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An Instrumental Analysis of English Monophthongs Produced by Thai EFL Learners

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ABSTRACT

This study examined the production of English monophthong vowels of native speakers of Thai. The results of the acoustic analysis of Thai English (ThaiE) monophthongs suggest the influence of Thai on ThaiE in the maintenance of length contrast between vowel pairs. The results also indicate transference of Thai vowel quality to comparable English vowels /iː/, /e/, /uː/, / ɔː/ and /æ/. One of the effects of this influence is the maintenance of the vowel contrast between /e/ and /æ/ in ThaiE. These findings lend some support to Flege's (1995) Speech Learning Model which posits that second language sounds which have phonetic similarity to those in the first language will tend to be merged. The findings contribute empirical evidence to and complement existing research on Thai English pronunciation.

Keywords: EFL, Thai English, vowel contrast, vowel quality, vowel duration

INTRODUCTION

Research into the characteristics of English pronunciation of native speakers of Thai can provide insights into the success of English language teaching in Thailand, where it is taught as a foreign language from Grade One in primary school to Grade 12 in secondary school (Tsukada, 2008). Within this context, this study investigated the acoustic properties of English monophthong vowels produced by native speakers of Thai focusing in particular on the extent to which vowel distinctions are maintained, and also the extent of first language (L1) influence. In addition, since previous instrumental studies on Thai English (ThaiE) have been based on speakers who are currently living outside Thailand with varying exposures to L1 environments (e.g. Tsukada, 2008, 2009; Sarmah *et al*., 2009), this study sought to investigate the pronunciation of a group of native speakers of Thai who have been learning English as a foreign language (EFL) in Thailand, and those who were

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residing in Thailand when the data were collected.

REVIEW OF RELATED STUDIES

ThaiE Vowels

The production of English vowels by native speakers of Thai has been previously described. For example Smyth (1987, p. 254), refers to the tendency of Thai speakers to pronounce English /æ/ as a long vowel, while diphthongs like /eɪ/, /əʊ/ and /eə/ are likely to be produced as long monophthongs, that is as /eː/, /oː/ and /æː/. Recent acoustic analyses on the production of English vowels by Thai speakers have confirmed this tendency to produce some diphthongs as monophthongs. Tsukada (2008), for instance, examined four English monophthongs and two diphthongs produced by 15 native speakers of Thai who had been living in Australia for an average of 3.2 years, and compared them to those produced by native Australian English speakers. Tsukada (ibid., p. 201) found that her Thai subjects produced the /ɪ/, /æ/, /ʊ/ and /ʌ/ vowels similar to the Australian speakers in terms of the vowel quality although there are no equivalent Thai vowels. Despite the fact that all her subjects had been living in Australia at the time of the recordings, Tsukada (ibid.) felt that they still retained the typical features of ThaiE pronunciation, citing the low success rate of acquiring native-like pronunciation among adult learners. Given the fact that the majority of the subjects were young adults in their 20s and were mostly university students, however, it is rather surprising that their English pronunciation is assumed to be unaffected by the exposure to Australian English.

Unlike Standard Southern British English which has 12 monophthong vowels (Roach, 2009), Standard Thai has 18 monophthongs (see Table 1). Thai vowels can occur phonemically as short or long vowels (Charunrochana, 2007; Nathong, 2003; Sarmah *et al*., 2009). This differs from English, where there is also quality contrast apart from the length distinction between vowel pairs, such as /ɪ/-/iː/, /ʌ/-/ɑː/, /ʊ/-/uː/ and /ɒ/-/ɔː/ (Wells, 1962). Most diphthongs in Thai also contrast for length, except for /ɪa/, /ɯa/ and /ua/ (Sarmah *et al*., 2009; Tsukada, 2008).

TABLE 1
Thai monophthong vowels

	Front unrounded		Central unrounded		Back rounded	
Close	i	iː	ɯ	ɯː	u	uː
Mid	e	eː	ɤ	ɤː	o	oː
Open	æ	æː	a	aː	ɔ	ɔː

Source: Roengpitya (2001, as cited in Sarmah *et al*., 2009, p. 201)

As noted by Sarmah *et al*. (2009), the symbol /ɛ/ is used in some of the literature for the open front vowel (e.g. Tingsabadh & Abramson, 1999; Wayland, 1997).

The large difference in duration between the short and long vowel pairs in Thai may account for Thai speakers producing shorter English vowels as compared to Australian English speakers (Tsukada, 2008). On the other hand, the two diphthongs Tsukada (2008) examined, /eɪ/ and /oʊ/, were generally produced longer by the

Thai speakers. Tsukada (ibid., p. 206) posits that "Thai speakers equate English monophthongs and diphthongs with short and long Thai vowels, respectively, and have exaggerated a durational difference between the two classes of English vowels". In other words, the diphthongs were being treated as long vowels.

Further, Tsukada (2009), in an experiment with /i/ and /ɪ/, also found that the Thai respondents, who had been living in Australia for periods ranging from 3 months to 30 years, tended to produce a shorter /ɪ/ compared to Australian speakers, but produced a longer /i/ resulting in a bigger mean difference between the duration of these two vowels. This is similar to Sarmah *et al*. (2009) who not only found a lack of quality contrast between English /iː/ and /ɪ/ produced by their Thai subjects, but also /ɪ/ and /ʊ/ being produced much shorter than /iː/ and /uː/, which was similar to the corresponding Thai vowels. Their results lend some support to Tsukada's (2009) suggestion that Thai speakers transfer phonemic length contrast in Thai to their production of English vowel pairs.

In relation to vowel quality, Sarmah *et al*. (2009) found differences between the vowels produced by their Thai subjects and American and British English in terms of vowel contrasts and the placement of the vowels in the vowel space. Not surprisingly, the findings revealed that the Thai subjects with less exposure to an L1 environment (less than for months in an English speaking country) merged the /iː/ and /ɪ/ vowels. On the other hand, this vowel pair was contrasted amongst those with more exposure (lived in America for more than 18 months). In comparison, the low and back vowels tended to show more contrast for both groups of subjects.

The subjects in Sarmah *et al*. (2009) with less L1 exposure produced the front vowels similar to comparable Thai vowels, which may be attributed to L1 influence. For both groups, however, the quality [as measured by the first (F1) and second (F2) formant values] of the back vowels differed from British and American English. In varieties, such as Brunei, Malaysian and Singapore English, the vowels also tend to occupy a more compact vowel space with many of the vowel pairs being merged, resulting in a smaller vowel set (Pillai *et al*., 2010b). This is unlike Tsukada (2008) who found that her Thai subjects produced /ɪ/, /æ/, /ʊ/ and /ʌ/ similar in quality to the Australian speakers in her study.

The findings from Tsukada (2008; 2009) and Sarmah *et al*. (2009) show that the presence of the phonemic vowel contrast in Thai is likely to have resulted in the Thai respondents producing length contrast in their production of English vowels. However, they appeared to have exaggerated this contrast, thus making their production of vowels sound different from native speakers of English. Further, Tsukada's (2008) findings that the Thai respondents were able to produce English vowels that were absent in the Thai vowel inventory lend support to Flege's (1995) Speech Learning Model (SLM).

Speech Learning Model

In this model, it is theorised that the acquisition of second language (L2) sounds is dependent on the level of perceived similarity between phonemes in L1 and L2, with phonemes having a higher level of dissimilarity being easier to acquire than those which are similar. The rationale for this model is that when a different phoneme is encountered in L2, the differences are noticed or perceived and following this, learners are able to create a new category for the particular phoneme (Flege, 1995). On the contrary, L2 sounds; for example, the vowels with phonetic similarity to L1 vowels will be merged with existing L1 categories and therefore, it can be expected that these vowels will be produced less native-like (Flege *et al*., 1999).

There is a problem, however, with SLM in relation to the identification of perceived similarity between sounds. Perhaps because of this, studies have found contrary evidence on the relationship between perceived similarity and the level of difficulty of learning L2 sounds. For instance, Iverson and Evans (2007) in their study on the acquisition of English vowels by different L1 groups (French, Spanish, German and Norwegian) found that the Spanish and Norwegian speakers did not show evidence of having learnt English /əʊ/, which is more dissimilar to the equivalent vowel in their L1s, while the German speakers were able to learn /aɪ/, which has a higher assimilation rating. Iverson and Evans (2007, p. 2842) concluded that speakers from different L1s "learned new aspects of the English vowel system rather than simply assimilating vowels into existing first language categories". They also found that speakers with a larger L1 vowel system (e.g. Norwegian) are more accurate at recognizing English vowels than those with a smaller one (e.g. Spanish).

Pillai *et al*. (2010b, p. 170) also found that Malaysian speakers of different ethnic groups "acquired English vowels with new qualities, namely, qualities that do not match vowels in Malay, Chinese or Tamil; the main L1s for the group". For example, evidence of length contrast between vowel pairs was discovered, and this a contrast which is not present in Chinese.

THE PRESENT STUDY

Acoustic analysis of ThaiE vowels is an emerging area of research, but previous studies tended to be based on speakers who were living outside Thailand in native English environments. In contrast, this paper focuses on speakers who are presently residing in Thailand and have been studying English in Thai schools, with the aim of capturing the production of vowels by Thai speakers who have not been influenced by a native speaker environment as may have been the case in the previous studies. More specifically, the current study aimed to examine the acoustic properties of English monophthong vowels produced by Thai speakers to investigate if vowel contrast is maintained and to ascertain the extent of L1 influence.

MATERIALS AND METHODS

Subjects

The subjects comprised 15 Grade 12 students (pre-university level) from a high school in Narathiwat in southern Thailand. The subjects were between 18 and 19 years old at the time of the study, and comprised only females to keep the gender variable constant. The subjects were chosen based on several criteria: they were native speakers of Thai with no exposure to a native English environment; they had learnt English in Thailand from native speakers of Thai; they were at the pre-university level to ensure that they had learnt English for at least 10-11 years; they had no speech impediments. The selection of the subjects was based on specific criteria which were aimed at answering particular research questions and the small number of subjects (e.g. 10-20) is common in phonetic research (see Harrington, 2010). None of the subjects had been abroad and all of them had been taught English by teachers who were native speakers of Thai throughout the 11 years that they had been studying English as a subject. Since the subjects' exposure to English is limited to the classroom context, it can be safely assumed that the results in this study are not be affected by direct exposure to native varieties of English which may have been the case in Sarmah *et al.* (2009) and Tsukada (2008; 2009).

In order to enable a comparison of the Thai vowels with the English ones produced by the subjects, recordings of Thai speech by five of the Thai female subjects were also carried out. Following Sarmah *et al*. (2009), it was felt that the speakers' regional Thai dialect would not drastically affect their production of vowels in Standard Thai, especially since they all used Standard Thai in school.

Data

Five of the Thai subjects were recorded reading a word list containing nine short and nine long Thai vowels which were placed in a carrier sentence /karuna ʔɔːksɪaŋ ... ʔiːkkraŋ/ (*Please say ... again*). The English data were collected by recording the subjects in two speaking contexts, a Word List Context (WLC) and an Informal Speaking Context (ISC).

For WLC, the target vowels for monophthongs were embedded in bVd words. The target words were put in a carrier sentence, *Say bVd again*, to obtain a more naturalistic production. The subjects were asked to read the sentences with the following words: *bead*, *bid*, *bed*, *bad*, *body*, *board*, *booed*, *Buddha*, *bird*, *bud*, and *bard*, which were taken from Ladefoged's list of words with English vowels (2005, p. 27). The choice of these bVd words to elicit monophthong vowels ensured a constant phonetic environment and made it easier to determine the vowel portion on the spectrogram. The words are all 'real' words that were familiar to the subjects. We do note that the word *Buddha* is the only two-syllable word in the list, but decided to use it as the target vowel appears on the stressed syllable. A survey of the recent literature on an acoustic analysis of English vowels has shown that researchers use a range of CVC

contexts. Sarmah *et al*. (2009), for example, used a combination of hVt, hVd and other CVC words, whilst Tsukada (2008) had words ending with voiceless stops. In the absence of a standard word list and to avoid the use of non-words, we decided to use a bVd context. The use of the voiced stops also minimised co-articulatory effects on the vowels.

The subjects were presented with the sentences in random order and they were asked to read the list twice. In each case, the first and last sentence contained words that were not used in the analysis and acted as fillers to counter for "beginning- and end-of lists effects" in reading (Hawkins & Midgley, 2005, p. 108). This yielded 22 tokens of vowels per subject giving a total of 330 tokens for the analysis.

Informal conversational speech was collected by recording the subjects talking about their future plans for approximately five minutes each. Informal speech was used to supplement the word list because read speech can yield different results due to a more careful pronunciation of words. Although the use of informal speech has the advantage of capturing target sounds being used in a more naturalistic and realistic context, there is obviously no control over the actual production and the number of occurrences of the target sounds. The number of usable data may also be reduced due to the unsuitable phonetic environment of the target sounds. This is because the vowels after approximants and before /ŋ/ and /l/ are generally avoided because of the "severe co-articulatory effects on the formants of the … vowels" (Deterding, 2003, p. 4).

The choice of the target vowels is also usually limited to the vowels in stressed syllables and content words (e.g. Harrington, 2006; Jacobi *et al*., 2006). Since only vowels that occurred in the stressed syllables and in content words without neighbouring approximants and nasals were extracted for analysis, this resulted in less than ten tokens for /ɑː/ and /ɔː/ (see Table 2), and hence, the results relating to these vowels need to be treated with caution.

The number of tokens that were extracted from the informal speech cannot be directly compared to the frequency of occurrences of English vowels (e.g. Cruttenden, 1994; Knowles, 1987) because as Knowles (ibid.) points out, the frequency distributions of phonemes will vary according to the different varieties of English and the types of text from which the frequencies are obtained. Further, not all the vowels that occurred in the informal speech of the subjects in this study were used for the analysis based on the criteria mentioned earlier.

Thus, whilst the vowel /ɜː/ is reported as the least frequently occurring monophthong in English in Cruttenden (1994, p. 137), this particular vowel was the second highest frequently occurring vowel extracted from the data. This could be explained by the high frequency of occurrence for the word *university* (32 occurrences) in the data due to the topic of conversation for data elicitation, where all the respondents had talked about their plans to further their education after completing their secondary

school education. The frequency of tokens for each of the monophthong vowels extracted in the ISC is shown in Table 2.

TABLE 2
Frequency of the vowels extracted from the informal speech context

Vowels	Frequency
iː	40
ɪ	70
e	58
æ	45
ʌ	57
ɑː	7
ɒ	39
ɔː	3
ʊ	26
uː	14
ɜː	54

Instruments

All the subjects were recorded in a quiet room in the school using a Marantz PMD661 Professional Solid State Recorder and an Audio Technica ATM73a cardioid condenser head worn microphone at a sampling rate of 44.1 kHz at a 16-bit rate.

Transcription and annotation

The data were transcribed and annotated using Praat Version 5.1.03 (Boersma & Weenink, 2009). In the first pass, the data were orthographically transcribed using the TextGrid function of Praat. Then, the target vowels were isolated and measured. For the WLC, PraatScripts were used to automatize the segmentation of the target words and to insert orthographic transcriptions of the words used. However, for the ISC, the transcription was done manually and the vowels to be measured were identified. The vowels were selected if they occurred in the stressed syllables of content words avoiding vowels that preceded and followed approximants and nasals as there are likely to be co-articulatory effects on the vowel quality. All the measurements were annotated in the subsequent tiers in TextGrids.

Data analysis

Visual inspection of the waveforms and spectrograms together with auditory examination of the data were used to determine and measure the F1 and F2, and the duration of the vowels in the target words in both the WLC and the ISC. The F1 and F2 frequencies were measured using the automatic linear predictive coding (LPC) tracker overlaid on a wide-band spectrogram in Praat. The measurements were made approximately at the midpoint of the vowel where the vowel is at its most steady state (see Harrington, 2010, p. 172).

For vowel length, the duration of the vowel was measured (in milliseconds) from the onset and offset of the vowel. For the bVd context, the onset of the vowel was preceded by the release of the initial stop consonant, while the vowel offset was preceded by the absence of the acoustic signal for the following stop consonant, *d*. The average durations of the vowel pairs in the WLC and the ISC were compared.

Once the measurements were taken and checked for accuracy, the average F1 and F2

values for the monophthongs were converted from Hertz into Bark scale (Zwicker & Terhardt, 1980) to enable the vowels to be plotted on a F1 vs. F2 vowel chart, with two separate charts being generated for the WLC and ISC. The average formant values and vowel durations were calculated separately for the WLC and ISC. In order to examine the extent to which the vowel pairs are contrasted, scatter plots of the vowel pairs were generated to determine the distribution of the vowels. In addition, comparisons were also made with the characteristics of Thai vowels to determine the extent of L1 influence. Wherever relevant, reference was made to the findings from other Southeast Asian varieties of English, with the aim of highlighting similar patterns of vowel production (see Sarmah *et al*., 2009).

RESULTS AND DISCUSSION

The average measurements for F1 and F2 or the monophthong vowels in the WLC and ISC are shown in Tables 3 and 4.

TABLE 3
The average values for F1 and F2 for the WLC

Vowels	F1 (Hz)	F2 (Hz)	F1 (Bark)	F2 (Bark)
iː	438	2615	4.19	14.78
ɪ	459	2712	4.38	15.00
e	571	2400	5.34	14.26
æ	715	1766	6.50	12.29
ʌ	803	1612	7.16	11.68
ɑː	865	1609	7.61	11.67
ɒ	683	1301	6.25	10.24
ɔː	736	1112	6.66	9.20
ʊ	447	1342	4.27	10.45
uː	433	1000	4.14	8.51
ɜː	613	1835	5.69	12.54
Average	615	1755	5.65	11.88

Table 3 (*continued*)

TABLE 4
The average values for F1 and F2 for the ISC

Vowels	F1 (Hz)	F2 (Hz)	F1 (Bark)	F2 (Bark)
iː	414	2570	3.97	14.68
ɪ	469	2538	4.46	14.60
e	614	2340	5.70	14.10
æ	809	1985	7.21	13.06
ʌ	809	1692	7.21	12.01
ɑː	896	1677	7.82	11.95
ɒ	746	1357	6.74	10.53
ɔː	605	1145	5.62	9.39
ʊ	493	1265	4.67	10.05
uː	452	1333	4.32	10.40
ɜː	610	1767	5.66	12.30
Average	629	1788	5.76	12.10

Vowel quality

Fig.1 shows the vowel chart for ThaiE vowels produced in the WLC, while Fig.2 depicts the ThaiE vowels produced in the ISC. In both the speaking contexts, the mid-central vowel is produced similarly. In terms of the vowel contrast, the vowel charts show that the contrast between /iː/-/ɪ/ and /ʌ/-/ɑː/ is not great in both these contexts. On the other hand, /e/-/æ/ and /ɒ/-/ɔː/ are contrasted in both the WLC and ISC. In the WLC, /ʊ/-/uː/ are also contrasted with the former being produced further back than in the ISC. The more apparent contrast between the vowel pairs in the WLC suggests that the subjects may have been more careful with maintaining the vowel contrast in this context which is to be expected in more careful speech.

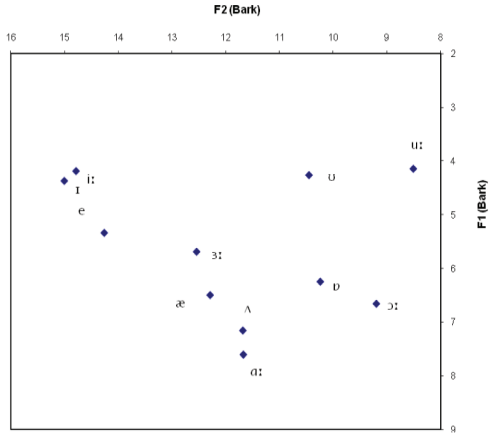

Fig.1: The vowel chart for Thai English vowels in the WLC

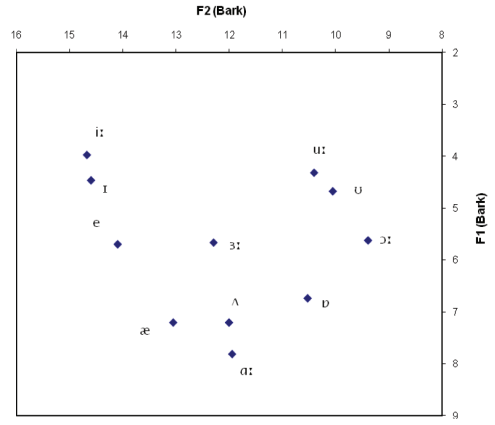

Fig.2: The vowel chart for Thai English vowels in the ISC

To obtain a clearer picture of the extent of the vowel contrast between the vowel pairs in ThaiE, the distribution of the vowels produced by the subjects in both speaking contexts is shown in the scatter plot diagrams (see Fig.3 to Fig.7). The scatter plots in Fig.3 show the overlapping tendencies of /iː/ and /ɪ/ in both speaking contexts. Consistently, no significant differences were found between the average F1 and F2 for these two vowels in the WLC [$t(29)=2.26$, $p=0.02$; $t(29)=0.84$, $p=0.20$]. However, an independent sample t-test shows a significant difference between F1 in ISC ($t(108)= 3.87$, $p<0.0001$; $t(108)=0.53$, $p=0.299$), indicating that /iː/ (M= 414 Hz) is produced higher in the vowel space than /ɪ/ (M=469Hz). This tendency to merge /iː/ and /ɪ/ has also been reported in neighbouring varieties of English (Deterding, 2003; Salbrina Haji Sharbawi, 2006; Pillai *et al*., 2010a; Pillai *et al*., 2010b).

Similarly for /ʌ/ and /ɑː/, there is an overlap between the two vowels in both speaking contexts (see Fig.4). There is no significant difference in the average F1 and F2 between both these vowels in the WLC [$t(29)=3.18$, $p=0.002$; $t(29)=0.03$, $p=0.49$]. The difference in the average F1 and F2 for the ISC for these vowels were not tested statistically as there were only 7 tokens of /ɑː/ in this context, but the merging of the two vowels can be observed in the scatter plot in Fig.4. The lack of contrast between these vowels is also common in other Southeast Asian varieties such as Malaysian English (Pillai *et al*., 2010b) and Singapore English (Deterding, 2003).

The scatter plots in Fig.5 show that there is an overlap between /ɒ/ and /ɔː/ in the WLC. The small number of tokens for /ɔː/ means that no conclusions can be made about these vowels in the ISC. There is a significant difference in F2, but there is no significant difference in the F1 of these vowels in the WLC (F1: $t(29)=3.27$, $p=0.001$; F2: $t(29)=4.78$, $p<0.0001$).

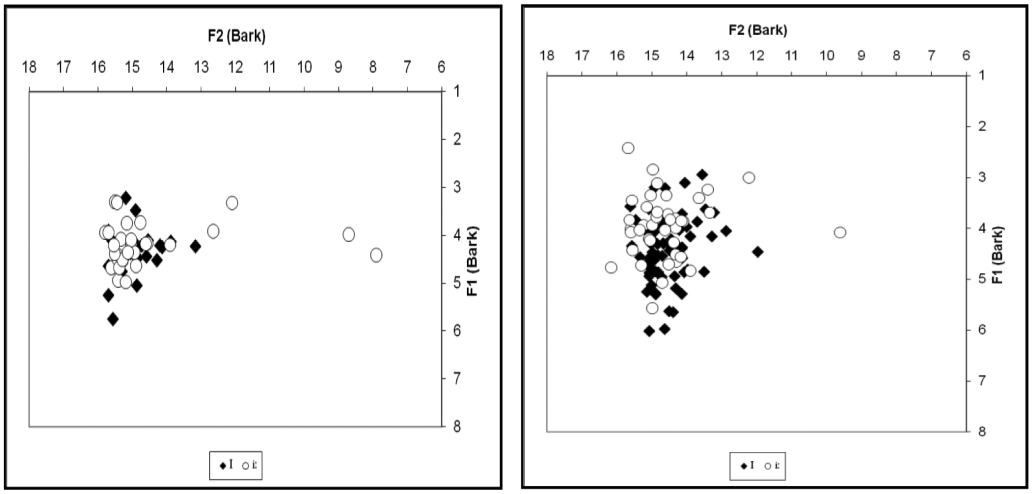

Fig.3: The distributions of /ɪ /-/iː/ in the WLC (top) and ISC (bottom)

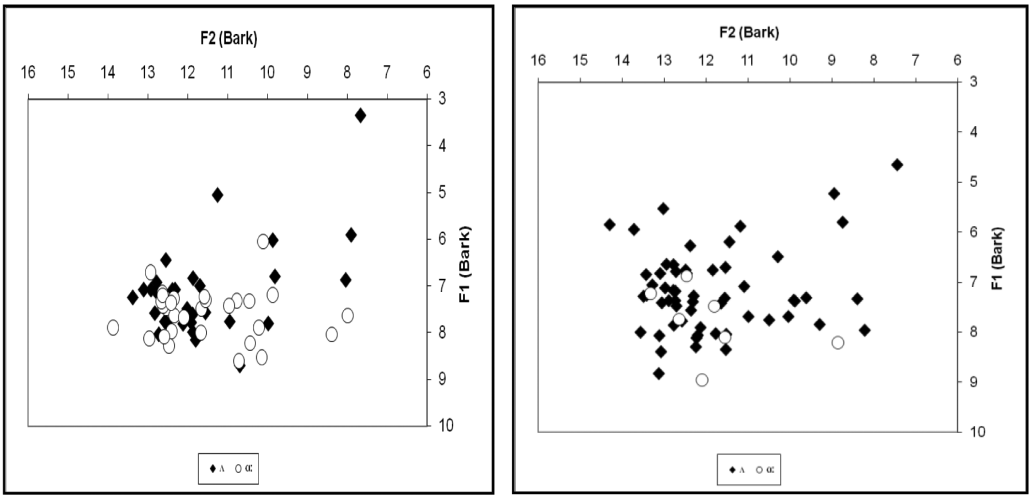

Fig.4**:** The distribution of /ʌ/-/ɑː/ in the WLC (top) and ISC (bottom)

Fig.6 shows the scatter plots for /ʊ/ and /uː/. Similarly for /ɒ/ and /ɔː/, a significant difference is only found between the average F2 for /ʊ/ and /uː/ in the WLC [F1: $t(29)=2.77$, $p=0.004$; F2: $t(29)=6.69$, $p<0.0001$]. Meanwhile, no t-test was carried out for the ISC due to the small number of samples for both vowels in this speaking context. Nevertheless, the scatter plot for ISC shows more overlap between the vowels in this speaking context compared to the WLC (see Fig.6). In other Southeast Asian Englishes, there tends to be more contrast between this vowel pair compared to other vowel pairs (e.g. Philippine, Malaysian and Singapore English).

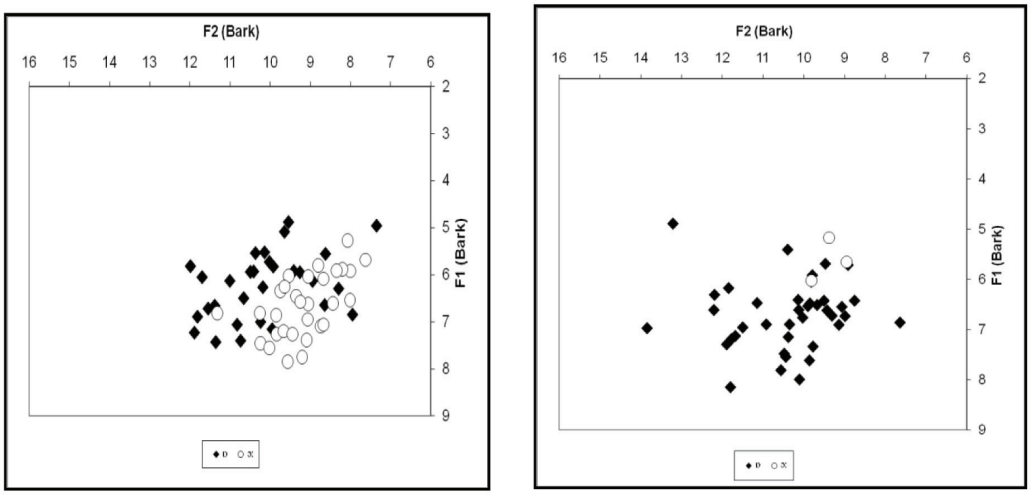

Fig.5: The distribution of /ɒ/-/ɔː/ in the WLC (top) and ISC (bottom)

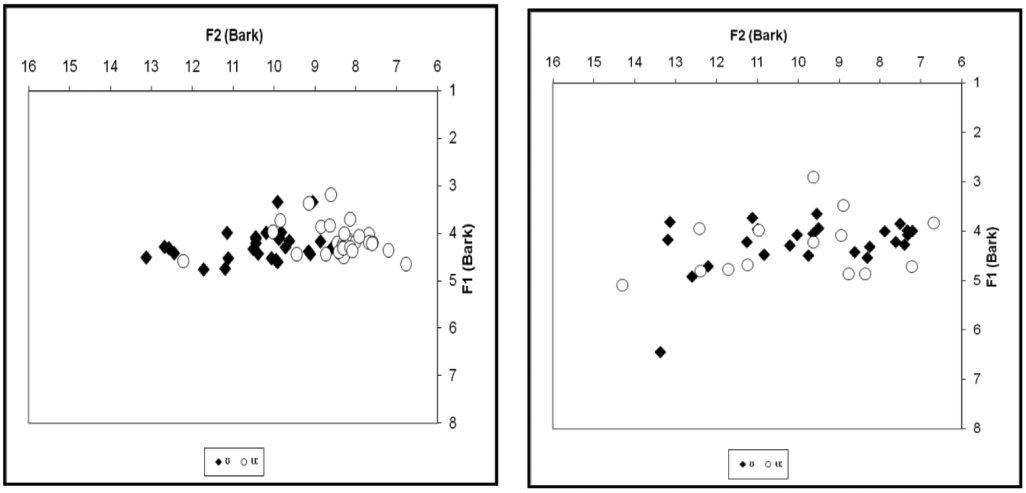

Fig.6: The distribution of /ʊ /-/uː/ in the WLC (top) and ISC (bottom)

Fig.7 shows the scatter plots for the vowels /e/-/æ/ in the WLC and ISC, where it can be seen that these vowels are contrasted. In fact, in both the speaking contexts, there is a significant difference between the average F1 and F2 of /e/-/æ/: WLC [$t(29)=5.26$, $p<0.0001$; $t(29)=5.4$, $p<0.0001$); ISC($t(101)=9.87$, $p<0.0001$; $t(101)=6.62$, $p<0.0001$]. These findings support the results reported by Sarmah *et al*. (2009). The contrast between /e/-/æ/ is one of the features that distinguish ThaiE from the neighbouring varieties of English, where these vowels tend to be merged (e.g. Deterding, 2003; Salbrina Haji Sharbawi, 2006; Pillai *et al*., 2010b).

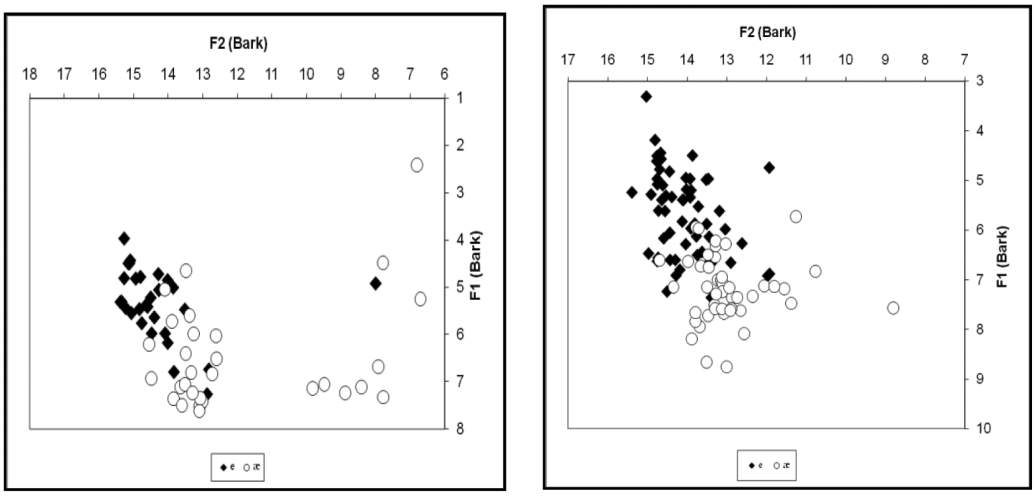

Fig.7: The distribution of /e/-/æ/ in the WLC (top) and ISC (bottom)

Vowel Duration

English monophthong vowels contrast in terms of vowel quality and also display length contrast (Wells, 1962). The ThaiE vowels produced in both speaking contexts were measured to determine if the length between the vowel pairs /ɪ/-/iː/, /e/-/æ/, /ʌ/-/ɑː/, /ɒ/-/ɔː/ and /ʊ/-/uː/ was distinguished. Table 5 shows the average duration (in milliseconds) of each of the monophthong vowels produced by the subjects in the WLC and ISC. There are significant differences between the average durations for all the vowel pairs (p<0.0001) in the WLC. For the ISC, no t-test was carried out for /ʌ/-/ɑː/, /ɒ/-/ɔː/ and /ʊ/-/uː/ since the sample size was rather small. A statistically significant difference was found between /ɪ/ and /iː/ [t(108)=4.98, p<0.0001], but not between /e/ and /æ/: [t(101)=3.2, p=0.001] in the ISC.

The ratios between the vowel pairs (see Table 5) indicate that the durations between the vowel pairs are distinguished more in the WLC (except for /e/-/æ/), which is to be expected as speakers would tend to focus on vowel length contrast in more careful speech. In general, it appears that the length contrast between the vowel pairs is maintained by the subjects. This is different from what has been reported for other Southeast Asian varieties of English, such as Brunei and Singapore English, where length tends not to be distinguished.

Comparison with Thai vowels

In order to investigate the influence of Thai vowels on the production of ThaiE vowels, the F1 and F2 measurements of Thai vowels were taken. Table 6 presents the average measurements for F1 and F2 and the duration for the Thai monophthongs, while Fig.8 shows the vowel chart for the short and long Thai vowels. In terms of the vowel contrast, the vowel pairs in Thai are produced similar in quality, whereas length is contrasted. Thus, if there is L1 transfer

TABLE 5
Vowel duration in Thai English

Vowels	WLC duration (msec)	Ratio between Vowel Pairs	ISC duration (msec)	Ratio between Vowel Pairs
ɪ	121	.61	82	.68
iː	197		120	
e	170	.83	102	.77
æ	206		132	
ʌ	152	.66	128	.79
ɑː	230		163	
ɒ	123	.54	115	.69
ɔː	226		167	
ʊ	72	.36	133	.94
uː	200		141	
ɜː	213		119	

TABLE 6
The average values for Thai vowels

Vowels	F1 (Hz)	F2 (Hz)	F1 (Bark)	F2 (Bark)	Duration (msec)	Ratio between Vowel Pairs
i	413	2825	3.97	15.25	139	0.74
iː	407	2961	3.91	15.53	187	
e	567	2500	5.31	14.51	112	0.50
eː	532	2722	5.01	15.03	226	
æ	740	2262	6.69	13.89	127	0.51
æː	781	2576	7.00	14.69	251	
ɯ	431	1767	4.13	12.29	78	0.40
ɯː	495	1783	4.69	12.35	195	
a	897	1691	7.83	12.00	117	0.39
aː	976	1798	8.36	12.41	300	
u	411	853	3.94	7.52	73	0.48
uː	368	767	3.55	6.90	152	
o	556	954	5.21	8.21	137	0.64
oː	499	900	4.73	7.85	215	
ɔ	680	1056	6.23	8.86	151	0.68
ɔː	658	1063	6.05	8.90	221	
ɤ	623	1586	5.77	11.57	133	0.37
ɤː	557	1725	5.23	12.14	360	
Average	588	1766	5.42	11.66		

from Thai, we can anticipate that the Thai speakers will be more likely to contrast vowel length rather than vowel quality when they produce English vowels. Based on the comparison of the formant and durational values between Thai and ThaiE, this appears to be the case. Length contrast is evident between the vowel pairs in ThaiE, but there is a lack of quality contrast between /ɪ/-/iː/ and /ʌ/-/ɑː/ and to a certain extent between the back vowels.

Based on Sarmah *et al*. (2009) and Tsukada (2008), we can assume that both Thai and English share the following vowels: /iː/, /e/, /uː/, /ɔː/ and /æ/ [although Tsukada (2008) says that /æ/ is not present in Thai]. A comparison of the five Thai and English vowels in Fig.9 and Fig.10 indicate that the vowels have comparable F1 and F2 values, suggesting that they were produced quite similarly. Based on the F1 values of the front vowels, we concur with Sarmah *et al*. (2009) that Thai speakers produce these English vowels similar to the comparable vowels in Thai.

CONCLUSION

The results of the acoustic analysis of the ThaiE monophthong points towards the influence of Thai on ThaiE in the maintenance of length contrast between the vowel pairs. The results also suggest a possible transference of Thai vowel quality in comparable English vowels /iː/, /e/, /uː/, /ɔː/ and /æ/, with one of the effects of this influence being the maintenance of the vowel contrast between /e/ and /æ/ in ThaiE. The similarly produced shared vowels (in terms of vowel quality) and the maintenance of the length contrast lend some support to Flege's (1995) SLM which advocates that

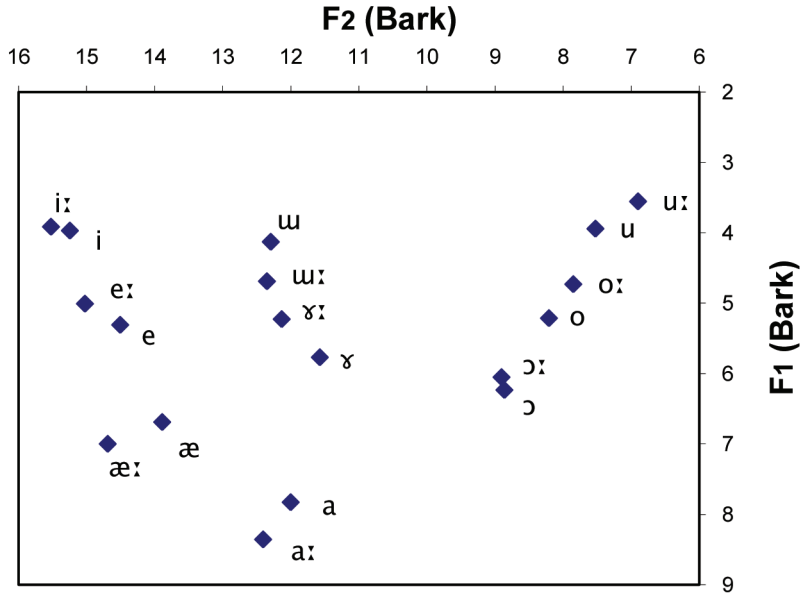

Fig.8: Thai monophthong vowels

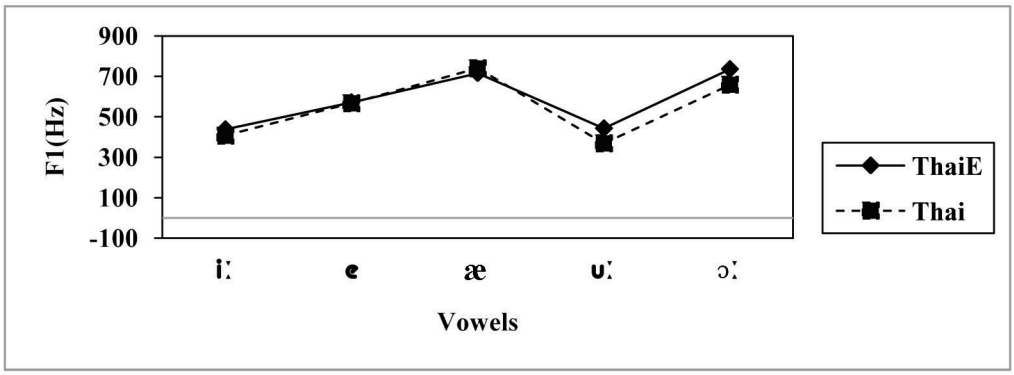

Fig.9: The average F1 values of similar ThaiE and Thai vowels

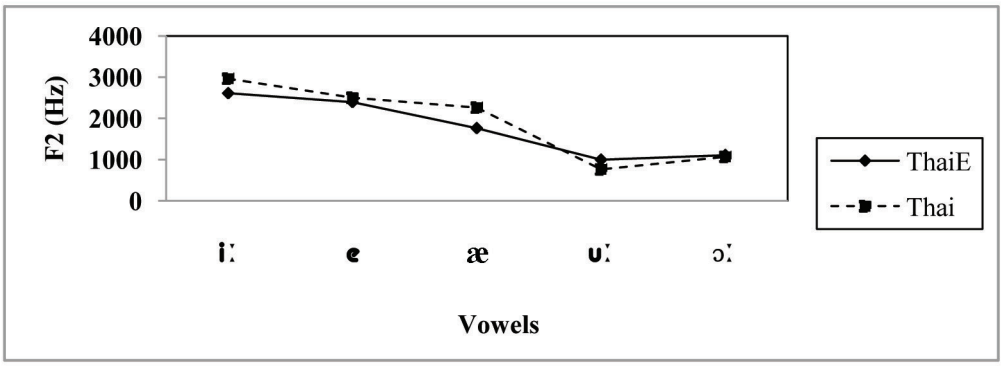

Fig.10: The average F2 values of similar ThaiE and Thai vowels

similar categories of L1 and L2 sounds will be merged. However, further research needs to be carried out to determine whether such a merger results in native-like sounds or whether speakers were producing equivalent vowels closer to their L1 vowel quality (see Flege *et al*., 1999). Further investigation is also needed to examine whether dissimilar vowels, such as English /ʌ/ and /ɑː/, were being produced more native-like by the speakers, since theoretically they should 'notice' the differences to, for example, Thai /a/ and /aː/.

Although the current findings, being confined to a specific group of speakers, are in no way exhaustive, they do contribute empirical evidence to and complement existing research on Thai English pronunciation. Further research is required to include other aspects of English pronunciation by Thai EFL learners and to provide a more exhaustive description of their pronunciation features.

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REFERENCES

Boersma, P., & Weenink, D. (2009). *Praat: Doing phonetics by computer* (Version 5.1.03) [Computer program]. Retrieved on March 21, 2009 from http://www.praat.org.

Charunrochana, M. L. J. (2007). *Introduction to linguistics*. Bangkok: Kasetsart University Press.

Cruttenden, A. (1994). *Gimson's pronunciation of English* (5th ed.). London: Edward Arnold.

Deterding, D. (2003). An instrumental study of the monophthong vowels of Singapore English. *English World-Wide*, *24*(1), 1-16.

Flege, J. E. (1995). Second language speech learning: Theory, findings and problems. In W. Strange (Ed.), *Speech perception and linguistic experience: Issues in cross-language research* (pp. 229-273). Timonium MD: York Press.

Flege, J. E., MacKay, I. R., & Meador, D. (1999). Native Italian speakers' perception and production of English vowels. *Journal of the Acoustical Society of America 106*(5), 2973-2987.

Harrington, J. (2006). An acoustic analysis of 'happy-tensing' in the Queen's Christmas broadcasts. *Journal of Phonetics 34*, 439–457.

Harrington, J. (2010). *Phonetic analysis of speech corpora*. Oxford: Wiley-Blackwell.

Hawkins, S., & Midgley, J. (2005). Formant frequencies of RP monophthongs in four age groups of speakers. *Journal of International Phonetic Association, 35*(2), 183-199.

Iverson, P., & Evans, B. G. (2007). Learning English vowels with different first-language vowel systems: Perception of formant targets, formant movement, and duration. *Journal of the Acoustical Society of America 122*(5), 2842-2854.

Jacobi I., Pols, L. C. W., & Stroop, J. (2006). Measuring and comparing vowel qualities in a Dutch spontaneous speech corpus. *Proceedings of Interspeech* 2006 (p. 701-704)*,* Pittsburgh PA.

Knowles, G. (1987). *Patterns of spoken English: An introduction to English phonetics*. London: Longman.

Ladefoged, P. (2005). *Vowels and consonants: An introduction to the sounds of languages* (2nd Ed.). Oxford: Blackwell Publishing.

Nathong, W. (2003). Contrastive analysis of English and Thai. Bangkok: Ramkhamhaeng University Press.

Pillai, S., Manueli, M. K. S., & Dumanig, F. P. (2010a). Monophthong vowels in Malaysian and Philippine English: An exploratory study. *Philippine Journal of Linguistics*, *41*, 80-93.

Pillai, S., Zuraidah Mohd Don, Knowles, G., & Tang, J. (2010b). Malaysian English: An instrumental analysis of vowel contrasts. *World Englishes 29*(2), 159-172.

Roach, P. (2009). *English phonetics and phonology: A practical course* (4th Ed.). Cambridge: Cambridge University Press.

Sarmah P., Gogoi, D. V., & Wiltshire, C. (2009). Thai English: Rhythm and vowels. *English World-Wide 30*(2), 196-217.

Salbrina Haji Sharbawi. (2006). The vowels of Brunei English. *English World-Wide 27*(3), 247-264.

Smyth, D. (1987). Thai speakers. In Swan, M., & Smith, B. (Eds.), *Learner English: A teacher's guide to interference and other problems* (pp. 252-263). Cambridge: Cambridge University Press.

Tingsabadh, M. R. K., & Abramson, A. S. (1999). Thai. In *Handbook of the International*

Phonetic Association: A guide to the use of the International Phonetic Alphabet (pp. 147-150). Cambridge: Cambridge University Press.

Tsukada, K. (2008). An acoustic comparison of English monophthongs and diphthongs produced by Australian and Thai speakers. *English World-Wide 29*(2), 194-211.

Tsukada, K. (2009). Durational characteristics of English vowels produced by Japanese and Thai second language (L2) learners. *Australian Journal of Linguistics 29*(2), 287-299.

Wayland, R. (1997). Non-native production of Thai: Acoustic measurements and accentedness ratings. *Applied Linguistics 18*(3), 345-373.

Wells, J. C. (1962). *A study of the formants of the pure vowels of British English* Thesis submitted in partial fulfilment of the requirements for the degree of M.A., University of London. Retrieved on March 21, 2009 from http://www.phon.ucl.ac.uk/home/wells/formants/index.htm

Zwicker, E., & Terhardt, E. (1980). Analytical expression for critical-band rate and critical bandwidth as a function of frequency. *Journal of the Acoustical Society of America 68*(5), 1523-1525.