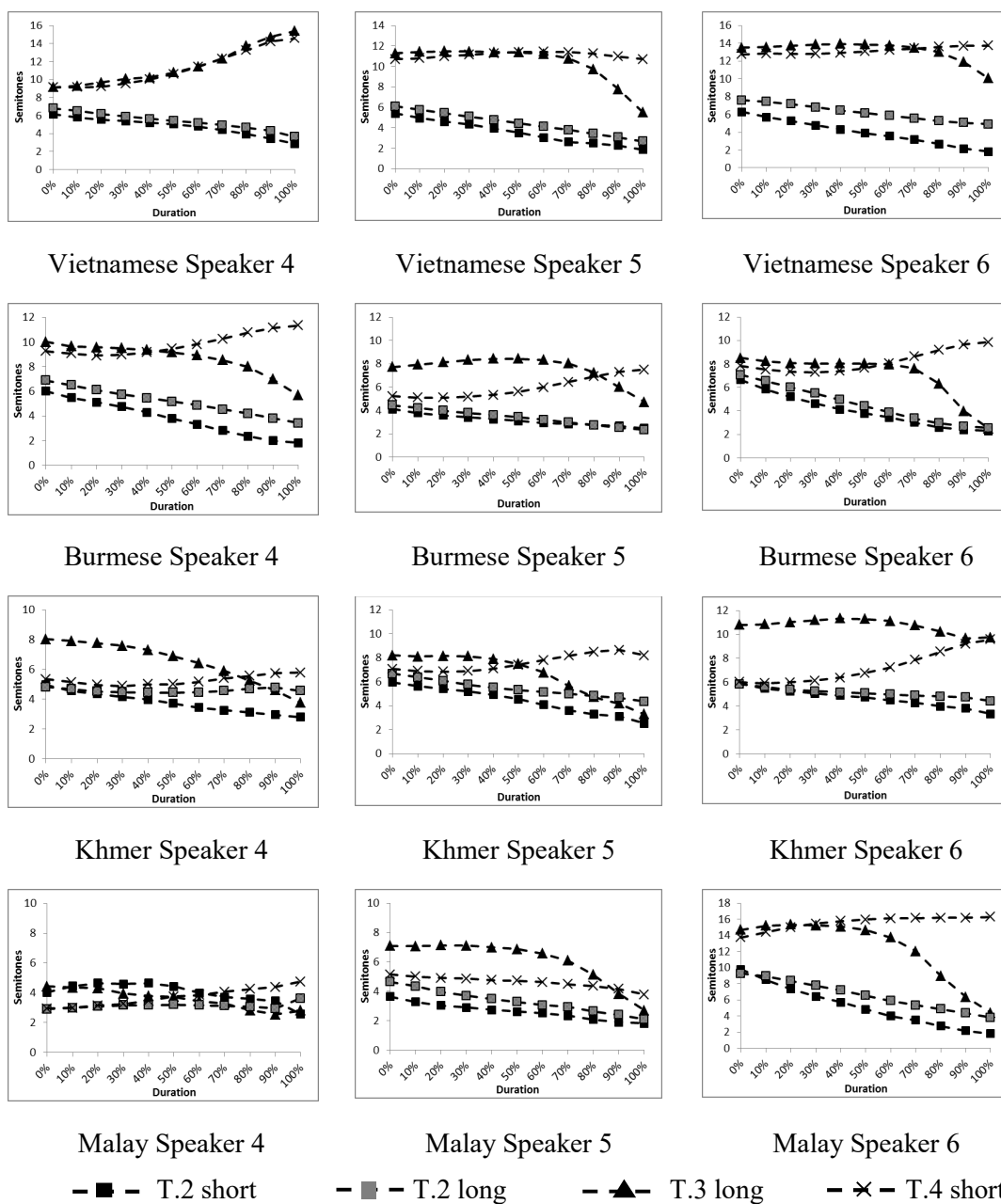


Figure 5 Semitones of Thai tones in checked syllables in citation form as spoken by the speakers with low experience in Thai

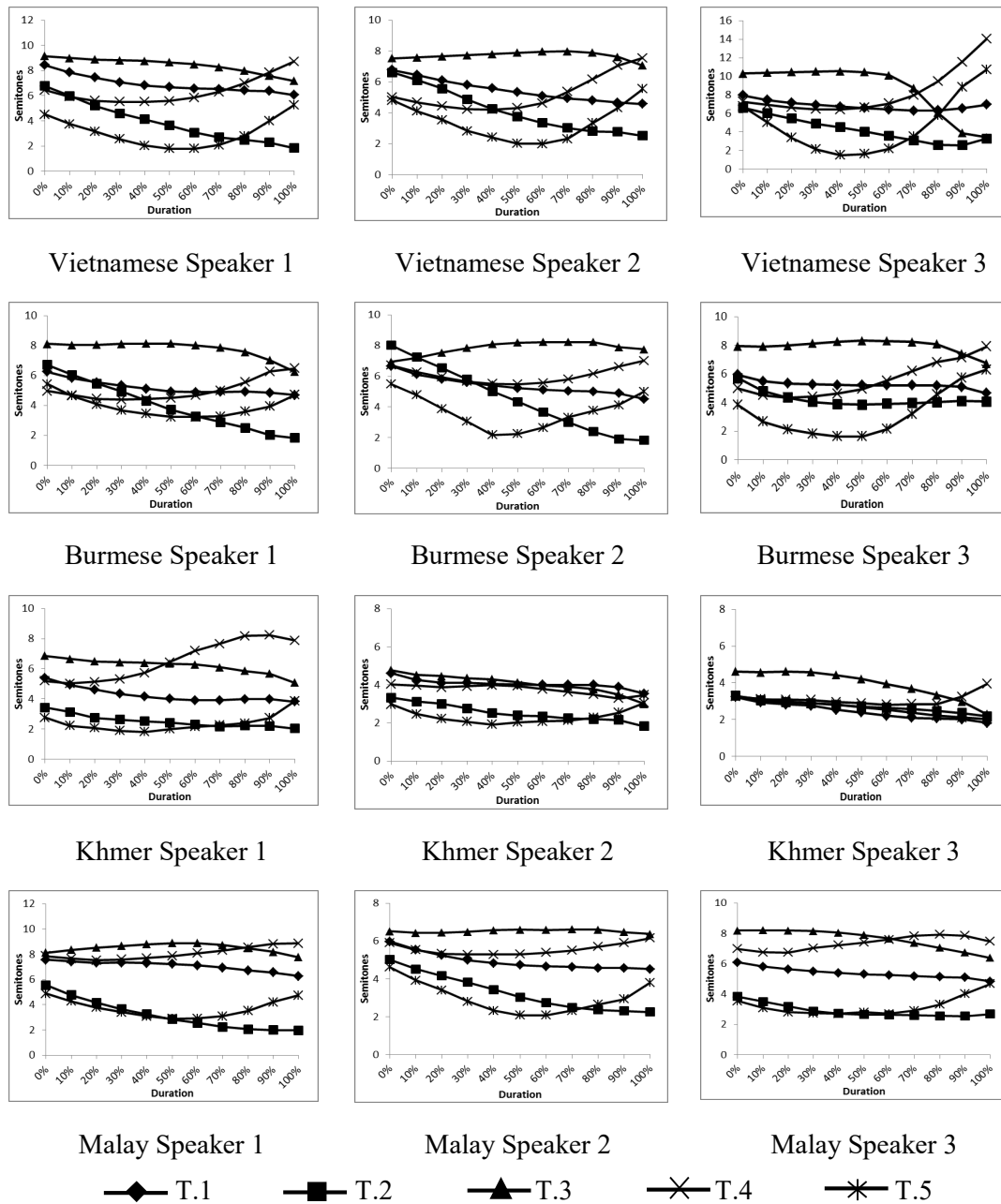


Figure 6 Semitones of Thai tones in non-checked syllables in connected speech as spoken by the speakers with high experience in Thai

# *Thai Tones Produced by Tonal and Non-tonal Language Speakers: An Acoustic Study*

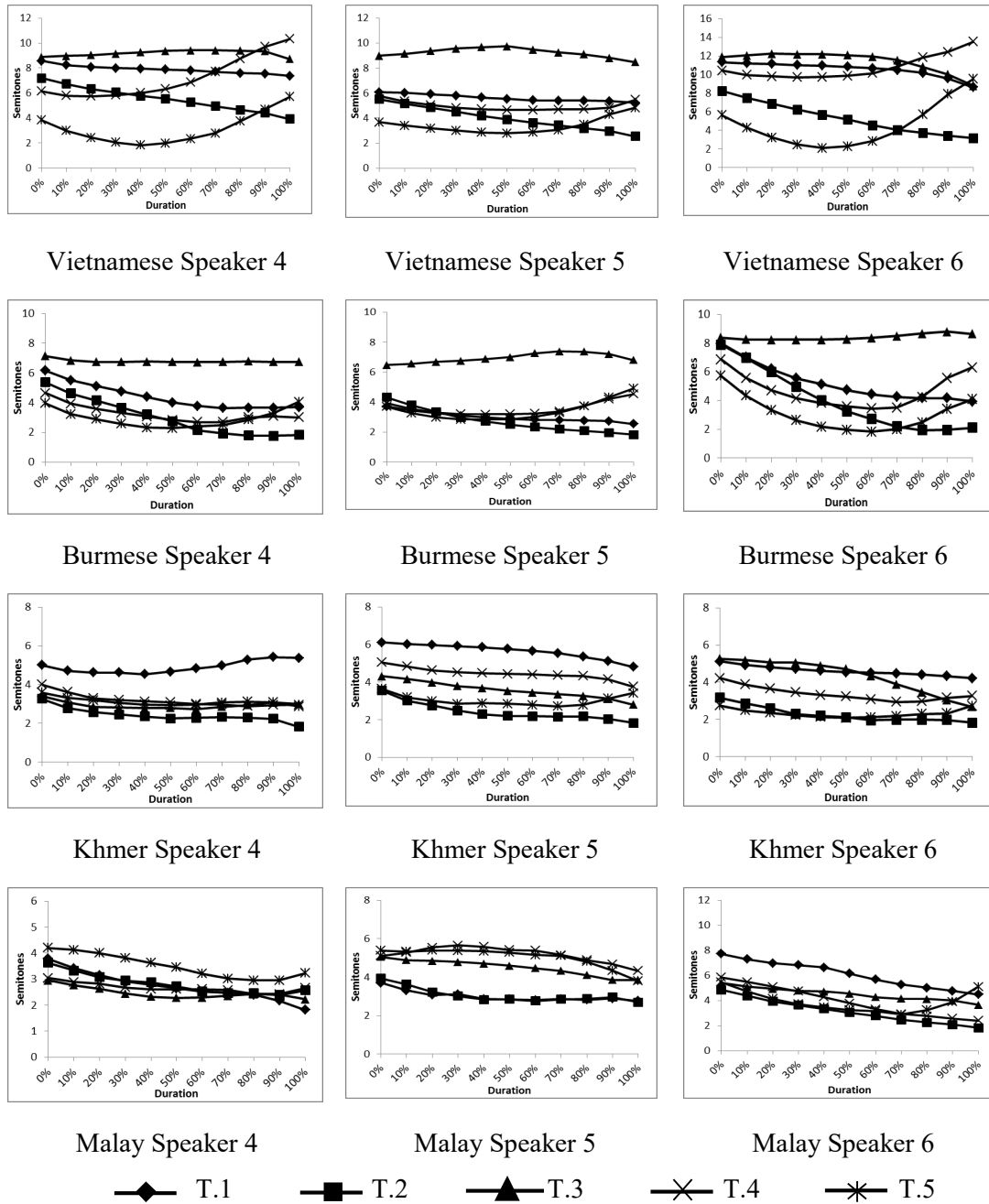


Figure 7 Semitones of Thai tones in non-checked syllables in connected speech as spoken by the speakers with low experience in Thai

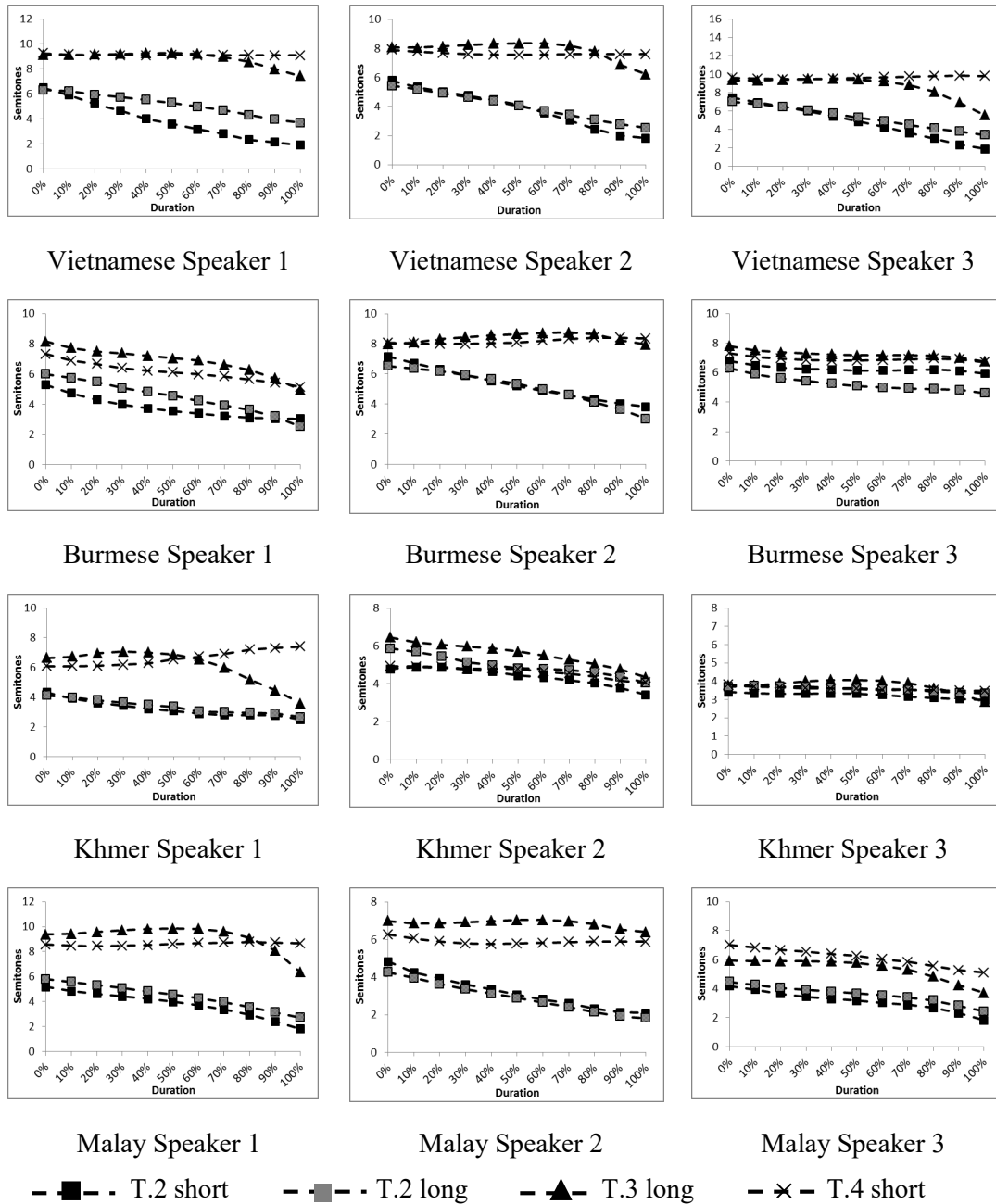


Figure 8 Semitones of Thai tones in checked syllables in connected speech as spoken by the speakers with high experience in Thai



# *Thai Tones Produced by Tonal and Non-tonal Language Speakers: An Acoustic Study*

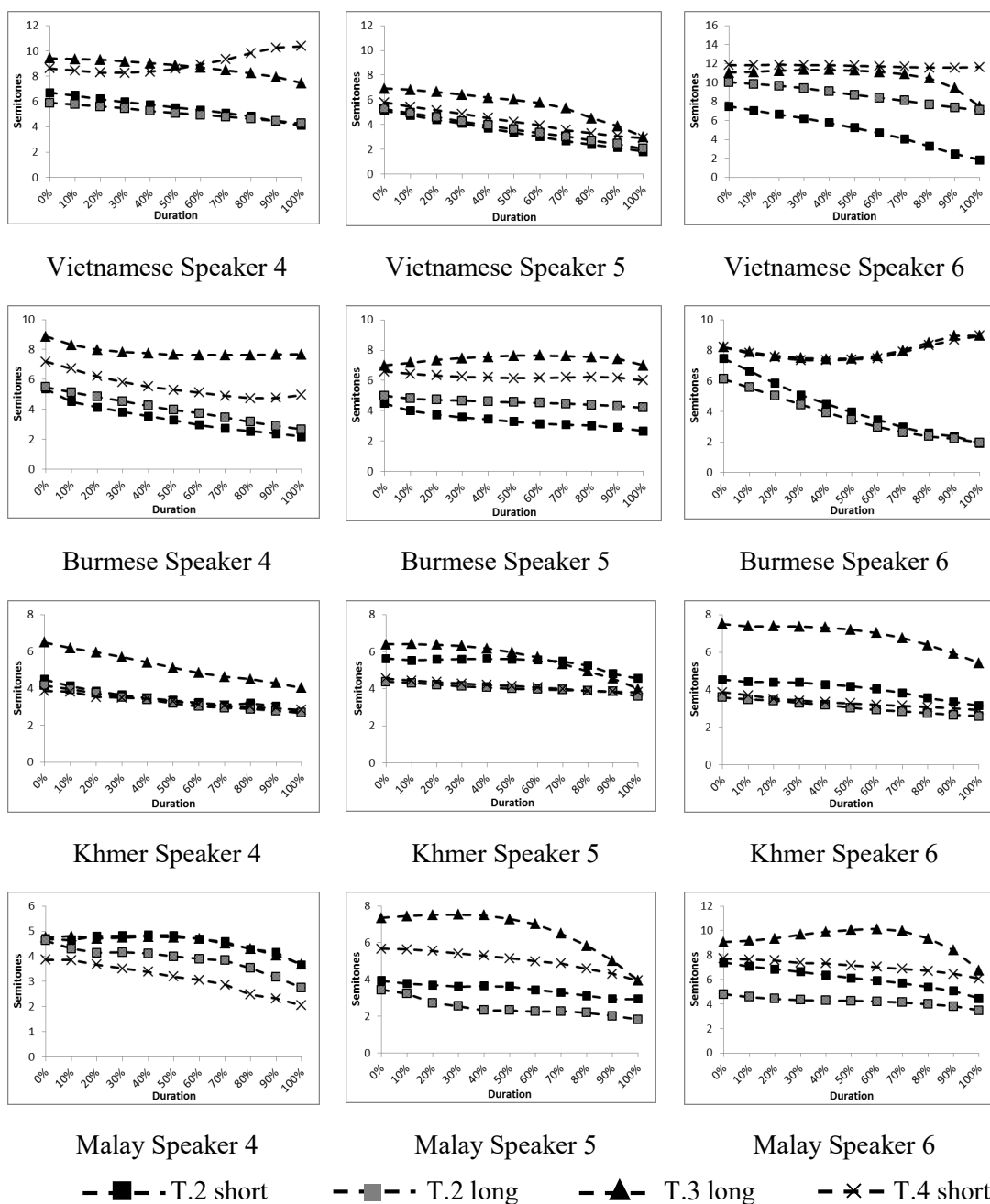


Figure 9 Semitones of Thai tones in checked syllables in connected speech as spoken by the speakers with low experience in Thai

## **Conclusion and Discussion**

Vietnamese and Burmese are tonal languages similar to the Thai language, whereas Khmer and Malay are non-tonal languages. However, the number of tones and acoustic characteristics for the tones in Vietnamese and Burmese are different from Thai. The acoustic characteristics of tones show that speakers whose native language is a tonal language do not gain an advantage when they study another tonal language. At the first stage of learning, both native speakers of a tonal language and native speakers of a non-tonal language have a problem when learning Thai tones. However, it does seem apparent that the native speakers of tonal languages can produce Thai tones better than native speakers of non-tonal languages after having more experience in Thai.

In comparison to L-Thongkum and Graduate Students (2011), it can be stated that Vietnamese speakers with high experience in Thai can produce Thai tones similar to those of Thai native language speakers in both checked syllables and non-checked syllables and also in both citation form and connected speech. As Nguyen Thi Van Chi (2006) found, Vietnamese speakers with high experience in Thai (study Thai more than 4 semesters) can produce Thai tones better than those with low experience in Thai (study Thai for about 2 semesters).

However, it is interesting that the high tone (T.4) clearly becomes high rising for all Vietnamese speakers, whereas for Burmese Speakers 2 and 3, the high tone (T.4) starts at a mid-pitch and rises to a high pitch before falling slightly at the 80% point of the duration. This is similar to the high tone found in Teeranon and Rungrojsuwan (2009). From Figure 10, it can be seen that the high tone (T.4) produced by Vietnamese speakers has a pitch contour similar to those high tones produced by the native Thai under-twenty group, whereas the acoustic characteristics of the high tone (T.4) produced by two Burmese speakers are similar to those high tones produced by the native Thai over-sixty group.

In line with the observation that a tonal language speaker does not gain an advantage when studying another tonal language, the non-tonal language speakers with low experience in Thai produce Thai tones with two or three tones merging. Otherwise, they have very similar acoustic characteristics. Hao (2012) studied Mandarin Chinese tones by tonal (Cantonese) and non-tonal (English) language speakers. He found that both Cantonese speakers and English speakers had a problem in learning Mandarin Chinese tones, especially Tone 2 and Tone 3. Moreover, the Cantonese speakers could not differentiate between Mandarin Chinese Tone 1 and Tone 4.

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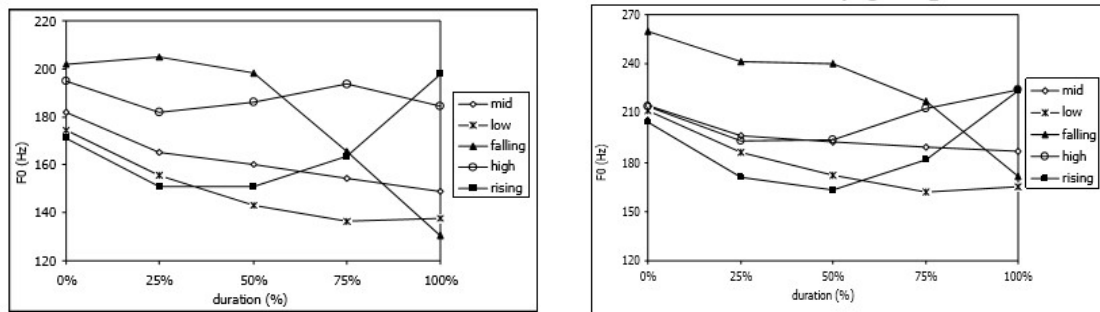


Figure 10 Fundamental frequencies of Standard Thai tones in the over-sixty group (left) and in the under-twenty group (right) (Teeranon and Rungrojsuwan, 2009: 40)

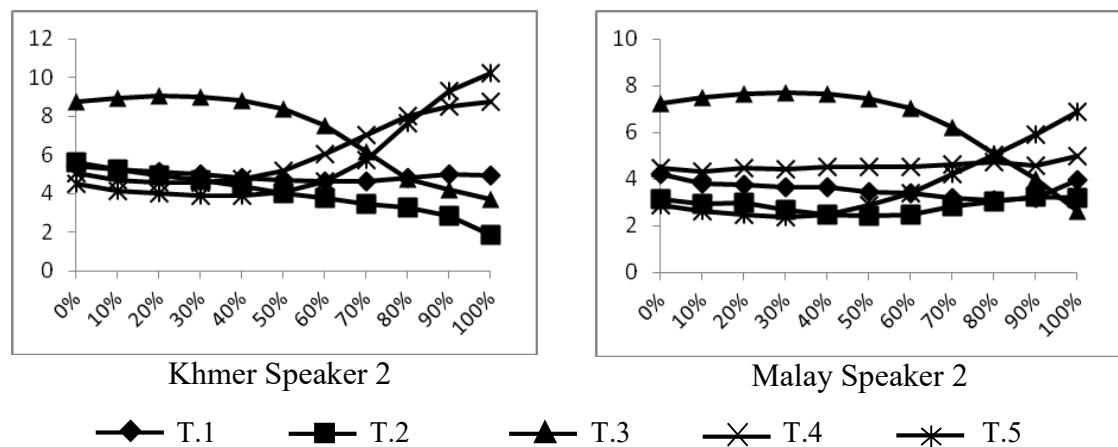


Figure 11 Semitones of Thai tones in non-checked syllable in citation form as spoken by the Khmer and Malay speakers with low experience in Thai

Figure 11 shows that the acoustic characteristics of the mid tone (T.1) and low tone (T.2) produced by the Khmer speaker with low experience in Thai are very similar in both pitch height and pitch contour. This also occurs with the high tone (T.4) and rising tone (T.5). For the Malay speaker, the mid tone (T.1) and low tone (T.2) are very similar, as well as the high tone (T.4), which is slightly higher in pitch than the mid tone (T.1).

In the meantime, the tonal language speakers of Vietnamese and Burmese with low experience in Thai also have a problem Figure 13 producing some tones, as shown in Figure 12.

In Figure 12, the mid tone (T.1) merges with the falling tone (T.3) for Vietnamese Speaker 1, whereas the high tone (T.4) merges with the rising tone (T.5) for Burmese Speaker 1. This merge also occurs in connected speech, e.g. the mid tone (T.1) merges with the falling tone (T.3) for Vietnamese Speaker 3, and the high tone (T.4) merges with the rising tone (T.5) for Burmese Speaker 2, as shown in Figure 13.

It is found that non-tonal language speakers of Khmer and Malay, with low experience in Thai have more problems producing Thai tones than those with high experience in Thai. Examples of tones in the citation form context (see Figures 2 and 3) are shown in Table 1.

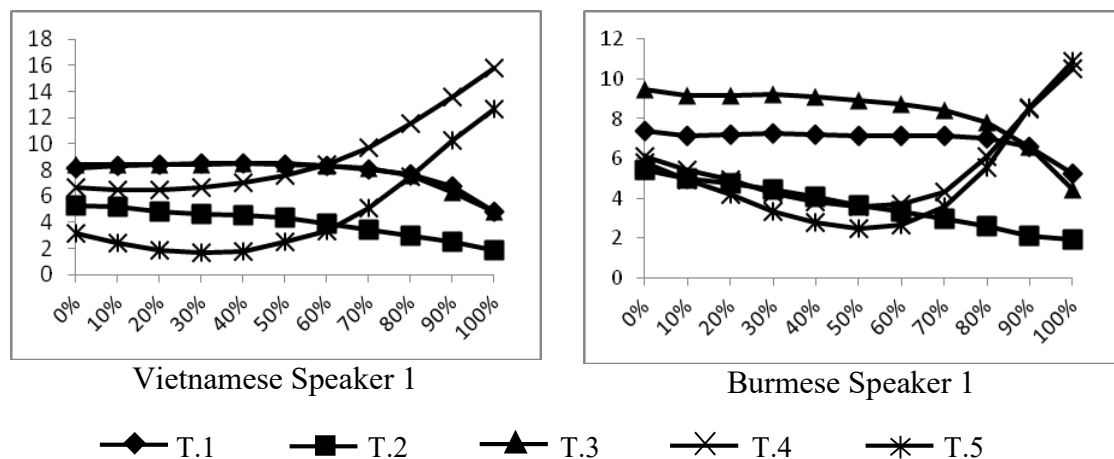


Figure 12 Semitones of Thai tones in non-checked syllable in citation form as spoken by the Vietnamese and Burmese speakers with low experience in Thai

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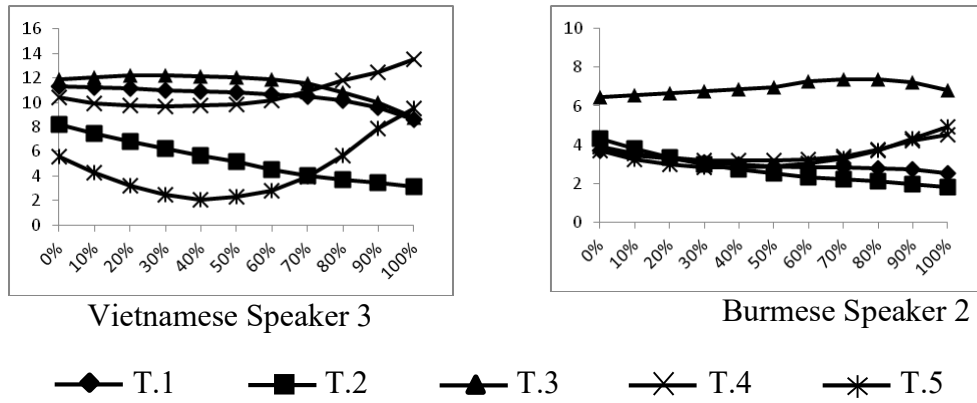


Figure 13 Semitones of Thai tones in non-checked syllables in connected speech as spoken by the Vietnamese and Burmese speakers with low experience in Thai

Table 1 Problems in tone production as produced by Khmer and Malay speakers with high experience and low experience in Thai

	High experience in Thai		Low experience in Thai	
<b>Khmer</b>	Speaker 1	-	Speaker 4	T.1, T.4, and T.5 nearly merge.
	Speaker 2	-	Speaker 5	T.1 and T.2 nearly merge. T.4 and T.5 nearly merge.
	Speaker 3	T.1 and T.2 have similar pitch height. T.4 and T.5 have similar pitch height.	Speaker 6	T.1 and T.2 have similar pitch height.
<b>Malay</b>	Speaker 1	-	Speaker 4	T.1 becomes low-rising. T.4 and T.5 merge.
	Speaker 2	-	Speaker 5	T.1 and T.4 have similar pitch height.
	Speaker 3	T.1 and T.2 merge.	Speaker 6	T.4 is high level (not high rising).

All Khmer and Malay speakers with low experience in Thai have problems producing the Thai tones, especially the mid tone (T.1), low tone (T.2), high tone (T.4) and rising tone (T.5). This problem was also found by Chuwarahawong (2000), who studied Thai tones produced by Chao Zhou and Sikh speakers. Those results showed that the mid tone (T.1) merged with the low tone (T.2) for the Chao Zhou speakers, whereas Sikh speakers had a problem when producing the high tone (T.4). Horpetch (2001) also found that the acoustic characteristics of Thai tones produced by Malay speakers were different from those produced by Thai and Chinese speakers, the reason being that Malay is a non-tonal language. Moreover, Malay speakers tend to speak in their own native language, whereas Chinese and Thai are tonal languages and have contact with each other in many situations. As well, Sinthawashewa (2009) found that Japanese speakers with high experience in Thai could produce Thai tones better than those with low experience in Thai. The problems that were found in speakers with low experience in Thai included confusion between the mid tone (T.1) and low tone (T.2), the mid tone (T.1) and high tone (T.4), and the high tone (T.4) and rising tone (T.5).

It is noticeable that there is no problem in producing the falling tone (T.3), even among the low experience speakers. This might be because the pitch pattern or pitch contour in the falling tone (T.3) is a contour tone and it is the only falling tone among the five tones,

and therefore it is easily perceived or distinguished by the learners. Meanwhile, the mid tone (T.1) and low tone (T.2) as well as the high tone (T.4) and rising tone (T.5) have the same pitch contour. This may cause the learners who speak non-tonal native languages to perceive the difference between pitch height with greater difficulty.

As for the tones in checked syllables, the tonal language speakers and non-tonal language speakers with high experience in Thai can produce Thai tones in checked syllables in citation form, which are the low tone in short vowel (T.2 short), the low tone in long vowel (T.2 long), the falling tone (T.3 long), and the high tone (T.4 short). However, a merge is found in some tones for connected speech, e.g. the low tone (T.2 short and long), falling tone (T.3 long), and high tone (T.4 short) merge for Khmer speakers, and the falling tone (T.3 long) and high tone (T.4 short) have similar pitch height and pitch contour for Vietnamese, Burmese, and Malay speakers. In contrast, more problems are found in connected speech than in citation form for speakers with low experience in Thai (see Figure 5 and 9), as shown in Table 2.

It can be said that the speakers with low experience in Thai have problems producing Thai tones, both in citation form and connected speech. Especially in connected speech, there are various tone merges among speakers of all four languages. Even though it should be noted that in the connected

speech there might be acoustical factors that cause variation among the speakers and tones, in general the results show that the contour tones become flatter and that there are some tone mergers, e.g. the mid tone (T.1) and low tone (T.2), which have also been found in Tingsabadh and Deeprasert (1997) and L-Thongkum and Graduate Students (2011).

In conclusion, the acoustic characteristics of Thai tones produced by Vietnamese,

Burmese, Khmer, and Malay speakers suggest that experience measured by years of study, frequency of usage, and the objectives of study, all influence the ability of second language speakers to correctly form Thai tones. Moreover, speaking a native tonal language does not benefit a speaker learning another tonal language because the speaker still has to distinguish the native tone system from the second language tone system, as found by Wang (2006) and Hao (2012).

**Table 2 Problems in tone production in citation form and connected speech as produced by the low experience speakers**

		Low experience in Thai	
		Citation form	Connected speech
<b>Vietnamese</b>	Speaker 4	T.3 long and T.4 short merge.	T.2 short, T.2 long and T.4 short merge.
	Speaker 5	-	-
	Speaker 6	-	T.2 short and T.2 long have different pitch height.
<b>Burmese</b>	Speaker 4	-	T.3 and T.4 have level contour.
	Speaker 5	-	T.3 and T.4 have level contour.
	Speaker 6	-	T.3 and T.4 merge.
<b>Khmer</b>	Speaker 4	T.2 short, T.2 long and T.4 have similar pitch height.	T.2 short, T.2 long and T.4 short merge.
	Speaker 5	-	T.2 short and T.4 short merge T.2 long and T.3 long merge
	Speaker 6	T.2 short, T.2 long and T.4 have similar pitch height.	T.2 short, T.2 long and T.4 short merge.
<b>Malay</b>	Speaker 4	T.2, T.3 and T.4 merge.	T.2, T.3 and T.4 have similar pitch contour.
	Speaker 5	T.4 becomes level contour.	-
	Speaker 6	-	T.2 short, T.2 long and T.4 have similar pitch height.



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