English Language Teaching; Vol. 15, No. 7; 2022
ISSN 1916-4742 E-ISSN 1916-4750
Published by Canadian Center of Science and Education

Discrimination of L2 British English Monophthong Contrasts: The Case of L2 Thai Learners of English

Patchanok Kitikanan[1]

[1] English Department, Faculty of Humanities, Naresuan University, Phitsanulok, Thailand

Correspondence: Patchanok Kitikanan, English Department, Faculty of Humanities, Naresuan University, Phitsanulok, Thailand.

Received: May 18, 2022 Accepted: May 31, 2022 Online Published: June 2, 2022

doi: 10.5539/elt.v15n7p1 URL: https://doi.org/10.5539/elt.v15n7p1

Abstract

This article reports on the second language (L2) perception of contrasts among British English monophthongs. This study has two aims: 1) to explore the discriminability of contrasts in L2 British English monophthongs; and 2) to test the perceptual assimilation model-L2 (PAM-L2) towards the ability to discriminate British English contrasts. The contrasts considered were: /iː/-/ɪ/, /æ/-/ʌ/, /ɜː/-/ʌ/, /uː/-/ʊ/, /e/-/æ/, /ʌ/-/ɒ/, /ʊ/-/ɔː/, /ɑː/-/ʌ/, /ɜː/-/ɔː/. Fifty-two native speakers of Thai who were learning English as a foreign language in Thailand participated in a forced-choice ABX discrimination task. The participants were divided between two groups – those high-experienced and those low-experienced. The results evidence how both groups performed well on most contrasts (over 80% correct), except for /ʌ/-/ɒ/. Although the discriminability of the contrast /ʌ/-/ɒ/ was lower than with the other contrasts, the discrimination scores among both groups remained in a middle range (over 70%). No effect of L2 experience was found, thus suggesting that the abilities of both groups did not differ. The PAM-L2 was accurate in predicting that neither group of L2 Thai learners would have difficulty in discriminating the considered L2 sound contrasts. These results imply that the results gained from a perceptual assimilation task are useful in predicting the discriminability of L2 sound contrasts, as suggested by the PAM-L2.

Keywords: perceptual assimilation model-L2, British English monophthongs, Thai learners, discrimination of sound contrasts

1. Introduction

Earlier, the language of L2 learners was considered to be interlanguage. According to Selinker (1972) and Tarone (1994), interlanguage is a separate system based on output which is an attempt of the L2 learners to produce target language, and this system is different from both L1 and L2 system. Later, it is widely accepted within Linguistics research that second language (L2) learners perceive L2 sounds via the phonological system(s) of their first language(s) (L1s) (Best, 1995; Flege, 1995). In agreement with the notion that a transfer arises from one's first language (L1) towards one's L2 learning, Lado (1957) developed the Contrastive Analysis Hypothesis (CAH) which predicts that L2 sounds which do not exist in the L1 sound system of learners will be difficult to learn. For example, Japanese learners of English might find the English contrast /l/-/ɹ/ difficult to discriminate – as evidenced by Best and Strange (1992). This is because neither of these sounds appear in the phonological system of Japanese. However, the prediction on L2 sound learning based on the comparison between L1 and L2 sounds, as suggested by the CAH, seems to be inadequate in some regards as some L2 sounds that do not exist in an L1 sound system might be easy to learn. For example, L2 English learners have shown excellent discrimination of Zulu click contrasts which do not exist in English but poor discrimination of the Zulu plosive versus implosive bilabial stop /b/-/ɓ/ (Best, McRoberts, & Sithole, 1988).

To account for this phenomenon, Best (1995) developed the Perceptual Assimilation Model (PAM) based on speech perception via the focus on naïve listeners. The PAM holds that the perception of L2 sounds is based on articulatory gestures enacted within speech production (Best, 1995). According to the PAM, learners with little or no experience in their L2 shall fail to discriminate non-native sounds whereupon those sound contrasts have similar articulators as a native sound. For example, L2 Thai learners might have difficulty discriminating the English contrast /ð/-/d/ as they would assimilate them to the Thai /d/. This is because this English contrast shares a place of articulation with Thai /d/ in that the same speech organs, such as the tip of the tongue and the dental

area are involved in producing these two sounds. According to the PAM, although the two sounds, such as /p/ and /v/ in an L2 might not exist in the L1 sound system of L2 learners, the difference between them might be perceived as the learner shall match them with two sounds in their L1. In the same year, Flege (1995) and his colleagues developed the Speech Learning Model (SLM) which accounts for changes across the life-span of L2 speech learning. The SLM names the sounds which do not exist in an L1 sound system phonemically as a new sound, predicting that L2 learners will learn the new sound with ease as it shall differ from their L1 sounds.

Later, Best and Tyler (2007) developed the Perceptual Assimilation Model-L2 (PAM-L2) by building upon the PAM. This revised model shifts the focus from naïve listeners and instead focuses on learners in 'natural communicative situations' (Best & Tyler, 2007, p. 17) rather than in controlled contexts. Such learners are those who learn L2 to achieve a specific purpose – e.g., for a function, communication and/or education. PAM-L2 provides four predictions as to the perception of L2 sound contrasts: 1) Two-category (TC) assimilation, when both L2 sounds are perceived as equivalent to given L1 phonological categories; 2) Category goodness (CG) assimilation, when both L2 sounds are perceived as equivalent to the same L1 sound but where one is perceived as being more similar to the L1 sound category than the other; 3) Single-category (SC) assimilation, when both L2 sounds are perceived as equivalent to the same L1 sound in the same degree; and 4) Uncategorised-uncategorised (UU) assimilation, when there is no L1-L2 phonological assimilation as no L1 categories can be assigned to either L2 sound. From the three assimilations: TC, CG and SC, the TC contrast should be the easiest for learners to perceive, followed by the CG and SC contrasts, respectively.

The classification of L2 sound contrast according to PAM and PAM-L2, is based on the classification of L2 sounds in terms of their closest L1 sounds in the perceptual assimilation task and in the similarity rating sounds between L1 and L2 using a goodness rating. However, there is no range of recommended scales to be used for such goodness ratings in classifying L2 sound contrasts in PAM-L2, as suggested by Kitikanan (2016). Many studies have been produced to consider the discrimination of L2 sound contrasts based on the results of the perceptual assimilation task as suggested by the PAM and PAM-L2 (e.g., Al Mahnoud Mahmoud, 2013). For example, Al Mahnoud Mahmoud (2013), in exploring the discrimination of Arabic contrasts by American learners, utilized nine Arabic consonant contrasts as stimuli. Here, it was found that most discrimination among the L2 Arabic contrasts were as predicted by the results from the non-native sound classification. These findings suggest that the PAM is efficient in classifying non-native contrasts and hypothesise the success liable to be encoutered in discriminating them. However, to the best of my knowledge, the present research is the first study as to L2 sound discrimination among L2 Thai learners.

The discriminability of L2 British English vowel contrasts is essential for L2 learners as perceiving two L2 vowels as one vowel might affect the intelligibility achieved in communication. For example, L2 learners might mishear the word 'bit' as 'beat'. In this study, two research objectives are set: 1) to explore the discriminability of nine British English vowel contrasts /iː/-/ɪ/, /æ/-/ʌ/, /ɜː/-/ʌ/, /uː/-/ʊ/, /e/-/æ/, /ʌ/-/ɒ/, /ʊ/-/ɔː/, /ɑː/-/ʌ/, /ɜː/-/ɔː/ by L2 Thai learners; and 2) to identify the extent to which the PAM-L2 can account for the results of this study. These vowel contrasts have been selected as they are those that L2 learners are likely to have difficulty with. Notably, they have been used as stimuli in prior research studies as to L2 English vowel discrimination: 1) /iː/-/ɪ/ (Iverson, Pinet, & Evans, 2012; Jia, Strange, Wu, Collado, & Guan, 2006; Lengeris & Hazan, 2007; Mokari & Werner, 2017; Rauber, Escudero, Bion, & Baptista, 2005; Sisinni & Grimaldi, 2009); 2) /æ/-/ʌ/ (Lengeris & Hazan, 2007; Mokari & Werner, 2017; Sisinni & Grimaldi, 2009); 3) /ɜː/-/ʌ/ (Iverson et al., 2012); 4) /uː/-/ʊ/ (Lai, 2010; Lengeris & Hazan, 2007; Mokari & Werner, 2017; Rauber et al., 2005; Sisinni & Grimaldi, 2009); 5) /e/-/æ/ (Lai, 2010; Mokari & Werner, 2017); 6) /ʌ/-/ɒ/ (Iverson et al., 2012; Mokari & Werner, 2017); 7) /ʊ/-/ɔː/ (Mokari & Werner, 2017); 8) /ɑː/-/ʌ/ (Lengeris & Hazan, 2007; Mokari & Werner, 2017; Sisinni & Grimaldi, 2009); and 9) /ɜː/-/ɔː/ (Iverson et al., 2012). The effect of the L2 experience is investigated in relation to whether it affects the discriminability of the English contrasts. If not, then the discriminability of each British English vowel contrast can be generalised across groups of listeners. In addition, the comparison of the discriminability of each sound contrast by the participants is to be reported.

2. Research Questions and Hypotheses

The research questions of this study are based on the findings of the perceptual assimilation task enacted in the study of Kitikanan (2020a), as showed the difference of assimilation as to British English monophthongs to Thai monophthongs between the two groups, whereby predictions of discriminability were divided between two groups of L2 Thai learners. In light of this, the research questions held were as follows:

1) What is the extent of discriminability as to the contrasts in British English monophthongs among Thai high-experienced versus low-experienced learners?

Based on the findings of Kitikanan (2020a), the high-experienced group should not have faced difficulty in discriminating any of the contrasts in the British English monophthongs as no overlapping Thai sounds exist for the target British English monophthongs. All contrasts were classified as TC contrasts for this group as those vowels were mostly matched with different Thai vowels. For the low-experienced group, it was predicted that they would have high correct discrimination scores for most sound pairs as they would match most target British English monophthongs with different Thai sound categories. Hence, most British English vowel contrasts would be TC for the low-experienced group. For British English /iː/-/ɪ/, these were mostly matched to Thai /i/. For British English /æ/-/ʌ/, these were mostly matched with Thai /a/. For the two contrasts of /iː/-/ɪ/ and /æ/-/ʌ/, though difficulty should not have been encountered in perceiving these two sound pairs as they were classified as CG, the correct discrimination scores of these two sound pairs should be lower with other TC pairs.

2) To what extent does the PAM-L2 account for the results of the discriminability of the L2 sound contrasts in this study?

It was predicted that this speech model could account for the results of this study to a great extent. The results should be according to the predictions in Research question 1. Since the research question 1 and 2 are interrelated, the results of these are presented together in the Results and discussion.

3. Monophthongs in Thai and British English

In regards to monophthongs in Thai and British English, the former has a greater number than the latter. There are nine pairs within Thai: /i, iː, e, eː, æ, æː, ə, əː, a, aː, u, uː, o, oː, ɔ, ɔː, ɯ, ɯː/ as distinguished by the length of the vowels. Thai long vowels are 2 to 3.5 times longer than their short counterparts (Abramson, 1962). Based on the study of Roengpitya (2001), while short vowels in Thai are, on average, 106 miliseconds (msec) long, Thai long vowels are, on average, 320 msec long. Apart from duration being an important cue in distinguishing long vowels from short vowels in Thai, vowel quality is also helpful in distinguishing these two vowels groups. According to Abramson and Reo (1990), short vowels are more open than long vowels and, furthermore, and the long vowels of /uː/ and /oː/ are more rounded than their short counterparts.

In British English, there are eleven monophthongs: /ɑː, iː, uː, ɔː, ɜː, æ, e, ɪ, ɒ, ʌ, ʊ/ (Roach, 2004). The vowel /ə/ is, in fact, also a short vowel in British English but only occurs in an unstressed syllable. Hence, /ə/ was excluded from this research, following the study of Deterding (1997). From the eleven monophthongs of British English, six vowels are short: /ɪ, ʊ, e, ʌ, æ, ɒ/. Roach (2009) has described British English monophthongs as follows:

1) /ɪ/ is in the close front area as compared to the cardinal vowel [i]. However, it is, in fact, produced with the lips being more open and closer to the centre and with slight lip spreading. The part of the tongue between the front and the centre is raised to the above mid-close position (Skandera & Burleigh, 2011);
2) /e/ is a front vowel produced between the cardinal vowel [e] and [ɛ], but where the lips are less spreading. The tongue front is raised between the mid-close and mid-open positions (Skandera & Burleigh, 2011);
3) /æ/ is close to the cardinal vowel [a], but is less open and has less lip-spreading. The tongue front is raised between the mid-open and completely open positions (Skandera & Burleigh, 2011);
4) /ʌ/ is central and the jaw will be more open than the open-mid vowel. The lip rounding is neutral. As this vowel is central, the tongue centre is raised between the mid-open and completely open positions (Skandera & Burleigh, 2011);
5) /ɒ/ is between the open-mid and open vowels, and is produced in the back area but not fully back. The lips are slightly rounded. When producing this vowel, the tongue back is lowered to an almost completely open position (Skandera & Burleigh, 2011);
6) /ʊ/ is close to the cardinal vowel [u] but is more open and nearer to the centre. The lips are rounded. The tongue is between the centre and the back is raised to above the mid-close position (Skandera & Burleigh, 2011);
7) /iː/ has its production closer to the cardinal vowel [i] but with the lips being slightly open. It is produced with the tongue front raised close to the palate and the lips slightly spread (Skandera & Burleigh, 2011);
8) /uː/ is close to the cardinal vowel [u] but the tongue is much less backward and the lips are more open and moderately rounded. The tongue back is raised to be close to the palate (Skandera & Burleigh, 2011);

9) /ɔː/ is produced with the lips being strongly rounded and closer to the cardinal vowel [o]. The tongue height is between the cardinal vowels of [ɔ] and [o] and the tongue is rather fully back. The back of the tongue is raised between the mid-close and mid-open positions (Skandera & Burleigh, 2011);
10) /ɜː/ is mid-central and is made with neutral lip-rounding. When producing this vowel, the centre of the tongue is raised between the mid-close and mid-open positions (Skandera & Burleigh, 2011);
11) /ɑː/ is close to the cardinal vowel [ɑ], but less backward and the lips are neutral. The tongue is between the centre and the back is lowered to a completely open position (Skandera & Burleigh, 2011).

When comparing monophthongs in British English and Thai in terms of phonemic inventory, Sarmah, Gogoi, and Wiltshire (2009) have argued that the shared sounds occur in both languages are /iː, uː, ɔː, æ, e/. The non-shared sounds which occur only in English are /ɑː, ɜː, ɪ, ɒ, ʌ, ʊ/.

4. Studies on English Vowel Perception by L2 Thai Learners

Most studies as to English vowel learning by L2 Thai learners have been carried out on production (e.g., Kallayanamit, 2016; Pillai & Salaemae, 2012; Richards, 1968; Tsukada, 2009; Varasarin, 2007). Thus, the studies on English vowels in terms of perception by L2 Thai learners are limited (e.g., Kitikanan, 2020a; Lerdpaisalwong, 2015). One study, by Kitikanan (2020a), has investigated the perceptual assimilation of British English monophthongs to Thai monophthongs by L2 Thai learners (i.e., Thai students at a university in Thailand). The British English vowels utilised /iː, ɪ, e, æ, ɒ, ɑː, ɔː, ʊ, uː, ʌ, ɜː/ in a /bVt/ context. The Thai participants identified British English vowels in terms of Thai sound categories, demonstrating that the assimilation patterns between the high-experienced and low-experienced groups did not differ for the British English /ɪ, e, ɑː, ɔː, ʊ, ʌ, ɜː/. Here, British English /ɪ/ was mostly matched with Thai /i/; British English /e/ with Thai /e/; British English /ɑː/ with Thai /aː/; British English /ɔː/ with Thai /oː/; British English /ʊ/ with Thai /u/; British English /ʌ/ with Thai /a/; and British English /ɜː/ with Thai /əː/. Notably, British English /æ, iː, uː, ɒ/ showed different assimilation patterns between the two groups, thus suggesting the influence of L2 experience. Specifically, British English /æ/ was mostly matched with Thai /æ/ in the high-experienced group, but with Thai /a/ in the low-experienced group. British English /iː/ was mostly matched with Thai /iː/ in the high-experienced group, but with Thai /i/ in the low-experienced group. British English /uː/ was mostly matched with Thai /uː/ in the high-experienced group, but with Thai /ɯ/ in the low-experienced group. British English /ɒ/ was mostly matched with Thai /ɔ/ in the high-experienced group, but with Thai /o/ in the low-experienced group. This difference in the matchings of British English /æ, iː, uː, ɒ/ between the high- and low-experienced groups suggests the involvement of L2 experience in influencing discrimination.

A further study, by Lerdpaisalwong (2015), has explored the effect of perceptual training towards English vowels by L2 Thai learners. In the perceptual training of the English vowels, the set training of Nishi and Kewley-Port (2007) was used as a model. The participants were undergraduate students at a university in Thailand, and the stimuli were produced by American speakers. The American English vowels in this study were /i, ɪ, ɛ, æ, ɑ, ɔ, ʊ, u, ʌ/ presented in 72 real words. These vowels were also presented in 54 nonsense words. The findings show that, post-training, the overall scores of the perception towards the American English vowels was significantly improved. However, the ability to perceive the vowel /ɑ/ had not significantly improved, and the vowel /ɔ/ was found to be difficult for the Thai participants. The author suggested that this might be because the American English /ɔ/ is auditorily considered a ‘mid-vowel’ whereas the closest Thai vowel is /ɔː/ which is auditorily considered a ‘low-vowel’. From these two studies, it is evident that a gap arises in the English vowel perception of L2 Thai learners in terms of discriminability. To my knowledge, the present research is the first study in this area.

5. Studies on the Discrimination of L2 English Vowel Contrast

Research as to the discriminability of L2 English vowel contrast has gained increasing attention since the emergence of the PAM (Best, 1995), with the discrimination task having been set to explore the extent that the perceptual assimilation task is good at predicting the discriminability of sound contrast by naïve and L2 learners. Although, the PAM was later developed to manifest the PAM-L2 (Best & Tyler, 2007), the discrimination task is still used to explore the discriminability of L2 sound contrast and to investigate the predicting ability of perceptual assimilation results.

For discrimination experiments set to explore L2 sound contrast perception, most studies have explored L2 American vowel contrast rather than doing so in relation to British English (e.g., Jia et al., 2006; Lai, 2010; Rauber et al., 2005). Many have been conducted with a lesser number of L1 vowel categories than L2 vowel categories. For example, Rauber et al. (2005) investigated the discriminability of American English vowel

contrasts: /i/-/ɪ/, /i/-/eɪ/, /ɛ/-/æ/, /u/-/ʊ/, /ɔ/-/ɑ/, /ʊ/-/ʌ/, /ʊ/-/oʊ/, and /ʌ/-/ɑ/ among L2 Brazilian Portuguese (BP) learners, using seven BP vowels and eleven American English vowels. The vowels /ɪ/, /eɪ/, /æ/, /ʌ/, /ɑ/, /oʊ/, and /ʊ/ do not exist in the BP vowel inventory. The findings evidence that the discrimination of the pairs /ɛ/-/æ/, /u/-/ʊ/, /ɔ/-/ɑ/ was poor with less than a 55% accuracy rate. The /ʌ/-/ɑ/ contrast received the lowest scores of discrimination accuracy.

In regards to the discrimination of L2 British vowel contrast, fewer studies have been produced when compared to the research which has considered L2 American vowel contrast (Lengeris & Hazan, 2007, 2010; Sisinni & Grimaldi, 2009). Similarly, most studies carried out on the discrimination of L2 American vowel contrast have investigated the discriminability of L2 learners with a smaller number of L1 vowel categories than L2 vowel categories. For example, in the study of Lengeris and Hazan (2010), L2 Greek learners were trained to discriminate Southern British English vowel contrasts /iː/-/ɪ/ with a natural duration and neutralised duration, and /æ/-/ʌ/. In the natural duration condition, the duration of /iː/ was 110 ms while that of /ɪ/ was 70 ms. For the neutralised duration condition, the duration of /iː/ was 90 ms. The findings demonstrate, post-training, the discriminability of the contrast /iː/-/ɪ/ was improved while the discriminability for the contrast /æ/-/ʌ/ was not, thus suggesting that five sessions of English vowel training can only improve the categorisation of synthetic stimuli to a certain extent. Although some studies have been produced as to the discrimination of L2 British vowel pairs, the present research is the first study on the discriminability of British vowel contrast by L2 Thai learners. Additionally, this study is one of the few studies where the number of vowels in the L2 is smaller than in the L1.

6. Methodology

6.1 Participants

The participants of this study were those who participated in the studies of Kitikanan (2020a). The number of participants was 52 (50% males), with one half being English major university students and the other half being Computer Science major university students – both groups which used English mainly in the classroom and hence their English background constituted an 'English as a foreign language' (EFL) context. This demographic had studied English mostly with Thai teachers. Most modules of the Computer Science major were taught in Thai whereas many modules of the English major were taught in English. The high-experienced group comprised those with an English major background whereas the low-experienced group comprised those with Computer Science major. The high-experienced group had undertaken training in the transcription of IPA symbols for English sounds within an English Phonetics and Phonology module. All of the participants were 18-19 years old (M = 18.27), thereby being in their first year of university. All of the participants joined the research voluntarily and none had any impairments of speech or hearing at the time of the study being carried out.

6.2 Stimuli

The stimuli consisted of nine sound contrasts – /iː/-/ɪ/, /æ/-/ʌ/, /ɜː/-/ʌ/, /uː/-/ʊ/, /e/-/æ/, /ʌ/-/ɒ/, /ʊ/-/ɔː/, /ɑː/-/ʌ/, /ɜː/-/ɔː/. These contrasts were in the /b/-V-/t/ context. With this carrier phrase, the production of the stimuli should be more natural than having the speakers saying only the word list. They were produced in a carrier phase: 'Say___again.' The stimuli were derived from 11 English words: 'beet' /iː/, 'bit' /ɪ/, 'bet' /e/, 'bat' /æ/, 'bot' /ɒ/, 'bart' /ɑː/, 'bought' /ɔː/, 'butcher' /ʊ/, 'boot' /uː/, 'but' /ʌ/ and 'burt' /ɜː/. These were produced by three native speakers of British English from the English cities of Norwich, Oxford and Birmingham. The speakers were 34-36 years old, male and living in Thailand at the time of the research. None of the speakers reported having any impairments of speech and hearing at the time of the study. A Zoom: H4n Pro recorder was used to record the sounds in stereo at 44.1 kHz (16-bit quantisation). To ensure good-quality sounds, the recordings were made in a soundproofed meeting room at Naresuan University, Thailand. To ensure target-like realisations of the production by these speakers, these stimuli were impressionistically transcribed by the author who had undertaken phonetic training for British English sounds.

6.3 Data Collection

The collection of data in this study occurred in a computer room at Naresuan University. The task was run with a script on the Praat MFC (Boersma & Weenink, 2016). Each subject sat with a PC and headphones to listen to the sounds. The discrimination task constituted ABX, the most well-known method of investigating L2 sound contrast discriminability (Kitikanan, 2020b). The data subjects were told that they would hear three intervals in a trial and that they should pay attention to the vowels of each interval. Then, the participants had to choose whether the last interval was similar to the first interval or the second interval. Each listener heard 90 sound contrast trials, being able to have a break per every 50 sound contrast trials. They were told that the first interval

was always different from the second one. The intervals were randomised with a <PermuteBalancedNoDoublets> command. For each sound contrast, the participants were given 10 trials to listen to – five with the last one similar to the first one, and then five with the last one similar to the second one. The 10 trials were randomly selected from the production of the speakers. The data collection process took approximately 30 minutes per participant. This experiment holds ethical approval from the Naresuan University Institutional Review Board (COA No. 010/2019, IRB No. 0877/61).

6.4 Data Analysis

The total number of responses from this study was 4,680 (90 trials x 52 listeners). The responses from the Praat MFC (Boersma & Weenink, 2016) were transferred to Microsoft Excel. The discriminability of each contrast in the British English monophthongs by Thai learners was analysed and recorded as a percentage. It should be noted that not only does the PAM-L2 not specify specific rating scales for a goodness rating in classifying L2 sound contrast, but it also fails to provide the ratio discrimination difficulty. Thus, justifying discrimination difficulty as to L2 sound contrasts may be subjective. For example, discriminability of 80% may be held to be high and as suggesting a lack of discrimination difficulty for some people. In contrast, others may consider this percentage as an acceptable degree of discriminability. In this study, the cut-off point of 'no difficulty' in discriminating British English vowel contrasts was 80%.

To investigate the effect of L2 experience, as shown by Kitikanan (2020a), linear mixed models (LMM) using the *lme4* package (Bates, Maechler, Bolker, & Walker, 2015) was run via *RStudio* statistical software (RStudio Team, 2016). The score was dependent variable, with the full score being ten. The independent variables were L2 experience (high-experienced and low-experienced) and sound contrast. A model with the interaction of two factors was compared with a one-level model. The comparison of models using the *anova* function has shown no significant difference between the two models. Hence, the one-level model was used to report the results of this study. The significant difference between each pair of sound contrasts was then explored through *emmeans* package (Lenth, Love, & Herve, 2018) via *RStudio* statistical software (RStudio Team, 2016).

7. Results and Discussion

The hypotheses for this research were based on the findings of Kitikanan (2020a). Here, it was predicted that the high-experienced group should find discriminating all British English monophthong contrasts easy due to there being no overlapping match between the Thai sounds and target British English monophthongs. For the low-experienced group, it was hypothesised that high scores would be gained in correctly discriminating all sound contrasts as they matched most target British English monophthongs and different Thai sound categories. Additionally, for the British English /iː/-/ɪ/ and /æ/-/ʌ/, the low-experienced group were expected to find these two sound pairs easy to discriminate as they were classified as CG. As aforementioned, no scales exist for the discrimination difficulty of L2 sound contrasts suggested in the PAM-L2 and so the cut-off for 'discriminability with no difficulty' for this study was 80%.

For both groups of learners, this prediction was accurate for all discriminating pairs – with correct discrimination scores of over 80% being gained. The high percentage of correct discrimination as to the contrast /e/-/æ/ among both groups is in line with the finding that L2 Spanish learners discriminate this vowel contrast well as they match these two vowels to two different L1 vowel categories (Flege, Bohn, & Jang, 1997). The high levels of discriminability of most vowels might be due to the number of monophthongs in Thai outnumbering those in British English. This is supported by the finding in Lengeris and Hazan (2007), as evidenced that Japanese listeners benefited from the duration of Japanese vowels – the existence of short and long vowels – in completing a discrimination task as to Southern British English vowel contrasts. Many researchers (e.g., Best, 1995; Flege, 1995; Lado, 1957; Leung et al., 2021) have noted that L2 learners perceived L2 sounds via the filter of the L1 phonological system. The findings of this study suggest that the availability of L1 sound categories assist L2 sound contrast discriminability and that L1 experience could enhance the discriminability of sound pairs in an L2. However, for the /ʌ/-/ɒ/ contrast, the discrimination level was slightly lower as only a correct discrimination score of 75% was achieved.

In addition, as the British English /iː/-/ɪ/ and /æ/-/ʌ/ were classified as CG, it was expected that they would witness lower correct discrimination scores than other pairs. However, these hypotheses were only partially accurate as these two pairs were discriminated at a higher rate than the TC pairs of /ʌ/-/ɒ/ and /ɑː/-/ʌ/ but not other TC pair contrasts. The results as to the discrimination of British English vowels are presented in Table 1. Figure 1 also illustrates the discrimination of British English vowels, where it is clearly indicated that the /ʌ/-/ɒ/ contrast witnessed lower correct discrimination than other vowel contrasts and that both groups achieved consistent patterns of correct discrimination.

Table 1. British English contrast discrimination results by L2 Thai learners (percentage)

	/iː/-/ɪ/	/æ/-/ʌ/	/ɜː/-/ʌ/	/uː/-/ʊ/	/e/-/æ/	/ʌ/-/ɒ/	/ʊ/-/ɔː/	/ɑː/-/ʌ/	/ɜː/-/ɔː/
High-experienced	90.7	91.9	90.0	84.4	92.2	74.8	97.4	85.6	97.8
Low-experienced	83.2	84.8	85.6	86.0	88.4	74.4	91.2	81.6	94.0

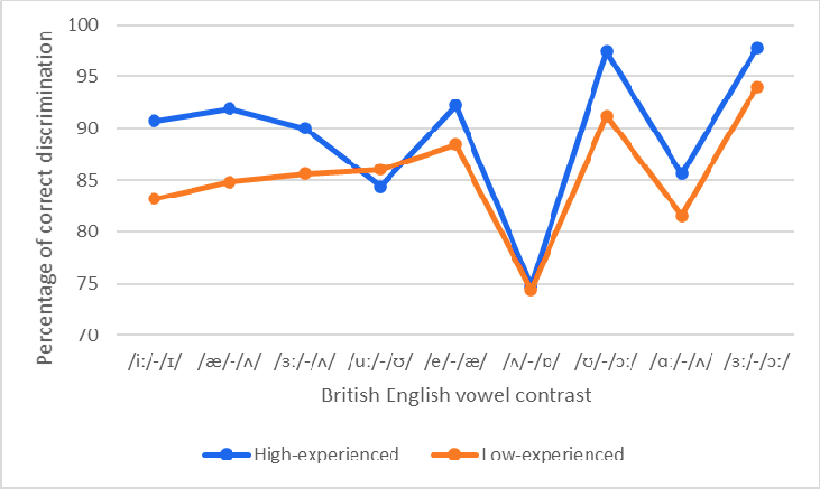

Figure 1. ABX results in the discrimination of British English contrasts by two groups of L2 Thai learners (percentage)

In regards to the effect of L2 experience, the LMM results showed the lack of effect of this factor in the discriminability of the learners ($p > 0.05$). This finding is in line with the finding that the discrimination of experienced and inexperienced L2 French speakers in perceiving British English vowels did not differ significantly post-training, thus suggesting no effect of L2 experience in discriminating British English vowel contrasts (Iverson et al., 2012). However, in contrast, Flege et al. (1997) and Jia et al. (2006) found that L2 exposure – in relation to the age of acquisition and number of years of experience – had a positive correlation with the ability to discriminate L2 sounds. This may be because Thai has many monophthongs allowing L2 Thai learners, regardless of their L2 experience, to match them with L2 British English monophthongs – as shown in the mapping of British English vowels to Thai vowels in a previous study (Kitikanan, 2020a). This matching of L1 Thai and L2 British English monophthongs enables L2 Thai learners to perceive the difference between the two L2 sounds, thereby resulting in high L2 sound discrimination scores for both high-experienced and low-experienced groups.

However, inferential statistical results have revealed that the /ʌ/-/ɒ/ contrast was the most difficult pair for L2 Thai learners to discriminate, receiving significantly lower correct discrimination scores than other vowel contrasts. This result is consistent with the discriminability of L2 Azerbaijani learners who gained A' mean score for the Southern British English (SSBE) contrast /ʌ/-/ɒ/ of below 0.5 (Mokari & Werner, 2017). This was the only pair among 11 vowel contrasts in SSBE that had a score of below 0.5, as suggests discrimination by chance or without phonetic sensitivity. As pointed out by Roach (2009), these two vowels are similar in that they are short vowels and produced with the jaw opening in the open-mid and open position. These similarities might cause difficulty for L2 learners in discriminating them. In addition, for some native speakers of British English, these two vowels are rather similar as shown in the acoustic study of Williams and Escudero (2014) wherein it was that Sheffield English speakers do not distinguish /ʌ/ from /ɒ/ in the production of their speech. Thus, the production of words, such as 'could' and 'cud' could be homophonous in Northern dialects. According to Carr (2013), the British vowel /ɒ/ is realised as /ɑ/ in American English. When the vowel /ɑ/ was tested with /ʌ/ via a discrimination task, it was found that L2 learners had difficulty in discriminating them. For example, the American English vowel pair /ʌ/-/ɑ/ gained the lowest accurate discrimination score among speakers of Brazilian Portuguese (20.83%), as may be due to the small F1-F2 difference between the vowels in this contrast (Rauber et al., 2005). This is supported by a plot presenting F1 and F2 values of British English monophthongs which were the stimuli of this study (Kitikanan, 2020b). Here, it was shown that the positions of the vowels /ʌ/ and /ɒ/ are close to one another.

The /ʊ/-/ɔː/ contrast received significantly higher correct discrimination scores than /ɑː/-/ʌ/, /æ/-/ʌ/, /iː/-/ɪ/, /uː/-/ʊ/ and /æ/-/ʌ/. The /ɜː/-/ɔː/ contrast received significantly higher correct discrimination scores than /ɑː/-/ʌ/,

/æ/-/ʌ/, /iː/-/ɪ/, /uː/-/ʊ/ and /ɜː/-/ʌ/. The prediction that the discrimination of British English /iː/-/ɪ/ and /æ/-/ʌ/ classified as CG would witness lower correct discrimination scores than other pairs has been found to be partially true. This prediction was correct in reflection that the two pairs received significantly lower discrimination scores than the /ʊ/-/ɔː/ and /ɜː/-/ɔː/ contrasts. The LMM results also show that the /ɑː/-/ʌ/ contrast received significantly lower correct discrimination scores than the /e/-/æ/ contrast. Table 2 shows the vowel pair contrasts which significantly differ from one another whereas Figure 2 indicates the discrimination scores of British monophthong contrasts across learner groups based on the LMM results. Table 3 presents the detail of the LMM results.

Table 2. Comparison of discriminability for each British English monophthong contrast across two groups of L2 Thai learners

	/iː/-/ɪ/	/æ/-/ʌ/	/ɜː/-/ʌ/	/uː/-/ʊ/	/e/-/æ/	/ʌ/-/ɒ/	/ʊ/-/ɔː/	/ɑː/-/ʌ/	/ɜː/-/ɔː/
/iː/-/ɪ/						*	*		*
/æ/-/ʌ/						*	*		*
/ɜː/-/ʌ/						*	*		*
/uː/-/ʊ/						*	*		*
/e/-/æ/						*			
/ʌ/-/ɒ/									
/ʊ/-/ɔː/						*			
/ɑː/-/ʌ/					*	*	*		*
/ɜː/-/ɔː/						*			

ns = insignificant at the level of .05

* ***p*** < .05

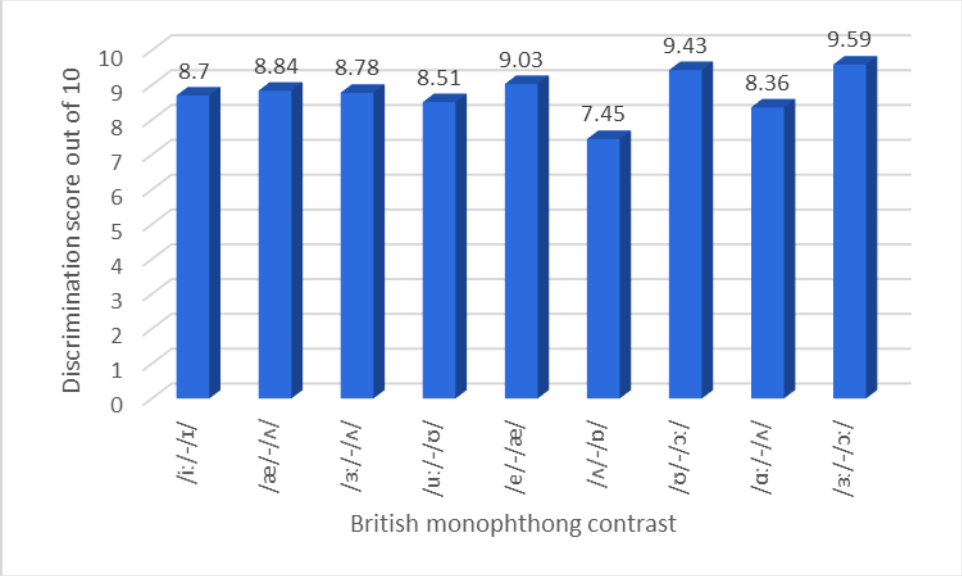

Figure 2. Discrimination scores of British monophthong contrasts across groups of the learners based on the LMM result

Table 3. Comparison of discriminability for each British English monophthong contrast across two groups of L2 Thai learners

	Estimate	Std. Error	df	t-value	p-value
/ɑː/-/ʌ/ vs /e/-/æ/	-0.67	0.18	424.16	-3.75	0.01
/ɑː/-/ʌ/ vs /ʊ/-/ɔː/	-1.08	0.18	424.16	-6.00	<.00
/ɑː/-/ʌ/ vs /ɜː/-/ɔː/	-1.23	0.18	424.16	-6.85	<.00
/ɑː/-/ʌ/ vs /ʌ/-/ɒ/	0.90	0.18	424.16	5.03	<.00
/æ/-/ʌ/ vs /ʊ/-/ɔː/	-0.60	0.18	424.16	-3.32	0.03
/æ/-/ʌ/ vs /ɜː/-/ɔː/	-0.75	0.18	424.16	-4.18	0.00
/æ/-/ʌ/ vs /ʌ/-/ɒ/	1.38	0.18	424.16	7.71	<.00
/iː/-/ɪ/ vs /ʊ/-/ɔː/	-0.73	0.18	424.16	-4.07	0.00
/iː/-/ɪ/ vs /ɜː/-/ɔː/	-0.88	0.18	424.16	-4.92	<.00
/iː/-/ɪ/ vs /ʌ/-/ɒ/	1.25	0.18	424.16	6.96	<.00
/e/-/æ/ vs /ʌ/-/ɒ/	1.58	0.18	424.16	8.78	<.00
/uː/-/ʊ/ vs /ʊ/-/ɔː/	-0.92	0.18	424.16	-5.14	<.00
/uː/-/ʊ/ vs /ɜː/-/ɔː/	-1.08	0.18	424.16	-6.00	<.00
/uː/-/ʊ/ vs /ʌ/-/ɒ/	1.06	0.18	424.16	5.89	<.00
/ʊ/-/ɔː/ vs /æ/-/ʌ/	0.65	0.18	424.16	3.64	0.00
/ʊ/-/ɔː/ vs /ʌ/-/ɒ/	1.98	0.18	424.16	11.03	<.00
/ɜː/-/ɔː/ vs /ɜː/-/ʌ/	0.81	0.18	424.16	4.50	0.00
/ɜː/-/ɔː/ vs /ʌ/-/ɒ/	2.13	0.18	424.16	11.88	<.00
/ɜː/-/ʌ/ vs /ʌ/-/ɒ/	1.33	0.18	424.16	7.39	<.00

8. Conclusion and Implication for Teaching and Learning

This study provides evidence that both high-experienced and low-experienced groups witnessed high L2 sound discrimination scores for most contrasts – recorded with an accuracy of over 80%. Phonetic training for most British English vowel contrasts might not be important as the availability of L1 Thai vowels seems to help learners perceive monophthongs in British English. However, this conclusion does not apply to the contrast of /ʌ/-/ɒ/, where the correct discrimination scores for both groups were only higher than 70% – this representing a moderate degree. In this study, no effect of L2 experience was found. Thus, the PAM-L2 correctly hypothesised that L2 Thai learners, regardless of their L2 experience, would easily discriminate L2 monophthong contrasts in British English. These results promote the use of perceptual assimilation experiments in exploring the mapping of L1 and L2 sounds and in using these findings to generate predictions for L2 sound contrast discrimination.

The implications of the study pertain, firstly, to the perception of the British English contrast /ʌ/-/ɒ/, whereby phonetic training might be necessary as this contrast has been found to be the most difficult to discriminate. Teachers might provide examples of these two vowels in other consonantal contexts besides /b_t/ - such as /ʌ/ in 'drunk', 'cut' and 'much', and /ɒ/ in 'lock', 'posh', and 'fox'. This may allow learners to gain a higher level of experience in perceiving these vowels and consequently a better ability to discriminate them. In addition, articulatory and phonetic descriptions for these two vowels should be provided to L2 Thai learners. Such learners should be aware that although both vowels are similar in being short vowels, the produced lip rounding and tongue height differ.

The second implication is that perceptual assimilation experiments are a good tool through which L2 teachers can investigate the representation of L2 sounds in terms of L1 sounds. The results from the matching of L1 sounds and L2 sounds is effective in predicting the discriminability of L2 sound contrasts. Whereupon a teacher finds an L2 sound contrast that L2 learners have difficulty with (i.e., two L2 sounds that are matched to the same L1 sound category), statistical analysis may be applied to see if the mappings comprise CG or SC assimilation. If SC assimilation is found, teachers can enhance the understanding of L2 learners towards the two sounds with more detail and examples of how they differ phonetically, auditorily, phonemically and articulatorily.

This study also indicates that L2 learners might rely on other ways of comparing L1 and L2 sounds. Thus, solely using a perceptual assimilation task might not be sufficient to understand the mechanism(s) of L2 sound learning. This implication is reflected in how the discriminability of British English /iː/-/ɪ/ and /æ/-/ʌ/ was higher than /ʌ/-/ɒ/ and /ɑː/-/ʌ/ though not other pair contrasts. The British English /iː/-/ɪ/ and /æ/-/ʌ/ were classified as CG and were expected to receive lower correct discrimination scores of than other TC pairs according to the PAM-L2. However, as aforementioned, this hypothesis was only partially found to be true. This suggests that, apart from exploring the perception of L2 sounds via a perceptual assimilation experiment, other methods (such as acoustic studies, impressionistic analysis, and the phonemic comparison of L1 and L2 sounds) should be used alongside perceptual assimilation tasks.

9. Limitations and Direction for Further Studies

The first limitation of this study relates to its participants. In this regard, both high-experienced and low-experienced groups were L2 Thai learners in an EFL context. This may be the reason as to why an effect of L2 experience was not found. In future studies, the discrimination of L2 sound contrasts by L2 Thai learners in an EFL context might be compared to that of L2 Thai learners in an 'English as a second language' (ESL) context where English is used as a medium of instruction. The higher exposure to English of ESL learners over that of EFL learners might result in better discriminability as indicated by the statistical difference between the discriminating scores as to L2 sound contrasts.

The second limitation of this study is that the stimuli used were in the /b/-V-/t/ context. The high L2 sound discrimination scores gained could be because the British monophthongs were in one particular context. It would be interesting to identify whether L2 Thai learners find the British monophthong contrasts easier in another consonantal context and thus this may be investigated – for example, by considering target vowels between fricative and stop sounds or between fricative and nasal sounds. It is possible that in such research, the participants might find L2 vowel contrasts in one consonantal context easier than in others.

Acknowledgement

This research would not have been possible without the exceptional comments of Alex Ho-Cheong Leung.

References

Abramson, A. S. (1962). The vowels and tones of standard Thai: Acoustical measurements and experiments. *Indiana University Center in Anthropology, Folklore, and Linguistics, 20*.

Abramson, A. S., & Reo, N. (1990). Distinctive vowel length: duration vs. spectrum in Thai. *Journal of Phonetics, 18*(2), 79-92. https://doi.org/10.1016/S0095-4470(19)30395-X

Al Mahnoud Mahmoud, S. (2013). Discrimination of Arabic contrasts by American learners. *Studies in Second Language Learning and Teaching, 3*(2), 261-291. https://doi.org/10.14746/ssllt.2013.3.2.6

Bates, D., Maechler, M., Bolker, B., & Walker, S. (2015). Fitting Linear Mixed-Effects Models Using lme4. *Journal of Statistical Software, 67*(1), 1-48. https://doi.org/10.18637/jss.v067.i01

Best, C. T. (1995). A direct realist perspective on cross-language speech perception. In W. Strange (Ed.), *Speech perception and linguistic experience: Issues in cross-language research* (pp. 171-204). Timonium, MD: York Press.

Best, C. T., & Strange, W. (1992). Effects of phonological and phonetic factors on cross-language perception of approximants. *Journal of Phonetics, 20*(3), 305-330. https://doi.org/10.1016/S0095-4470(19)30637-0

Best, C. T., & Tyler, M. D. (2007). Nonnative and second-language speech perception: Commonalities and complementarities. In M. J. Munro & O.-S. Bohn (Eds.), *Language Experience in Second Language Speech Learning: In honor of James Emil Flege* (pp. 13-34). Amsterdam: John Benjamins. https://doi.org/10.1075/lllt.17.07bes

Best, C. T., McRoberts, G. W., & Sithole, N. M. (1988). Examination of perceptual reorganization for nonnative speech contrasts: Zulu click discrimination by English-speaking adults and infants. *Journal of experimental psychology: human perception and performance, 14*(3), 345-360. https://doi.org/10.1037/0096-1523.14.3.345

Boersma, P., & Weenink, D. (2016). *Praat, a system for doing phonetics by computer* (Version Version 6.0.19). Retrieved from https://www.praat.org/

Carr, P. (2013). *English Phonetics and Phonology: An Introduction* (Vol. 2nd ed.). Oxford: Blackwell Publishing Ltd.

Deterding, D. (1997). The formants of monophthong vowels in Standard Southern British English pronunciation. *Journal of the International Phonetic Association, 27*(1-2), 47-55. https://doi.org/10.1017/S0025100300005417

Flege, J. E. (1995). Second language speech learning: Theory, findings, and problems. *Speech perception and linguistic experience: Issues in cross-language research*, 233-277.

Flege, J. E., Bohn, O.-S., & Jang, S. (1997). Effects of experience on non-native speakers' production and perception of English vowels. *Journal of Phonetics, 25*(4), 437-470. https://doi.org/10.1006/jpho.1997.0052

Iverson, P., Pinet, M., & Evans, B. G. (2012). Auditory training for experienced and inexperienced second-language learners: Native French speakers learning English vowels. *Applied Psycholinguistics, 33*(1), 145-160. https://doi.org/10.1017/S0142716411000300

Jia, G., Strange, W., Wu, Y., Collado, J., & Guan, Q. (2006). Perception and production of English vowels by Mandarin speakers: Age-related differences vary with amount of L2 exposure. *The Journal of the Acoustical Society of America, 119*(2), 1118-1130. https://doi.org/10.1121/1.2151806

Kallayanamit, S. (2016). Production of English vowel duration in monosyllabic words by Thai learners of English and its intelligibility. *Journal of Humanities, Naresuan University, 13*(2), 1-26.

Kitikanan, P. (2016). *L2 English fricative production by Thai learners* (PhD thesis). Newcastle University, Newcastle.

Kitikanan, P. (2020a). The Effect of L2 Experience on the Perceptual Assimilation of British English Monophthongs to Thai Monophthongs by L2 Thai Learners. *English Language Teaching, 13*(5), 1-10. https://doi.org/10.5539/elt.v13n5p1

Kitikanan, P. (2020b). *L2 Phonology*. Phitsanulok: Naresuan University Publishing House.

Lado, R. (1957). *Linguistics Across Cultures*. Ann Arbor, Mich.: University of Michigan Press.

Lai, Y.-h. (2010). English vowel discrimination and assimilation by Chinese-speaking learners of English. *Concentric: Studies in linguistics, 36*(2), 157-182.

Lengeris, A., & Hazan, V. (2007). Cross-language perceptual assimilation and discrimination of southern British English vowels by Greek and Japanese learners of English. Paper presented at the *Proceedings of ICPhS.*

Lengeris, A., & Hazan, V. (2010). The effect of native vowel processing ability and frequency discrimination acuity on the phonetic training of English vowels for native speakers of Greek. *The Journal of the Acoustical Society of America, 128*(6), 3757-3768. https://doi.org/10.1121/1.3506351

Lenth, R., Love, J., & Herve, M. (2018). *emmeans: Estimated Marginal Means, aka Least-Squares Means*. Retrieved from https://CRAN.R-project.org/package=emmeans

Lerdpaisalwong, S. (2015). *Perception Training of Thai Learners: American English Consonants and Vowels* (Doctoral dissertation). The University of Wisconsin-Milwaukee. Retrieved from https://dc.uwm.edu/cgi/viewcontent.cgi?article=2014&context=etd&sei-redir=1&referer=https%3A%2F%2Fscholar.google.co.th%2Fscholar%3Fhl%3Den%26as_sdt%3D0%252C5%26q%3DPerception%2BTraining%2Bof%2BThai%2BLearners%253A%2BAmerican%2BEnglish%2BConsonants%2Band%2BVowels%26btnG%3D#search=%22Perception%20Training%20Thai%20Learners%3A%20American%20English%20Consonants%20Vowels%22

Leung, A. H.-C., Young-Scholten, M., Almurashi, W., Ghadanfari, S., Nash, C., & Outhwaite, O. (2021). (Mis) perception of consonant clusters and short vowels in English as a foreign language. *International Review of Applied Linguistics in Language Teaching*, 000010151520210030. https://doi.org/10.1515/iral-2021-0030

Mokari, P. G., & Werner, S. (2017). Perceptual assimilation predicts acquisition of foreign language sounds: The case of Azerbaijani learners' production and perception of Standard Southern British English vowels. *Lingua, 185*, 81-95. https://doi.org/10.1016/j.lingua.2016.07.008

Nishi, K., & Kewley-Port, D. (2007). Training Japanese listeners to perceive American English vowels: Influence of training sets. *Journal of Speech, Language, and Hearing Research, 50*(6), 1496-1509. https://doi.org/10.1044/1092-4388(2007/103)

Pillai, S., & Salaemae, W. (2012). An Instrumental Analysis of English Monophthongs Produced by Thai EFL Learners. *Pertanika Journal of Social Sciences & Humanities, 20*(4).

Rauber, A. S., Escudero, P., Bion, R. A., & Baptista, B. O. (2005). The interrelation between the perception and production of English vowels by native speakers of Brazilian Portuguese. Paper presented at *the Ninth European Conference on Speech Communication and Technology*. https://doi.org/10.21437/Interspeech.2005-769

Richards, J. C. (1968). Pronunciation features of Thai speakers of English. Paper presented at *the Proceedings of The Linguistic Society of New Zealand, Auckland*.

Roach, P. (2004). British English: Received Pronunciation. *Journal of the International Phonetic Association, 34*(2), 239-245. https://doi.org/10.1017/S0025100304001768

Roach, P. (2009). *English Phonetics and Phonology: A practical course*. Cambridge: Cambridge University Press.

Roengpitya, R. (2001). *A study of vowels, diphthongs, and tones in Thai* (PhD Thesis). University of California, Berkeley.

RStudio Team. (2016). *RStudio: Integrated Development for R. RStudio, Inc*. Boston, MA. Retrieved from https://www.rstudio.com/

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

Selinker, L. (1972). Interlanguage. *International Review of Applied Linguistics in Language Teaching, 10*(1-4), 209-232. https://doi.org/10.1515/iral.1972.10.1-4.209

Sisinni, B., & Grimaldi, M. (2009). Second language discrimination vowel contrasts by adults speakers with a five vowel system. Paper presented at *the Tenth Annual Conference of the International Speech Communication Association*. https://doi.org/10.21437/Interspeech.2009-508

Skandera, P., & Burleigh, P. (2011). *A Manual of English Phonetics and Phonology* (2nd ed.). Dischingerweg: Narr Francke Attempto Verlag GmbH + Co. KG.

Tarone, E. (1994). Interlanguage. *Elsiver Ltd*, *4*, 1715-1719.

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. https://doi.org/10.1080/07268600902823144

Varasarin, P. (2007). *An action research study of pronunciation training, language learning strategies and speaking confidence* (PhD Thesis). Victoria University.

Williams, D., & Escudero, P. (2014). A cross-dialectal acoustic comparison of vowels in Northern and Southern British English. *The Journal of the Acoustical Society of America, 136*(5), 2751-2761. https://doi.org/10.1121/1.4896471