Vowel Adaptation in English Loanwords in Thai

Chanuwan Phetkla

A thesis submitted in partial fulfilment of the requirement

for the degree of Doctor of Philosophy (Integrated)

School of English Literature, Language and Linguistics

Newcastle University

February 2020

Declaration

I declare that this thesis is my own work. I have correctly acknowledged the work of others and no part of the material offered has been previously submitted by me for any other award or qualification in this or other university.

Signature: _____

Date: _____

Abstract

The use of English loanwords in everyday conversations of native Thai speakers is prevalent since many English words have been introduced to the Thai lexicon over the past 200 years. The nativisation of English loanwords into Thai has been carefully investigated in the last three decades; however, previous studies of Thai loanword phonology have primarily focused on consonants and tone assignment. Phonological adjustments made to the vowels have been less well-studied. This thesis investigates the phonological adaptation of English loanwords in Thai, focusing on adaptation patterns of monophthongs and diphthongs, and strategies employed to resolve non-native syllable structures which are ill-formed in Thai.

The study examines the phonological processes that are involved in the Thai adaptation of English vowels, investigates how the best match for non-native vowels is determined and explores the role of native phonology in vowel adaptation. The loan data examined in the study were mainly drawn from standard Thai dictionaries. The analysis is conducted within the framework of Optimality Theory (OT) to explore how the grammar of the borrowing language deals with non-native segments and syllable structures which are ill-formed in the native language. The OT analysis demonstrates that English vowels which are not in accord with markedness constraints cannot surface in Thai, and their best matches are determined on the basis of acoustic closeness together with the phonological structure of the borrowing language. It also reveals that different repair strategies for imperfect syllable structures in native words and loanwords result from distinct constraint rankings for native lexical items and foreign words.

The adaptation patterns identified in the loan corpus appear to show, firstly, that the phonetic characteristics of source vowels which are contrastive in the borrowing language are faithfully preserved in their adapted form, giving rise to phonological perception; secondly that a range of factors including phonetic, phonological, and non-linguistic factors are involved in determining how English vowels are realised in Thai; and thirdly that orthography plays a role if adaptation is underdetermined by other factors.

Acknowledgements

This thesis would not have been possible without the contributions of several people. First and foremost, I would like to express my sincere gratitude to my first supervisor Dr. S.J. Hannahs for his continuous support and constant encouragement throughout my PhD study. He always boosted my confidence and gave me suggestions with enthusiasm and patience at every stage of this study. I would also like to thank my second supervisor Dr. Danielle Turton who introduced me to acoustic phonetics which enabled me to account for adaptation patterns which could not be explained by phonological features. Without my supervisors' expertise, guidance and encouragement, it would not have been possible to complete the thesis.

My grateful thanks are also extended to Office of the Higher Education Commission in Thailand for the full sponsorship which enabled me to undertake the PhD study and to Faculty of Humanities and Social Sciences, Prince of Songkla University for granting me study leave while I was pursuing my studies.

My sincere thanks also go to Associate Professor Dr. Prathana Kannaovakun who encouraged me to apply for a PhD scholarship, to Assistant Professor Apapan Wannachot and Assistant Professor Dr. Cherdchai Udomphan for their help in verifying the Thai pronunciation of English loanwords and suggestions concerning the sound system of Thai. I would also like to thank Nisit Kamphikul who helped me with plotting vowels and Len Brooks for proofreading whenever needed.

I would also like to take this opportunity to thank my Thai friends at Newcastle University, fellow students at School of English Literature, Language, and Linguistics, and English friends for their beautiful friendship. Without them, my PhD life would have been more difficult.

Finally, I wish to thank my parents for their endless support and encouragement and my sister and brother for taking a very good care of Mum and Dad while I was away from home doing my PhD.

Table of Contents

List of Abbreviations

Am	American English
Br	British English
GenAm	General American
L1	First language
L2	Second language
OT	Optimality Theory
RP	Received Pronunciation
V_1	The first vocalic element of a diphthong
V_2	The second vocalic element of a diphthong
VG	A short vowel followed by a glide
V:G	A long vowel followed by a glide

List of Tables and Figures

Tables

Figures

Chapter 1

Introduction

1.1 Introduction

In language contact situations, we often find that speakers of one language will borrow words from the other to fill lexical gaps in their language. This may be due to cultural innovation, the prestige of the donor language, or the use of names of foreign cities or institutions, for example (Calabrese and Wetzels 2009). Foreign words borrowed into a language often contain segments and syllable structures which are illegal in the borrowing language. It has been reported that words from the source language will be systematically adapted, to a greater or lesser degree, so as to fit the phonological pattern of the borrowing language (e.g. Yip 1993; Paradis and LaCharité 1997; Kenstowicz 2007). Therefore, the way in which words borrowed from the same language are adapted differs widely from language to language. The English word 'cream' [k^hɹi:m], for instance, is rendered as [k^hri:m] in Thai (Rungruang 2008), [kei.li:m]/[k^{wh}i:m][1] in Cantonese (Hamann and Li 2016), and [kɯ.ɾi:.mɯ] in Japanese (Smith 2006). These different surface forms of the same loanword in different borrowing languages raise linguistically interesting questions. Do speakers of different languages perceive the same source sounds differently? Or are the sounds faithfully perceived, with some adjustments resulting from the phonology of the borrowing language? It is also reported that there are cases where a given phoneme of the source language has different adapted forms even in the same borrowing language. English voiceless stops in postvocalic position are mapped to either unapirated stops or aspirated stops with an epenthetic vowel in Korean (Kang 2003: 223). In Hawaiian, English /t, d/ are adapted to /k/ in general but the adaptation varies between /k/ and /ʔ/ in word-final position (Adler 2006: 1207). English nasal codas are variably mapped to either /n/ or /ŋ/ in Korean (Hsieh *et al.* 2009: 134). This raises a question as to whether the input to the adaptation process includes the phonetic details of the source language and if non-phonological factors such as orthography are behind variable matches. Another pattern is that foreign syllable structures in loanwords may be resolved through a repair strategy which is specific to loanwords. Some researchers propose that the native grammar includes loanword-specific

[1] The English word cream has two loan forms in Cantonese: [kei.li:m] (an earlier form) and [k^{wh}i:m] (a more recent form) (see a detailed discussion in Hamann and Li (2016)).

faithfulness constraints which are distinct from native input-output constraints (e.g. Kenstowicz and Suchato 2006; Yip 2006; Smith 2009). They argue that the adapter exercises some control over the native grammar to choose a strategy that produces an output which closely resembles the source word. An alternative view proposes that loanwords are in the periphery of the lexicon and they are allowed to violate constraints that are enforced in the core (Itô and Mester 1995a,b; 1999). Evidence for these emergent patterns from previous studies mainly revolves around consonant adaptation while behaviour of vowels has been less explored.

Despite the fact that the way in which English loanwords are nativised in Thai contexts has been systematically investigated over the past 30 years, previous studies of Thai loanword phonology have mainly focused on consonant behaviour, foreign syllable structure and tone assignment (e.g. Gandour 1979; Nacaskul 1979; Panlay 1997; Kenstowicz and Suchato 2006; Rungruang 2008) while adjustments made to vowels have been less well-studied. Previous studies which touch on vowel adaptation in Thai do not provide detailed descriptions of how vowels in English loanwords are adapted to comply with the Thai phonological system (Nacaskul 1979; Panlay 1997). Therefore, investigation of vowel adaptation which is a less understood area of loanword phonology can shed light on the phonological processes involved in loanword adaptation as well as the grammatical knowledge of speakers in ways that the native data cannot.

The rest of this chapter discusses language contact and English borrowings in Thai, describes aims of the study and its research questions, considers the loan data serving as the basis of analysis, and then explains the organisation of the thesis.

1.2 Language contact and English loanwords in Thai: a socio-historical history

The first contact between Thai and English dates back to the 17th century when British people began trading with Thais during the reign of King Songtham (1610-1628). English words, however, were not introduced into the Thai language until the reign of King Rama III (1824-1851) (Foley 2005: 224). Due to the growth of British overseas trade and power in Southeast Asian countries at that time, at least seventy English words consisting of personal names, titles, and place names were written in the Thai orthography (Nacaskul 1979: 151). To cope with British colonial power, King Rama IV (1851-1868), a son of King Rama III, started to learn English with a missionary when he was a prince. He was thus the first king who possessed a good knowledge of English and did not need an interpreter when communicating with foreigners (Darasawang 2007: 187). During his reign, diplomatic relations between Thailand

and the United States were established, and the wives of American missionaries were recruited to teach English to the King's children and members of royal family (Panlay 1997: 11). The King also sent his children and Thai scholars to study in Europe. During the subsequent reign of King Rama V (1868-1910) many westerners visited Thailand, which gave rise to a greater need for English. Accordingly, the King encouraged young Thai people, including his sons and relatives and the sons of nobles, to pursue their studies in Europe (Rungruang 2008: 24). English became the most prestigious foreign language at this time. As a result, a large number of English words began to enter the Thai lexicon because of the influence of Western civilisation in Thailand. Thai needed to borrow words from English as the former did not have native words to refer to Western ideas and inventions. Given that the King was also a writer, a lot of English loanwords were found in his *Far from Home*, a collection of letters written to his daughter when he visited Europe in 1908 (Khongnakhorn 2011: 79-80). Of 400 words, 123 are still used by Thai speakers, e.g. 'picnic', 'party', 'uniform', 'wine', 'tent', and 'sauce', and found in standard Thai dictionaries which are used as a major source of the loan data in the present study. The rest have been replaced by Thai native words, e.g. 'bread', 'castle', 'monument', and 'ticket'. Since then English has become the most popular source for word borrowing in Thai (Nacaskul 1979: 151). Thai kings, princes and other members of the royal family appeared to have been the first group of borrowers who introduced English loanwords to the Thai language as they had frequent contact with foreigners and English teaching was mainly restricted to the royal courts.

In 1921, English was first introduced into Thai formal education but it was only taught to primary students beyond grade four (Wongsothorn *et al.* 2002). However, it has become a compulsory subject for all primary students from grade one onwards since 1996. Students in Thailand are now required to learn English as a foreign language at school and university (Baker 2012). The Thai Ministry of Education has recommended a wide range of commercial textbooks that English language teachers can use as the basis of courses at the secondary level (Watson Todd and Keyuravong 2004). Most of the recommended textbooks feature standard written and spoken British English (henceforth Br). General American English (henceforth GenAm) is another variety which has been taught to Thai learners of English. We can see that Thai speakers are exposed to standard varieties rather than other specific dialects. English is also used widely in other domains in Thailand, for example, international business transactions, tourism, the internet, scientific and technology transfer, and the media (Foley 2005), which has given rise to the influx of English borrowed words into Thai. Hence, I assume that English loanwords are introduced by Thai speakers who have learned English at schools and universities.

English loanwords are used both in spoken and written discourse in Thai. They cover a wide rage of vocabulary including, science and technology, food and drinks, clothing and fashion, education, gambling, measurement units, art, medical sciences, music and dancing (Nacaskul 1979:152). To the best of my knowledge, the variety of English each word is borrowed from has not been documented in the literature. They also appear in the Royal Institution Dictionary which is an official dictionary of the Thai language. The first edition of the Royal Institution Dictionary (1950) contains approximately 50 English loanwords. A large number of them, more than 400 words, are added to the second edition (1982). This dictionary provides information on the origin of each foreign word but information on when it was borrowed is not available. As a native Thai speaker, I have observed that the use of English loanwords is prevalent among native Thai speakers who are monolingual or bilingual. Many of them even have English nicknames derived from English loanwords such as 'cherry', 'apple', 'cream', and 'honey'. Words borrowed from English are also widely found in Thai publications, including newspapers and magazines (Panlay 1997: 14). Certain English loanwords are used predominantly among educated people or bilingual speakers; these are rarely used by monolinguals and may not be understood by all Thai people. Examples are 'meeting', 'delay', 'debate', and 'summer'. Nevertheless, many English loanwords are widely used and have become fully nativised; they are used by Thai people as native words. These words are integrated into everyday Thai conversations and can be seen regularly in all kinds of publications. Examples are 'taxi', 'free', 'beer', 'cake', and 'football'. I observe that the English loanwords that are mainly used by educated people and those that are accepted by all Thai people are both adapted to fit the phonological system of Thai when they are used in the Thai context.

1.3 Aims of the study and research questions

The present study primarily aims to examine the phonological processes that are involved in the Thai adaptation of English loanwords, focusing on the behaviour of English monophthongs and diphthongs. Given that vowel adaptation has been less well-studied in Thai loanword phonology and that the majority of source vowels are not present in the native phonology, it also aims to investigate how Thai determines the best match for non-native vowels and to explore the role of native phonology in vowel adaptation. Therefore, the present study seeks to answer the following research questions.

1. Is the input to adaptation phonetic or phonological in nature?
2. How do Thai speakers deal with unlicensed vowels and syllable structures in English loanwords?
3. To what extent does the native phonology play a role in loanword adaptation?
4. What factors are involved in variations in the Thai adaptation of vowels in English loanwords?

To answer the above questions, a corpus of English loanwords in Thai has been compiled. The following section considers the loan data which serves as the basis of the analysis in this study.

1.4 Data

1.4.1 Data collection

As outlined in Section 1.2, English words have been introduced into the Thai lexicon for over 200 years. Some of these words are no longer used as they have been replaced by equivalent Thai words. The question arises as to which loanwords with paticular phonemic shapes are still being used by native speakers of Thai. Thus, standard Thai dictionaries were used as a major source of the loanwords examined in the present study. This is due to the fact that loanwords which are found in dictionaries must be used by native speakers of the borrowing language who are either monolingual or bilingual. The loan data examined in this study consist of 1,018 English loanwords with 1,724 loan vowel tokens (see the Appendix A for a corpus of the loanwords). Of the 1,018 loanwords, 408 were drawn from the fourth edition of the Royal Institute Dictionary (2011), 271 from three dictionaries of new Thai words (the Royal Institute Dictionary of New Words[2] 2007, 2009, 2011), and 101 from the Royal Institute's (2006) publication compiling foreign words that are used by Thai speakers and their Thai equivalents. The rest were taken from previous studies of English loanwords in Thai (Gandour 1979; Nacaskul 1979; Kenstowicz and Suchato 2006; Rungruang 2008) and other publications.

Moreover, the standard Thai dictionaries provide information about the origin of each loanword; this enabled me to compile foreign words which have been borrowed from English. As Thai has also borrowed several words from French (Boonyapaluk 2004), the use of standard dictionaries thus allowed me to exclude words which are borrowed directly from French; for

[2] The three volumes of this dictionary contain new Thai native words and loanwords which have not been added to the third and fourth editions of the the Royal Institute Dictionary.

example, words for units of measurement 'metre', 'litre', and 'gramme'. Such words are found in both English and French but they have different phonemic shapes in these two languages. If I had not consulted the dictionaries, I would have assumed that they were borrowed from English. Nevertheless, Thai has borrowed some other words for units of measurement from English where the roots of the words are 'metre', 'litre', and 'gramme'; for example, 'centimetre', 'centilitre', and 'centigramme'. These words were not included in the corpus as the Thai pronunciation of the root of each word matches the French phonology. It might also be the case that some loanwords used in Thai have been indirectly borrowed from French via English and their Thai pronunciation is similar to English. I treat such words as English loanwords rather than French loanwords.

Words related to chemistry and physics are also found in the Royal Institute Dictionary (2011). Despite the fact that they are not used by non-specialist native speakers of Thai, they were added to the corpus as I have observed that the adaptation of such words is not different from that of English loanwords which are widely used in Thai conversations. For example, the word 'manganese' [mæŋ.gə.niːz], which is a chemical element, and the word 'magazine' [mæ.gə.ziːn] which is understood by the general public are realised as [mæŋ.kaː.niːt] and [mǽk.kaː.siːn] respectively. It can be seen that the English vowels in these two words are realised as the same Thai vowels.

The English loanwords that are taken from the dictionaries and other publications are transliterated into the Thai orthography. The Thai spelling of an English loanword can tell us how the word becomes nativised in Thai. Take the English word 'bar' as an example. The spelling of this word in Thai is 'บาร์' pronounced [baː]. The graphemes <บ>, <า>, and <ร> represent the segments [b], [aː], and [r] respectively, and the special character above the grapheme <ร์> indicates that this consonant is not pronounced. Given that Thai does not allow a trill to occur in the coda position, the Thai orthography shows that the English /r/ is deleted. As seen in this example, although the trill is not allowed to occur syllable-finally in Thai, the spelling of this loanword in the source language is retained with the use of a special character to indicate that the English postvocalic /r/ is not realised in the loan. We can see that the Thai orthography can tell us how English loanwords are adapted to fit the native phonology.

1.4.2 Data analysis

The target phonological structures analysed in this study are monophthongs and diphthongs in English loanwords that contain up to three syllables. As all English phonemic vowels can occur

in stressed syllables, except for an English schwa, only monosyllabic loanwords cannot exhibit the behaviour of English schwa that is mainly found in unstressed position.

After the corpus of loanwords had been compiled, pronunciations of the English loanwords in Thai as well as those of their source words in English were transcribed using IPA symbols by the researcher, followed by the syllabification of each word, a comparison of syllable structure between the loan forms in Thai and their equivalents in English, and an examination of patterns of vowel adaptation. Given that the majority of loanwords were taken from dictionaries, prescriptive pronunciations of them might differ from their most frequent pronunciation by native speakers. To ensure that the phonetic transcription of the English loanwords in the corpus accurately represents their actual pronunciation, it was verified by two linguists who were native speakers of Thai. Online versions of Oxford English Dictionary and Cambridge Dictionary were used as a major source for the phonetic transcription of the source words in English.

The analysis of vowel adaptation in the present study is based on Optimality Theory and more details of this theoretical framework are presented in the next chapter. Any characteristics of the input to the adaptation process are based on the perception of the Thai speakers. The implication of this is that, for example, the vowel length in 'sight' is shorter than that in 'wine' (see a detailed discussion in Section 4.3.2). RP English vowels are mainly used as the input to the adaptation process, as I assume that British English is the chief source of most of the English loanwords in Thai. Take the words 'shock' (RP /ʃɒk/ vs GenAm /ʃɑːk/) and 'staff' (RP /stɑːf/ vs GenAm /stæf/) as examples. They are realised as [c^hɔk] and [staːp] respectively instead of *[c^haːk] and *[stæːp], suggesting that they have British English origins rather than American English origins. The possible influence of American English will be pointed out when relevant.

1.5 Organisation of the study

The rest of this thesis is structured as follows. Chapter 2 provides an overview of the Thai and English phonologies and presents current models of loanword phonology. In addition, it reviews previous studies on vowel adaptation in Thai and other languages and describes the theoretical framework adopted in this study. Chapters 3, 4, and 5 examine the adaptation patterns of English vowels emerging in the loan corpus and an OT analysis is proposed for the patterns observed. More specifically, Chapter 3 considers the behaviour of English monophthongs; Chapter 4 analyses the adaptation of English diphthongs; and Chapter 5 deals with the realisation of English unstressed vowels. The final chapter, Chapter 6, concludes the

thesis by summarising the main findings, discussing contributions and limitations of the study, and offering suggestions for future research.

Chapter 2

Linguistic Context

2.1 Introduction

The present study aims to examine the phonological processes that are involved in the Thai adaptation of English vowels, to investigate how the best match for non-native vowels is determined and to explore the role of native phonology in vowel adaptation. To achieve this, Section 2.2 provides an overview of the Thai and English phonologies. Section 2.3 then considers what phonological aspects of loanwords typically undergo adaptation. Section 2.4 describes current approaches to loanword phonology which have been proposed to capture the adaptation process. Section 2.5 deals with the role of orthography which is an extralinguistic factor appearing to condition certain adaptation patterns in several languages including Thai. Section 2.6 reviews previous studies on vowel adaptation in Thai and other languages, and Section 2.7 describes the theoretical framework adopted in this study.

2.2 Languages under investigation

This section addresses the fundamental features of the Thai and English phonological systems which are relevant to the content of later chapters. It covers the consonant and vowel systems of Thai and English, Thai and English syllable structures, Thai tones, and Thai speech styles. Recall that less than half of the English loanwords, which were found in the literary work written by King Rama V in 1908, are added to standard Thai dictionaries. Hence, I assume that the majority of English loanwords examined in this study are from a modern standard variety of English, but the possible influence of a historic variety is pointed out when relevant.

2.2.1 Thai and English consonants

Thai and English consonants are illustrated in Tables 2.1 and 2.2 respectively. They are classified along three major dimensions: voicing, place of articulation, and manner of articulation. Thai has 21 consonants and English has 24. Considering the descriptions of Thai and English consonants in the tables, it can be seen that the two aspects of consonants which constitute the main differences between Thai and English consonant systems are the phonemic status of aspiration, and voicing.

2.2.1.1 Aspiration

Both Thai and English have aspirated and unaspirated voiceless stops; however, as can be seen in Table 2.1, aspiration is phonemic in Thai, but this phenomenon is an allophonic feature of English voiceless stops. In Thai, the aspirated voiceless stops /p^h/, /t^h/, /c^h/, /k^h/ are distinct phonemes; replacing them with their unaspirated counterparts will cause a change in meaning as shown in the following minimal pairs.

(1)	/p^han/	'to bind'	/pan/	'to share'
	/t^ham/	'to make'	/tam/	'to pound'
	/c^ha:n/	'terrace'	/ca:n/	'plate'
	/k^ha:ŋ/	'chin'	/ka:ŋ/	'to spread out'

Unlike in Thai, aspiration in English is allophonic. With respect to the English voiceless stops /p, t, k/, when they occur initially in a stressed syllable, they are usually accompanied by aspiration and realised as [p^h, t^h, k^h], e.g. [p^hæn] 'pan', [t^hæn] 'tan', and [k^hæn] 'can'. As for the stops preceding a vowel in an unstressed syllable as in 'polite' or occurring word-finally as in 'lip', there may also be aspiration, but it is relatively weak (Cruttenden 2001). Stops that follow initial /s/ are pronounced with no aspiration, as in [spɪn] 'spin', [stɑ:f] 'staff', and [skɪn] 'skin'. Given that aspirated and unaspirated English voiceless stops occur in complementary distribution, it is clear that aspiration is not contrastive in English.

Table 2.1: Thai phonemic consonants (Luksaneeyanawin 1983)

Manner	Place					
	Bilabial	Labio-dental	Alveolar	Palatal	Velar	Glottal
Stop	p b p^h		t d t^h	c c^h	k k^h	ʔ
Nasal	m		n		ŋ	
Fricative		f	s			h
Lateral			l			
Trill			r			
Glide	w			j		

Table 2.2: English phonemic consonants (Roach 2004: 240)

Manner	Place							
	Bilabial	Labio-dental	Dental	Alveolar	Post-alveolar	Palatal	Velar	Glottal
Stop	p b			t d			k g	
Affricate					tʃ dʒ			
Fricative		f v	θ ð	s z	ʃ ʒ			h
Nasal	m			n			ŋ	
Lateral approximant				l				
Approximant	(w)				ɹ	j	w	

2.2.1.2 Voicing

Voicing appears to play a more important role in English than in Thai. As shown in Table 2.1, Thai exhibits voicing contrast only in stops and there are two pairs of stops that differ only in voicing; they are /p, b/ and /t, d/. Such contrasts only occur in initial position, as in /pâːn/ 'blunt' vs /bâːn/ 'house' and /tam/ 'to pound' vs /dam/ 'black'. Thai has no voicing contrast in final obstruents since only the voiceless stops /p, t, k/ can occur in the coda, as in /rûːp/ 'picture', /rák/ 'love', and /wát/ 'temple'. For the other Thai consonants, there is no voicing contrast; Thai fricatives are voiceless while nasals and approximants are voiced. Considering the English consonants in Table 2. 2, we can see that there are several pairs of consonants that are distinguished by voicing. English has voicing contrasts in stops, affricates, and fricatives (with the exception of /h/). As far as English voiced stops are concerned, it is noted in the literature (e.g. Cruttenden 2001; Ladefoged and Disner 2012) that the phonemes /b, d, g/ are fully voiced when they occur between voiced sounds, as in 'eager', 'windy' and 'rub out'. They may be partially voiced or completely voiceless in initial and final positions as in 'bin', 'deal', 'game', 'cab', 'lid', and 'wig'; in these positions, they are realised as [b̥, d̥, g̊]. By contrast, Thai has fully voiced stops. The Thai /b,d/ are always realised as [b,d]. The next section deals with the Thai and English vowels.

2.2.2 Thai and English vowels

This section introduces the vowel systems of Thai and English. Two types of vowels presented here are monophthongs and diphthongs. English vowels are based on the RP British English vowel inventory. The reason for selecting this variety as a basis for discussion is that the majority of English loanwords in the loan corpus are borrowed from RP British English[3].

2.2.2.1 Monophthongs

Thai has 18 monophthongs and British English has 12, as illustrated in Tables 2.3 and 2.4 respectively. All of the Thai vowels in Table 2.3 can occur in monosyllabic words and stressed syllables. Of the 12 English monophthongs, 11 of the vowels can occur in stressed position whereas the vowel /ə/ is restricted to unstressed position. In the tables, the vowels are classified along the three dimensions of tongue height (high/low), tongue backness (front/back), and lip rounding (rounded/unrounded).

Table 2.3: Thai monophthongs (Luksaneeyanawin 1983)

	Unrounded		Rounded
	Front	Central	Back
High	i iː	ɯ ɯː	u uː
Mid	e eː	ɤ ɤː	o oː
Low	æ æː	a aː	ɔ ɔː

Table 2.4: British English monophthongs (Roach 2004)

	Unrounded			Rounded
	Front	Central	Back	Back
High	ɪ iː			ʊ uː
Mid	ɛ	ɜː ə		ɔː
Low	æ	ʌ	ɑː	ɒ[4]

[3] One of the strong pieces of evidence showing that most English loanwords in Thai have British English origins is that BATH and LOT words have [aː] and [ɔ] respectively in Thai loan forms. In the loan corpus, three English BATH words, namely 'dance', 'cast', and 'sample', are borrowed from American English because the vowels in these three words surface as [æː] in Thai.

[4] Wells (1982b:281) notes that CLOTH words such as 'cross' and 'soft' have /ɔː/ rather than /ɒ/ in older RP. Given that English loanwords have been introduced into Thai for over 200 years, there are cases where vowel tokens in such words are mapped to Thai /ɔː/ in the loan corpus (see Section 3.4.1).

Thai and English vowels have three height distinctions: high, mid, and low vowels. The Thai vowels /i, iː, ɯ, ɯː, u, uː/ and the English vowels /ɪ, iː, ʊ, uː/ are high vowels. The Thai mid vowels are /e, eː, ɤ, ɤː, o, oː/ and the English mid vowels are /ɛ, ɜː, ə, ɔː/. Thai has six low vowels which are /æ, æː, a, aː, ɔ, ɔː/ and English has four low vowels which are /æ, ʌ, ɑː, ɒ/. With respect to the front/back dimension, there are three-way distinctions in both languages. The Thai /i, iː, e, eː, æ, æː/ and English /ɪ, iː, ɛ, æ/ are front vowels. Thai has six central vowels: /ɯ, ɯː, ɤ, ɤː, a, aː/, but English has three: /ɜː, ə, ʌ/. Meanwhile /u, uː, o, oː, ɔ, ɔː/ are Thai back vowels and /ʊ, uː, ɔː, ɒ, ɑː/ are English back vowels. As far as lip rounding is concerned, it can be seen that the front and central vowels in the two languages are all unrounded. Moreover, we can see that all Thai back vowels are rounded, suggesting that unrounded back vowels are marked in Thai. Unlike in Thai, not all English back vowels are pronounced with lip rounding. As shown in Table 2.4, the vowels /ʊ, uː, ɔː, ɒ/ are rounded whereas /ɑː/ is unrounded.

Although the classifications of the Thai and English vowels presented in Tables 2.3 and 2.4 are based on the three major aspects—tongue height, tongue backness, lip rounding, the length of vowels is another important aspect of vowel classification. For Thai monophthongs, vowel length is contrastive and they can be grouped into short and long vowels. All Thai short vowels have their long counterparts, as illustrated in Table 2.3; for example, /i, iː/, /e, eː/, and /æ, æː/. Acoustic studies of distinctive vowel length in Thai have shown that vowel duration is the main cue to distinguish between short and long vowels in Thai (e.g. Abramson 1962, 1974; Abramson and Ren 1990; Abramson 2001; Roengpitya 2002b; Tsukada 2009). British English vowels can also be characterised in terms of length. The English short vowels are /ɪ, ɛ, æ, ə, ʌ, ʊ, ɒ/ and the long vowels are /îː, ɜː, uː, ɔː/. Acoustic studies of English vowels have shown that vowels before voiced and voiceless consonants exhibit a systematic difference in duration (e.g. Peterson and Lehiste 1960; Hogan & Rozsypal 1980; Luce & Charles-Luce 1985). That is, vowels are considerably longer before a voiced consonant than before a voiceless consonant. Of the short vowels, Cruttenden (2001) points out that the vowel /æ/ generally has longer duration in RP than the others. It can be as long as long vowels when it appears in the context of voiced consonants, as in ‘man’, ‘bad’, ‘bag’, and ‘cab’. English monophthongs can also be classified as tense and lax classes since vowel length contrast is not phonemic in English (Hillenbrand *et al.* 2000; Reetz and Jongman 2009). This is due to the fact that English tense and lax vowels differ primarily in quality and not in duration. The pairs /ɪ-iː/ and /ʊ-uː/, for example, are distinguished by a tense-lax opposition as they are different not only in length but

also in quality; that is, the lax vowels are shorter, more central and less high than their tense counterparts (Carr 2013: 22). The next section describes Thai and English diphthongs.

2.2.2.2 Diphthongs

British English is richer in diphthongs than Thai. There are eight diphthongs in RP[5], namely /eɪ/, /aɪ/, /ɔɪ/, /əʊ/, /aʊ/, /ɛə/, /ɪə/, and /ʊə/ (Roach 2004) while Thai has only three phonemic thongs, namely /ia/, /ɯa/, and /ua/ (Nacaskul 2013). The Thai diphthongs are all opening diphthongs, and vowel sequences that can form a diphthong in Thai begin with a high vowel and end with /a/. This type of diphthong in Thai is said to be rising diphthongs as they start with a vowel of lower prominence and end with a more prominent vowel. Thai diphthongs are not contrastive in length (Nacaskul 2013; Roengpitya 2001, 2002a). Short and long diphthongs are not phonemically distinctive. They are basically long when they occur in monosyllabic words or in stressed position, as shown in (2). They will become shorter when they are followed by a final glottal stop or appear in unstressed syllables, and only /ia/ and /ua/ can occur before the glottal stop, as in (3) (Nacaskul 2013). However, the short diphthongs [ia] and [ua] are restricted to Chinese loanwords and onomatopoeic words (Ruangjaroon 2006: 4).

(2) /sĭaŋ/ → [sĭːaŋ] 'noise'
/lûuak/ → [lûːak] 'to choose'
/wua/ → [wuːa] 'cow'

(3) /pʰìaʔ/ → [pʰìaʔ] 'a sound of slapping'(an onomatopoeic word)
/kíaʔ/ → [kíaʔ] 'wooden sandals'(a Chinese loanword)
/júaʔ/ → [júaʔ] 'angry' (a Chinese loanword)

It is noted in the literature (Luksaneeyanawin 1983) that Thai has many vowel plus glide sequences as shown in (4). This might raise a question concerning the status of Thai glides. It is argued that such sequences are not diphthongs given that the glide is not part of the nucleus. A vowel plus glide sequence acts like a nucleus plus coda in Thai because the off-glide cannot be followed by any tautosyllabic consonants in the coda position as seen below.

[5] a. It is noted in the literature (Carr 2013: 25; Cruttenden 2001: 135) that GOAT words are pronounced with [oʊ] among older speakers of RP. Given that English words have been introduced into the Thai lexicon since 1824, it is assumed that early English loanwords with the GOAT vowel in Thai must have had /oʊ/in the source language. English /əʊ/ is likely to serve as the input to the adaptation process in recent loanwords. The way that Thai speakers deal with these two English diphthongs is discussed in Section 4.3.1.
b. Cruttenden (2001: 83) notes that English /ɪə/ and /ʊə/ can be realised as [ɪː] and [ʊː] in RP, which is a recent trend. These changes are reflected in the adaptation of some English loanwords having the NEAR and CURE vowels.

(4)	/hĭw/	‘hungry’	/kàj/	‘chicken’
	/rew/	‘fast’	/lɔːj/	‘to float’
	/kaːw/	‘glue’	/kʰuj/	‘to talk’

Among the English diphthongs, the vowels /eɪ, aɪ, ɔɪ, əʊ, aʊ/ are closing diphthongs; the first element can be a mid or low vowel and the second one is restricted to a high vowel. The other three diphthongs /ɛə, ɪə, ʊə/ are centring diphthongs; mid and high vowels can occur as the first element of this type and the second element is limited to a mid vowel /ə/. The English diphthongs are also referred to as falling diphthongs as the second element is less prominent than the first one. It can be seen that falling diphthongs are preferred in English; Thai, on the other hand, favours rising diphthongs.

2.2.3 Thai and English syllable structures

There is a marked contrast between Thai and English syllable structures. Thai has a simple structure containing at least two parts, namely, an onset and a nucleus: C(C)V(C) (Nacaskul 2013: 170). A tone is also obligatorily associated with the syllable in Thai (see section 2.2.4 for Thai lexical tones). Unlike Thai, English has a more complex syllable structure: (C)(C)(C)V(C)(C)(C)(C) (Hammond 1999: 37) which allows a very wide range of syllable types. The syllable types permissible in Thai and English are shown below in (5) and (6).

(5) Thai syllable types

a. Open syllables

CV	/nâː/	‘face’
	/bʉ̀a/	‘bored’
CCV	/kʰruː/	‘teacher’
	/pʰlía/	‘a small insect’

b. Closed syllables

CVC	/ŋɤn/	‘money’
	/mêːk/	‘cloud’
CCVC	/wan/	‘day’
	/kʰwăːn/	‘axe’

(6) English syllable types

a. Open syllables

V	‘a’
CV	‘ray’
CCV	‘tray’
CCCV	‘stray’

b. Closed syllables

VC(C)(C)(C)	‘oat’, ‘apt’, ‘angst’, ‘angsts’
CVC(C)(C)(C)	‘boat’. ‘range’, ‘text’, ‘texts’
CCVC(C)(C)	‘bloat’, ‘trains’, ‘sphinx’
CCCVC(C)(C)	‘stroke’, ‘strange’, ‘strengths’

Hammond (1999: 37)

As can be seen from the permissible syllable structures of Thai and English, an onset is obligatory in Thai but it is optional in English. As illustrated in (5), the maximum number of consonants that can make up the syllabic onset in Thai is two; however English, as shown in (6), allows up to three consonants to appear in the onset of a syllable.

Thai allows only vowels to occupy the nucleus of a syllable. Only long vowels and diphthongs can form the nucleus of an open syllable, as Thai monosyllabic words are bimoraic (Morén and Zsiga 2001: 184). Thai short vowels can occur only in closed syllables. Similarly, a lax vowel cannot end a monosyllabic word in English to satisfy a bimoraic minimum (Hammond 1999: 41). All stressed English monosyllables must consist of at least a tense vowel, a diphthong, or a lax vowel (with the exception of /ə/) followed by a syllable coda. Unlike Thai, English permits certain consonants to form a syllable nucleus. The possible pronunciations of ‘bottle’ in British English, for example, are [bɒtəɬ], [bɒtl̩], and [bɒʔl̩] (Carr 2013: 62). Although the [ə] is absent in the last two pronunciations, the word still has two syllables, given that the lateral becomes syllabic.

When it comes to codas, the permissible syllable types of Thai and English as shown in (5) and (6) reveal that neither language requires codas. Thai allows only a single consonant to occur in the coda of a syllable. On the other hand, complex codas are allowed in English; as English has inflectional suffixes, the maximum number of consonants that can make up the syllabic coda is four, as in [tʰɛksts] ‘text’ and [æŋsts] ‘angsts’. Apart from consonants and

vowels, tones are the other important aspect of the Thai phonological system, as outlined in the following section.

2.2.4 Thai tones

As Thai is a tonal language, tones play an important role in changing meaning of words. There are five lexical tones in Thai: three level and two contour tones (Nacaskul 2013). The level tones consist of mid, low, and high tones while the contour tones are falling and rising tones as shown in Table 2.5. The diacritics above the vowels in the table are tone markers: low (ˋ), falling (ˆ), high (ˊ), rising (ˇ). As for the mid tone, it is unmarked.

The distribution of these lexical tones is determined by syllable structure (Nacaskul 2013). All five tones can fall on open syllables and syllables having a short or long vowel followed by a sonorant, as in /pʰæː/ 'raft', /tàm/ 'low', /kʰâːw/ 'rice', /wún/ 'jelly', /fǎj/ 'mole'. Syllables having a short vowel with a final obstruent are assigned only the low and high tones, as in /pìt/ 'to close', /hàk/ 'broken', and /ríp/ 'to confiscate'. On syllables consisting of a long vowel or diphthong followed by an obstruent, excluding a glottal stop, only the low and falling tones are permitted, as in /bùak/ 'plus', /bìːp/ 'to squeeze', /mîːt/ 'knife', and /mûːt/ 'dark'.

Table 2.5: Thai lexical tones

Mid	/kʰaː/	'to stick'
Low	/kʰàː/	'a vegetable'
Falling	/kʰâː/	'value'
High	/kʰáː/	'to trade'
Rising	/kʰǎː/	'leg'

English words borrowed into Thai are assigned tones as well. The distribution of Thai tones in English loanwords is not random but is constrained by syllable structure (Gandour 1979; Nacaskul 1979). With respect to English monosyllables, those ending in vowels and sonorant segments are assigned a mid tone, as in [pʰlam] 'plum', [waːj] 'wine', [friː] 'free', and [cʰoː] 'show'. English monosyllabic words ending in obstruent segments are mainly assigned a high tone such as [sɔ́ːt] 'sauce', [cóːk] 'joke', [rǽp] 'rap', [bǽŋ] 'bank', and [sáj] 'size'. There are, however, some words with this syllable type which have a low tone, as in [sɜ̀ːp] 'serve' and [kʰlàp] 'club'. Nacaskul (1979) points out that the high tone appears to be favoured in English loanwords ending in non-sonorant segments. In Thai, a syllable consisting of a long vowel with

a final obstruent never possesses the high tone, but this tone can be found in English loanwords, as in [sɔ́ːt] ‘sauce’, and [cóːk] ‘joke’.

Gandour (1979) notes that the assignment of tones to English monosyllables is determined on the basis of the English syllable structure. Considering the words ‘wine’ and ‘size’, we can see that the final consonants are not realised in the Thai loan forms. These two words surface as [waːj] with mid tone and [sáj] with high tone respectively, for the former ends in a sonorant segment and the latter in a non-sonorant segment in English. With respect to English words having more than one syllable, syllables ending in vowels and sonorant segments are assigned mid tone in non-final position but falling tone in final position, as in [wiː.sâː] ‘visa’, [boː.lîŋ] ‘bowling’, and [fæː.cʰân] ‘fashion’. Meanwhile syllables ending in non-sonorant segments generally bear high tone in both final and non-final position, as in [rák.bîː] ‘rugby’, [lék.cʰɤ̂ː] ‘lecture’, [seː.lép] ‘celeb’, and [tʰen.nít] ‘tennis’.

Not only does syllable well-formedness in Thai determine the adaptation of English loanwords, but speech styles in Thai also play a role in the realisation of vowels in English loanwords containing more than one syllable. The next section introduces the realisation of polysyllabic Thai words in different speech styles.

2.2.5 Thai speech styles

Despite being regarded as a monosyllabic language, Thai has a large number of words which have more than one syllable. This is due to the fact that Thai has had long contact with Pali and Sanskrit in which words are typically non-monosyllabic (Luksaneeyanawin 1983). A lot of polysyllabic Thai words, therefore, have been derived from these two languages. As the loan data in the present study consist of not only monosyllabic but also polysyllabic words, the realisation of English loanwords having more than one syllable is conditioned by Thai speech styles, especially those with CV syllables.

Following Henderson (1949), Surintramont (1973), and Bennett (1995), I assume that Thai has three main speech styles: isolative, combinative, and rapid combinative. Each style of speech governs the realisation of monosyllabic and polysyllabic Thai words as shown in (7). Let us first consider the isolative style. All syllables of non-monosyllabic words in this speech style are pronounced as ‘a succession of monosyllables, each conforming in structure to the pattern appropriate to monosyllables uttered in isolation’ (Henderson 1949: 189). It follows that each syllable is bimoraic and stressed in this speech style. Henderson (1949) notes that this style of speech is commonly used for the deliberate pronunciation of words having more than

one syllable and is found in dictionaries. The data in (7) reveal that underlying CV syllables are realised with an epenthetic glottal stop in the isolative style. They are not stressed in the combinative and rapid combinative styles, except for in final position where syllables are always stressed regardless of speech style. In other words, non-final CV syllables do not surface with an epenthetic glottal stop in these two speech styles since they usually do not receive stress. As for final syllables, they are always stressed in all speech styles; thus final CV syllables always undergo glottal stop epenthesis, as seen in the Thai word for 'rubbish'.

(7)

Words	Underlying	Isolative	Combinative	Rapid combinative
'country'	/prat^{h}eːt/	[pràʔ.t^{h}êːt]	[pra.t^{h}êːt]	[pra.t^{h}êːt]
'rubbish'	/k^{h}aja/	[k^{h}àʔ.jàʔ]	[k^{h}a.jàʔ]	[k^{h}a.jàʔ]
'watch'	/naːlikaː/	[naː.lîʔ.kaː]	[naː.li.kaː]	[na.li.kaː]
'manner'	/kirijaː/	[kìʔ.ríʔ.jaː]	[ki.ri.jaː]	[ki.ri.jaː]

(Bennett 1995)

To sum up, this section has considered the fundamental features of the Thai (the borrowing language) and English (the source language) phonological systems, including their vowels, consonants, and syllable structures as well as the prosodic system and speech style of the borrowing language.

The following section deals with phonological aspects of loanwords which are typically modified to become acceptable words in borrowing languages.

2.3 Phonological adaptation of loanwords

Findings from previous loanword studies reveal that the output of adaptation processes is a native form that exhibits minimal changes from its original foreign form. Modifications made to loanwords can occur during production and/or perception (see Section 2.4 for approaches to loanword adaptation). It is reported in the literature (e.g. Kang 2011) that such adaptation affects all aspects of the phonological system, revealing the segmental, phonotactic and prosodic constraints of the borrowing language.

On the segmental level, when the foreign input contains a non-native segment, the speaker will replace it with a native one that most closely resembles the original sound. For example, the English voiced velar stop /g/ is adapted to [k] in Thai (Rungruang 2008), preserving the place feature of the input; the English coronal stops /t/ and /d/ are mapped to [k]

in all syllabic positions and to [ʔ] in word-final position instead of [l] or [n] in Hawaiian (Adler 2006), preserving the sonority of the input segments.

On the phonotactic level, illicit syllable structures are adapted to conform to those of the borrowing language. There are two possible repair strategies that bring the foreign input with imperfect syllable structure in line with native phonotactics (Kang 2011): epenthesis and deletion. As far as word-initial clusters are concerned, epenthesis is the most preferable repair strategy in most languages where onset clusters or certain sequences of consonants are not allowed (Uffmann 2007; Kang 2011). For example, Japanese does not allow consonant clusters, and onset clusters are repaired by vowel epenthesis; thus, the English loanword 'cream' /kriːm/ is realised as [kɯriːmɯ] (Smith 2006). Vowel insertion is also a common strategy for dealing with word-initial consonant clusters in loanwords in Tongan, as in 'flu' [fulu] (Riggs 2014: 100). When it comes to word-final coda clusters, repair strategies for such marked structure are more variable and it is not clear if epenthesis is preferred over deletion across languages. Examples of languages that simplify complex codas through vowel insertion are Japanese (Katayama 1998), Korean (Kang 1996), Gĩkûyû[6] (Mwihaki 2001), and Sesotho (Rose and Demuth 2006). There are, however, languages that favour deletion over epenthesis for repair, such as Burmese (Chang 2009) and Thai (Kenstowicz and Suchato 2006). For example, the English loanwords 'August' /ɔːˌgʌst/ and 'golf' /gɒlf/ surface as [ʔɔ̀.gouʔ] and [gauʔ] respectively in Burmese.

As for the prosodic level, when words in one language are borrowed into another language and the two languages do not share the same suprasegmental system, this raises a question as to how prosodic adaptation is accommodated (Davis *et. al* 2012). Taking English loanwords in Cantonese as examples, English is a stress language while Chinese is a tone language. English stress is mapped to particular tones in Cantonese (Silverman 1992). That is, a primary stressed syllable is assigned a high tone [H] and a non-primary stressed one is mapped to a mid tone [M], as in 'cigar' [süt[M] ka[H]]. An epenthetic syllable in non-final position receives a low vowel [L], as in 'stick' [si[L] tik[H]]. In the case that the two languages which come into contact have the same prosodic system, loanwords also undergo adaptation (Kang 2010). Let us consider cases where a stress language borrows words from another stress language. If the stress position in the input is not allowed in the native language, the ill-formed structure usually undergoes stress shift. For instance, stress in French is usually placed on the final syllable of a word. Words from English which have initial stress are repaired by shifting

[6] A major Bantu language spoken in Kenya

the stress to the final position in French, as in 'walkman' [wɔkmán] (Peperkamp and Dupoux 2003). Alternatively, the stressed syllable of the input is placed in an acceptable position by segmental deletion. Take a look at Spanish loanwords in Huave which is a language isolate spoken in southeastern Oaxaca State, Mexico. Here, stress falls on the final closed syllable in native words. If a word ends in an open syllable, the penultimate syllable receives stress (Davidson and Noyer 1997; Broselow 2009). Spanish loanwords which have non-final stress undergo segmental deletion so that stressed syllables in the source words will bear stress in adapted forms and also comply with the native metrical restrictions, as in /garabáto/ → [garabát] 'hook'.

This section has shown that, when a foreign word is introduced into a language and it does not conform to its phonological system, it undergoes adaptation. The question then arises as to whether such adaptation occurs during perception or production. The following section addresses two current models of loanword adaptation that account for the adaptation process.

2.4 Models of loanword adaptation

One of the major issues in loanword phonology still being debated is the question of whether adaptations take place at the phonemic level or at the phonetic level. The current literature distinguishes two major positions: phonological and perceptual stances.

2.4.1 Phonological stance

The phonological view proposes that loanword adaptation is phonological in nature and is entirely determined by the phonological grammar of the borrowing language (e.g. Paradis and LaCharité 1997, 2008, 2011; Jacobs and Gussenhoven 2000; LaCharité and Paradis 2005; Paradis and Tremblay 2009). Based on this approach, adapters are bilingual speakers who are fluent in both L1 and L2. It is assumed that the input to the adaptation process is the underlying representation of the source word containing the foreign segments and that its surface form is generated by using the phonological system of L1. In other words, the borrowed word is nativised to comply with the phonological system of the native language. Two studies supporting the phonology-only view are discussed here.

In line with this view, LaCharité and Paradis (2005) argue for the phonological input, as borrowers who are proficient bilinguals ignore the subphonemic details of an L2 word. Their claim is based on 12 large corpora of English and French loanwords in different languages

(Project CoPho)[7]. One piece of evidence that they use to support this claim is adaptation of English /b/ in English loanwords in French. Despite the fact that its phonetic surface form is acoustically closer to French /p/, the English voiced stop is mapped to French /b/ on the basis of category preservation, as the phoneme /b/ in these two languages has the same phonological features. This suggests that, when a phoneme in the source language exists in the borrowing language, it will be mapped even though the source phoneme is phonetically more similar to another phoneme in the native inventory. The other piece of evidence is adaptation of English high lax vowels /ɪ/ and /ʊ/ in Spanish. These two English high vowels are mapped to Spanish high vowels /i/ and /u/ despite the phonetic differences between English and Spanish high vowels. LaCharité and Paradis argue that, if phonetic approximation played a role in adaptation, the English vowels would be expected to be adapted to Spanish [e] and [o] as the first two formants of English [ɪ] and [ʊ] are closer to those of Spanish [e] and [o] than to those of Spanish [i] and [u]. This adaptation reveals that, if a certain phoneme in the source language is not available in the borrowing language, the adapter will determine the best match from a phonological perspective; that is a combination of phonological features.

The idea that the adapter does not pay attention to non-distinctive allophonic information of a source word is also defended by Paradis and Tremblay (2009), who examined the adaptation of English aspiration in Mandarin Chinese (MC). They argue that phonetic details of borrowed words are not central to the adaptation of loanwords. The paper shows that English stop aspiration, which is considered allophonic in English, does not influence phonemic categorisation in MC, despite the fact that the borrowing language makes a phonemic distinction between aspirated and unaspirated stops in the native phonology. The consistent mapping of English voiceless stops (both aspirated and unaspirated) to MC aspirated stops and that of English voiced stops to MC unaspirated stops suggest that MC speakers appear not to rely on aspiration or non-aspiration in English to determine phoneme categorisation in MC. The English words 'poker', 'tank', 'golf', and 'radar', for example, surface as [p^hu.k^hə], [t^han.k^hə], [kaw.ər.fu], and [lej.ta] respectively. Paradis and Tremblay conclude that the realisation of English stop aspiration in MC provides strong evidence that phonetic approximation plays a limited role in MC loanword adaptation.

[7] The database contains 7 corpora of English loanwords in Quebec City French, Montreal French, Paris French, Mexican Spanish 1, Mexican Spanish 2, Japanese and Calabrese Italian, and 5 corpora of French loanwords in Moroccan Arabic, Kinyarwanda, Lingala, Fula and Canadian English.

2.4.2 Perceptual stance

Unlike the previous approach, those taking the perceptual stance maintain that the input to the adaptation process is phonetic in nature. Evidence from a majority of loanwords studies strongly supports this view (e.g. Silverman 1992; Yip 1993, 2006; Dupoux *et al.* 1999; Kang 2003; Peperkamp and Dupoux 2003; Kenstowicz 2005, 2007; Adler 2006; Shinohara 2006; Peperkamp *et al.* 2008; Boersma and Hamann 2009; Calabrese 2009; Hsieh *et al.* 2009; Smith 2009; De Jong and Cho 2012). This view assumes that loanwords are introduced by non-proficient L2 speakers or speakers of the borrowing language who have no access to the phonology of the source language. It follows that borrowed words may be filtered by L1 perception rather than L2 perception. Thus, it is argued that the input to adaptation in loanwords is the phonetic representation of the source word that is constrained by the segmental and structural constraints of the borrowing language. The perceptual stance can be further divided into three models: perception-only, perception and production as separate processes, and phonological perception models.

2.4.2.1 Perception-only model

This view assumes that all adaptations occur during perception while phonology does not come into play (e.g. Peperkamp and Dupoux 2003; Peperkamp 2005; Peperkamp *et al.* 2008). In other words, the output of a loanword is not solely generated by the phonological grammar of the borrowing language, as argued by the phonological stance model. Given that borrowers have no access to the phonology of the source language, they cannot perceive non-native segments and syllable structure faithfully and the input to the phonology may lack some segments entirely. It follows that adaptation is a result of the borrower's misperception of the source language or perceptual assimilation which is a process that maps foreign segments and sound structures onto the closest native phonetic categories. Peperkamp and Dupoux (2003) review psycholinguistic evidence that all aspects of non-native phonological structure are distorted during speech perception. For instance, Korean listeners have difficulty in distinguishing between English [l] and [ɹ] as their native language has only one liquid phoneme realised as a lateral in the coda and as a rhotic elsewhere. In English loanwords, word-intial English [l] is mapped to Korean [r] (Kenstowicz and Sohn 2001). Peperkamp and Dupoux argue that this mapping is solely determined by perception. The English lateral surfaces as the Korean [r] because the adapter perceives this English consonant as the Korean [r].

Peperkamp (2005) argues that different repair strategies in foreign and native words are problematic for the phonological model that accounts for adaptations within the phonological grammar of the borrowing language. This is due to the fact that not all adaptations are in line with the native phonology. For example, in Lama[8] native words, a palatal nasal consonant [ɲ] is limited to onsets, as in /ɲə̰/ → [ɲə̀] 'they', and the underlying nasal palatal undergoes fronting syllable-finally, as in /ti - ɲə̰/ → [tî:n] 'elephants' (Ulrich 1997, cited in Peperkamp 2005: 342). In French loanwords, the palatal nasal consonant in a syllable coda is realised with an epenthetic vowel, as in 'vineyard' [viɲ] → [fiɲə̰]. Peperkamp argues that this phenomenon can be expected if we assume that loanword adaptations are phonetic and take place during speech perception whereas native alternations are computed during production.

Perceptual adaptation also occurs even with prosodic constituents such as syllables. Peperkamp *et al.* (2008) argue that an asymmetry in the treatment of word-final [n] in English and French loanwords in Japanese can be attributed to perception. The English word-final [n] is realised as a moraic nasal consonant, as in 'pen' [pen], whereas the French one surfaces with a following epenthetic vowel as in 'Cannes' [kannɯ]. The authors argue that differences in the phonetic realisation of word-final [n] in these two languages results in different adaptations in Japanese. Given that French but not English [n] in word-final position has a strong vocalic release, Japanese listeners perceive such release as their native vowel [ɯ] and consequently produce the word-final [n] with a final epenthetic vowel in French loanwords.

2.4.2.2 Perception and production as separate processes

This approach maintains that loanword adaptation is both perceptual and phonological and production and perception are treated as separate processes (e.g. Silverman 1992; Yip 1993, 2006). Researchers who support this model claim that the perceived form of the source word serves as an input to the production level.

Silverman (1992) provides evidence from English loanwords in Cantonese to argue for this view. He proposes that there are two stages in loanword adaptation: the perceptual and operative levels. At the perceptual level, speakers of the borrowing language do not perceive all of the same distinctions as the native speakers of the source language. It is assumed that the inventory of native segments and prosodies determines which segments will be perceived and which will not. For example, English [f] in 'lift' can be perceived by Cantonese borrowers, as it is present in the native inventory. Even though this segment is restricted to the onset position

[8] A language spoken by the Lamba people in Togo, Benin

in Cantonese, it is assumed that Cantonese speakers represent this English segment as such. Silverman also proposes that relative salience plays a role in perception. The word-final [t] is not perceived due to the fact that word-final obstruents are non-salient segments. Thus, the English word 'lift' is represented as [lif] at the perception level. At the operative level, the native syllable structure constraints will trigger phonological operations, and the perceived sound sequence will be modified to fit native syllable structures. Hence, the output at the production level is [lip].

Following Silverman (1992), Yip (1993, 2006) adopts Silverman's two-stage model to account for English loanwords in Cantonese. Instead of the rule-based approach adopted by Silverman, Yip's analysis is couched in Optimality Theory. She posits that the input to the operative level is based on how the borrowers perceive the acoustic signal of the source language, and that the borrowing language's phonological grammar imposes further changes. She also argues that perceptual salience plays a role in the adaptation process. For example, salient consonants, such as fricatives, are easily perceived and thus preserved, as in 'bus' [pa.si] (Yip 1993).

2.4.2.3 Phonological perception model

This model assumes that perception is as phonological as production, and the interpretation of phonetic representations from the source language is determined by the salient perceptual categories of the borrowing language (Iverson and Lee 2006; Boersma and Hamann 2009).

Iverson and Lee (2006) propose a principle of phonological perception which states that phonetic representations of the source language are interpreted according to the contrastive features of the borrowing language. The authors provide evidence from the adaptation of English /s/ in Korean where redundancies in the source language are rendered as contrasts in the borrowing language. English /s/ is mapped to either Korean lax /s/ or tense /s'/. The authors argue that different adapted forms of English /s/ can be attributed to phonemic consonantal length in Korean. In English, the duration of singleton /s/ is phonetically longer than that of /s/ occurring in clusters. Given that duration is the primary cue for distinguishing tense obstruents, which are phonologically geminates, from their lax counterparts in Korean, English /s/ which is not part of a cluster is borrowed into Korean as a tense [s'] given its long duration while English /s/ in a cluster which has short duration is perceived as a lax [s]. The present study adopts this principle to capture the Thai adaptation of vowels in English loanwords.

The perception of non-native segments and sound sequences constrained by the phonological system of the borrowing language is also proposed by Boersma and Hamann (2009). They point out that many loanword phenomena are attributed to first-language phonological perception and can be explained by the behaviour of listeners in their native language. This view is evidenced by vowel insertion in English loanwords in Korean. Boersma and Hamann argue that Korean listeners interpret English final sound sequences in terms of perceptual cues and phonotactics in their first language. This adaptation is illustrated by Korean perception of the English final /g/ and /k/ in 'tag' and 'deck'. These words are realised with an epenthetic vowel as [t^hæ.k$\imath$] and [tɛ.k$^h\imath$] respectively. In English, final plosives are pronounced with a release burst; by contrast, Korean plosive codas are unreleased. Thus, for Korean listeners, the presence of a release burst indicates that the consonant is in the initial position and that it is followed by a vowel. It follows that when they encounter the word-final release bursts in 'tag' and 'deck', such bursts are likely to be perceived as a cue for a phonological consonant in the onset instead of in the coda. This leads listeners to insert a vowel after the final plosives in the borrowing language.

This section has considered current models of loanword phonology. The crucial difference between the two stances is the nature of the input. The phonological model assumes that the input to adaptation is the phonological representation of the source word because loanwords are largely introduced by competent bilinguals. Modifications made to loanwords take place during production. By contrast, the perceptual approach assumes that the input is the phonetic representation of the source word since there is a possibility that borrowers do not always possess a good knowledge of the source language. Some studies that adopt this view posit that all adaptations are strictly based on the notion of phonetic similarity between the outputs of the source and borrowing languages and that all adaptations occur in perception. Some other studies, on the other hand, argue that the adaptation involves the same phonological processes that characterise speech production.

The behaviour of English consonants in English loanwords in Thai, as observed in previous studies (Kenstowicz and Suchato 2006; Rungruang 2008), reveals that the adaptation of English consonants does not support any particular view of loanword phonology. Different aspects of adaptation are compatible with each of the models presented here. Kenstowicz and Suchato (2006) report that the different adaptation patterns of English voiceless stops in Thai appear to support the perceptual stance, given that they are governed by the allophonic realisation of English input stops. Note that Thai has aspiration contrasts in voiceless stops, while English voiceless stops vary in aspiration depending on context. The results from their

corpus show that English voiceless stops in word-initial position are uniformly mapped to Thai aspirated voiceless stops, as in 'team' [tʰiːm] and 'cone' [kʰoːn], but to unaspirated ones if they occur after /s/, as in 'style' [sa.taːj] and 'scan' [sa.kæːn]. In word-medial position, the adaptations vary between aspirated and unaspirated stops, depending on the nature of English. They are adapted to either aspirated voiceless stops or unaspirated voiceless stops in pretonic position, as in 'shampoo' [cʰæm.pʰuː], 'cocaine' [kʰoː.kʰeːn], 'cartoon' [kaː.tuːn], and 'torpedo' [tɔː.piʔ.doː]; on the other hand, they tend to be realised as unaspirated in posttonic position, as in 'cupid' [khiw.pìt] and 'centre' [sen.tɤ̂ː]. The adaptation of the English voiceless stops reveals that Thai borrowers are sensitive to the phonetic details of the input segments which are contrastive in their native language. However, Kenstowicz and Suchato (2006) note that the Thai adaptation of English stops can also be explained in terms of category preservation. English voiced stops are not fully voiced in word-initial position and are acoustically closer to Thai unaspirated voiceless stops on the basis of voice onset time in English and Thai voiced and voiceless stops. They are uniformly mapped to Thai voiced stops as in 'bill' [bin] and 'dollar' [dɔn.lâː], preserving the feature [voice]. This adaptation is more supportive of the phonological view which argues for uniform substitution. In the present study, I argue that the majority patterns of vowel adaptation displayed in the loan corpus are more supportive of the perceptual stance, especially the model of phonological perception. That is, both phonetic (including perceptual) and phonological factors play a role in determining how English vowels are realised in Thai.

Besides phonological and perceptual factors, it has been documented in the literature that some adaptations can be attributed to the orthography of the source language. This is the case for some patterns of vowel adaptation in English loanwords in Thai, especially the behaviour of English unstressed vowels, which is discussed in Chapter 5. The following section explores orthographic effects in loanword adaptation.

2.5 The role of orthography

In addition to the linguistic factors that play an important role in loanword adaptations, it has been proposed in recent studies of loanword phonology (e.g. Vendelin and Peperkamp 2006; Daland *et al.* 2015; Hamdi 2017) that orthography appears to be an extra-linguistic influence in loanword adaptation if borrowers know the spelling of the loanwords in the source language or if adaptation is based on written input.

The influence of orthography has received passing mention in some studies (e.g. Smith 2006; Cohen 2009; Kang 2009; Guba 2016). Smith (2006) points out that different repair strategies for ill-formed syllable structure can be triggered by orthographic effects. The author provides evidence from English loanwords containing illicit codas or consonant clusters in Japanese. They have doublet forms, one with deletion, such as 'glycerine' [_ɾi.sɯ.ɾiɴ] and 'jitterbug' [dʒi.ɾɯ.ba_], and one with epenthesis as in 'glycerine' [gɯ.ɾi.se.ɾiɴ], and 'jitterbug' [dʒit.taː.bag.gɯ]. The author argues that when the input is auditory, usually undergoes deletion; however, if the input is orthographic, the adapted form usually involves epenthesis. Smith notes that epenthesis is the most common repair strategy for loanwords because they usually enter Japanese via the written rather than spoken language. Kang (2009) points out that adapters need not possess a good knowledge of the source language. They tend to look at orthography to find a cue to phonemic identity, especially when the adaptation pattern is underdetermined by other factors. The adaptation of non-morphemic /z/ in English words borrowed into Korean during the 1930s appears to be influenced by the English spelling. The non-morphemic /z/ was likely to be mapped to [c] if it was spelled with a <z>, as in 'bronze' [p*uL[9]oncɨ]. However, when it was represented with an <s>, the majority pattern was adaptation to [s] or [s*], as in 'pose' [Lo(:)s*ɨ] and 'rose' [p^{h}oːsɨ], which is similar to how English /s/ was adapted. The author notes that, in the 1930s, Korean adapters had some knowledge of the source language but they were not fully proficient. They were likely to look at the orthographic representation of the input word to determine a phonemic category. Moreover, orthographic effects tend to result in variations in adaptation. Cohen (2009) reports that some cases of English loanwords in Hebrew are influenced by the orthography of the source words, given that English segments with identical phonetic forms are mapped to different Hebrew forms according to the spelling. The author reports that about 26% of the loans in the corpus clearly demonstrate orthographic effects. For example, the tokens of English schwa in the final syllables of the words 'Evan' (name), 'Kevin' (name), 'sponsor', and 'user' surface as [a], [i], [o], and [e] respectively. He further notes that orthography comes into play if the adapter can access the orthography of the source language. Similarly, Guba (2016) points out that borrowers who are second language learners can access the orthography of the source word. Orthographic effects are apparent in the adaptation process when a source language segment is represented with more than one grapheme.

[9] L represents a liquid phoneme in Korean that alternates between [l] and [r] depending on its phonological context (Kang 2009).

Even though the role of orthography does not receive much attention in the majority of papers on loanword adaptation, some authors make orthography the focus of their research and demonstrate how adapters may be guided by aspects of the orthography of the source form rather than by its phonological and/or perceptual properties. A well-known experimental study in this vein was conducted by Vendelin and Peperkamp (2006), who made the influence of orthography the main focus of their study. In this paper, they reported on an experiment concerning how late French-English bilinguals adapt English non-words. They investigated orthographic effects in the adaptation of eight English vowels by varying the nature of the input. The participants were tested in two different conditions: an oral condition with oral stimuli only and a mixed condition with oral stimuli and their written forms. It was found that adaptations of the eight English vowels were different in these two conditions, indicating that the inclusion of orthographic representation conditioned how French listeners adapted the forms. For example, given that the French reading of the grapheme <u> is /y/, the English /ʌ/ represented with the same grapheme was adapted as [y] in 22.9% of the cases.

Following Vendelin and Peperkamp (2006), Daland *et al.* (2015) examined the role of orthography in the adaptation of vowels in English loanwords in Korean. Their paper shows that the adaptation of stressed vowels is more consistent than that of unstressed vowels. The authors claim that the consistent adaptation of stressed vowels can be attributed to perceptual influence while orthography plays a stronger role in the adaptation of unstressed vowels. These authors propose the Perceptual Uncertainty Hypothesis which holds that the spelling of loanwords in the source language is most likely to constrain loanword adaptation when it is not fully determined by perceptual factors alone. As far as English schwa is concerned, it is variably adapted to many Korean vowels. The authors argue that in the adaptation of the English word 'camera', the vowel in the second syllable and the one in the final syllable are adapted to [ɛ] and [a] respectively because the former is spelled with <e> and the latter is spelled with <a>. Given that these two vowels in this word always appear as schwas and they do not alternate, the authors posit that there is no phonological or phonetic evidence that adapters will be able to identify the underlying vowels in the English lexical representation.

Hamdi (2017) examined the influence of orthography on English loanwords adapted by bilingual Arabs. In Arabic, several loans have more than one written form, suggesting that orthography could be responsible for multiple loan forms. The study collected data from 13 late Arabic-English bilinguals. They were asked to complete an online questionnaire containing a set of ten English loanwords. Six of them were monomorphemic loanwords (e.g. 'cabin', 'biscuit') and four were compound loanwords (e.g. 'ice cream', 'hamburger'). Each has two

Arabic written forms. One is more similar to the orthographic representation of the source word than the other. The participants were asked to choose a better written loan form of each English loan. The results revealed that Arabic forms of loans are influenced by English orthography. The word 'biscuit', for example, has two different Arabic loan forms: [baskawi:t] and [basku:t]. The study shows that Arab bilinguals are sensitive to the spelling of the source word when they adapt it into their native language.

In the present study, some cases of English loanwords clearly exhibit orthographic effects. For example, consonant gemination in medial position, such as 'happy' [hǽp.pi̋:] and 'tennis' [t^{h}en.nít], is likely to be triggered by doubled consonant spellings; this is investigated in Chapter 3. Variations in the adaptation of English unstressed vowels also appear to be influenced by English orthography. Their realisation varies according to the spelling, which will be examined in Chapter 5. The following section reviews previous studies on vowel adaptation.

2.6 Previous studies on vowel adaptation

The aim of this section is to review previous research on vowel adaptation in Thai and cross-linguistically. It is shown that earlier studies on loanwords in Thai and in other languages have rarely considered the behaviour of vowels.

2.6.1 Vowel adaptation in Thai

Not many studies of Thai loanword phonology focus on vowel adaptation in loanwords. To the best of my knowledge, there is no research providing a detailed description of how vowels in English loanwords are adapted to fit the Thai phonological system. Previous studies have been mainly concerned with consonant adaptation (e.g. Nacaskul 1979; Panlay 1997; Kenstowicz and Suchato 2006; Rungruang 2008; Khongnakhorn 2011; Endarto 2015) and tone assignment (e.g. Gandour 1979; Bickner 1986; Panlay 1997; Kenstowicz and Suchato 2006) whereas vowel adaptation has been less studied. This is possibly due to the fact that English syllable structure is more complex than that in Thai, especially in respect of syllable margins (See Section 2.2.3). Moreover, these two languages have different prosodic systems; English is a stress language, but Thai is a tone language. The distribution of tones in English loanwords in Thai has been thoroughly explored by phonologists.

A few studies have examined how vowels in English loanwords are nativised in the Thai context. Nacaskul (1979) gives general characteristics of English loanword adaptations in Thai in terms of consonants, vowels, and tone assignment. However, the author does not provide a detailed description of how vowels in English loanwords are adapted to the Thai phonological system. As for English monophthongs, English and Thai correspondences are not considered in the study. The author simply notes that English simple vowels are mapped to Thai vowels that possess the quality closest to that of the English vowel without information on how Thai speakers determine what constitutes 'the closest quality'. Moreover, the behaviour of English schwa /ə/ which is restricted to unstressed position is not mentioned. Nacaskul points out that the English diphthongs /eɪ, eə, əʊ/ are replaced by Thai long vowels /eː, æː, oː/ respectively. According to the author, it is not always the case that English diphthongs are mapped to Thai long vowels. She adds that some are replaced by short vowels followed by final glides /j, w/. For example, English diphthongs /aɪ, ɔɪ, aʊ/ are changed into [aj, ɔj, aw] respectively. However, the study does not discuss why the same English vowels can be adapted to different Thai vowels. I have observed that English /ə/ occurring in an unstressed position is variably adapted to different native Thai vowels when it appears in different environments. This phenomenon is examined in Chapter 5.

Panlay (1997) mainly examines the behaviour of consonants and the distribution of tones in English loanwords, and also provides a brief discussion of the mapping of English vowels. The author collected loan data from three Thai females and three Thai males who were graduate students at American universities. The participants were asked questions and gave answers in Thai. Some questions contained English loanwords and some did not. All sentences produced by the participants were tape-recorded, and loanwords were then transcribed into a phonetic form. The study adopts the model of loanword phonology proposed by Silverman (1992) to capture the phonological adaptation of English loanwords. Silverman assumes that loanword adaptation involves two levels: perceptual and operative levels (see section 2.4.2.2 for more details). However, his explanations of phonological changes made to English loanwords revolve around the operative level. The perceptual level does not play much of a role in his analysis. With respect to English and Thai vowel correspondences, he reports his observations but does not propose a phonological rule to account for vowel adaptation. He observes that English short vowels /ɪ/, /ɛ/, /ʊ/, and /ɔ/ are mapped to Thai short vowels /i/, /e/, /u/, /ɔ/ respectively only when they appear in a syllable ending in a voiceless stop. He adds that the adaptation of English /æ/ is constrained by the following consonant. That is, if it appears before a voiceless stop, it is mapped to a Thai short vowel as in [bæt] 'bat' and [kæp] 'gap'; if

it is followed by a voiced stop, it is adapted to a Thai long vowel as in [bæːk] 'bag' and [mæːt] 'mad'. However, he claims that this is not always the case. Words like 'tab' and 'cab', which end in a voiced stop, receive a short [æ] in Thai. When it comes to the mapping of the English central vowel [ə][10], the author claims that this English vowel is equivalent to the Thai mid central vowels /ə, əː/[11] only when occuring in a stressed syllable as in the words 'hurry', 'dirt' and 'hurt'.

Kenstowicz and Suchato (2006) examined correspondences between English and Thai consonants, repair strategies for ill-formed syllable structures, and tone assignment in English loanwords. Their data consists of established loanwords drawn from an English-Thai dictionary and recent loanwords used by Thai students in the U.S. The study deals with the adaptation of English loanwords in Thai from the perspective of phonological and perceptual similarities. The authors claim that some of the Thai adaptations are predicted by the two models such as devoicing of English /ɡ/ and /z/ to Thai /k/ and /s/. However, adaptation of English /v/ to Thai /w/ instead of /f/, for instance, is based on auditory rather than articulatory grounds. They also argue that the phonetic details of the English input play a role in the mapping of English voiceless stops to Thai aspirated and unaspirated voiceless stops. It is reported that English word-initial voiceless stops are likely to be mapped to Thai aspirated voiceless stops while English voiceless stops preceded by /s/ are realised as Thai unaspirated voiceless stops. With respect to vowel adaptation, the study is concerned with the behaviour of English short vowels occurring in final open syllables. It is reported that they become lengthened in English loanwords to satisfy the bimoraicity requirement. In the Thai suprasegmental system, the final syllable is always stressed; hence, it must be heavy. The authors argue that the repair strategy for loanwords containing a light syllable in the final position is different from the one employed in the native grammar. In the native phonology, underlying CV syllables undergo glottal stop epenthesis as in the Thai native word for 'monk' /pʰra/ → [pʰraʔ]. When it comes to loanwords, Thai adapters employ a different strategy. That is, short vowels that occur syllable finally are lengthened. Kenstowicz and Suchato point out that vowel-lengthening is a loanword-specific repair strategy. They propose output-output correspondence constraints which are loanword-specific constraints to account for the preference for vowel lengthening over the insertion of a glottal stop in loanword phonology on the ground that the adapter chooses a strategy that produces an output which is more faithful to the output of the loanword in the source language. Consider the input 'coma', which is one example given in the paper. Two constraints are

[10] This English stressed vowel is represented with a different symbol by English phonologists.
[11] The present study uses /ɤ/ and /ɤː/ to represent the Thai mid central vowels.

proposed. One is an output-output faithfulness constraint militating against the insertion of a consonant, OO-Dep-C, and the other is a markedness constraint which prefers the avoidance of long vowels, *VV. Since the output [kʰoː.məː] is preferred to the candidate *[kʰoː.məʔ], OO-Dep-C is ranked above *VV.

2.6.2 Cross-linguistic studies of vowel adaptation

Turning to cross-linguistic investigations, not many studies focus on the behaviour of vowels in loanword phonology (but see Dohlus 2005; Yip 2006; Lin 2008a,b; Kenstowicz 2012). In addition to the two papers cited in Section 2.5 which investigate the influence of orthography on vowel adaptations (Daland *et al.* 2015; Vendelin and Peperkamp 2006), other studies examine the nativisation of vowels in loanwords from different perspectives. Yip (2006) examines the Cantonese adaptation of two English vowels [æ] and [ə] based on the view that the input to adaptation process is a transformed percept which is further modified by L1 grammar. Similar to Kenstowicz and Suchato (2006), she proposes that the L1 grammar includes loanword-specific constraints for mimicking foreign inputs; that is, MIMIC constraints which are a set of faithfulness constraints active in loanword adaptation. In loanwords, English [æ] is mapped to Cantonese long vowels [ɛː] and [aː] in open syllables and before nasals but to a short vowel [ɪ] in closed stop-final syllables. As for English schwa, it is adapted to Cantonese [aː] in open syllables but to [ɐ] and [ø] in closed syllables. The author accounts for this variation by comparing the acoustic data of the English vowels to that of the Cantonese ones. On acoustic grounds, the English [æ], which is fairly short, is acoustically closest to the Cantonese long vowels [ɛː], [aː], and [œː] and to the Cantonese short vowels [ɪ] and [ɐ]. The Cantonese long and short vowels that best match the English [ə] are [œː], [aː], [ø], and [ɐ]. Apart from acoustic data, a perceptual experiment was also conducted. The results show that the best matches for English [æ] are [ɛː] and [aː] and for English schwa [aː], [ɛː], and [œː]. Based on the acoustic and perceptual data, she argues that the adapter has more than one choice for the best match for each English vowel, and that the best match is determined by vowel quality. Take the words 'pan' and 'angle' as examples. In Cantonese, both short and long vowels are allowed in the context of a following nasal. They surface as [pʰaːŋ] and [ɛːŋ] respectively with long vowels. Yip argues that this adaptation results from the fact that MIMIC-VOWEL dominates MIMIC-LENGTH, and therefore Candidates with short vowels like *[pʰɪŋ] and *[ɪŋ] fail to surface. However, matching vowel quality is not always possible. Yip argues that grammar can outrank quality match in some cases. Stressed syllables must have high tone in order to mimic English stress, but the phonotactic constraint *V:O^5 (where the superscript 5 indicates high tone)

prohibits a syllable with a long vowel followed by an obstruent from bearing a high tone. It follows that, in obstruent-final stressed syllables, vowels are shortened and their quality changes in order to avoid violating MIMIC-TONE and *V:O[5] which dominate MIMIC-VOWEL. The ranking is illustrated by the realisation of English [æ] in the word 'Jack' as [ɪ] rather than [aː] and [ɛː]. She concludes that vowel quality is more faithfully replicated than vowel length in Cantonese.

Lin (2008a) investigates vowel adaptation in English loanwords in standard Mandarin (SM). The study aims to explore the general patterns and restrictions on vowel adaptation and to determine which aspects of vowel quality are more faithfully preserved in SM. The data examined in this study consist of more than 200 loanwords drawn from a variety of sources such as publications, media, and conversations. Based on the data, she observes that vowel adaptation in SM is highly variable; all English vowels are mapped to more than one SM vowel. Despite the high degree of variation, the results reveal that there are systematic patterns. Vowel backness is more faithfully replicated than vowel height and roundness in loan forms. English front vowels are replaced with SM front ones (e.g. English [i] → SM [i, ei]) and English back vowels with SM back ones (e.g. English [ɔ] → SM [wo, u, ɑu, ɑ]). The author points out that English central vowels appear to be treated as neither front nor back in SM as they are replaced with an SM front, central or back vowel (e.g. English [ə] → SM [ei, ə, ɤ, u]. Meanwhile, a height mismatch for vowels is tolerated but remains minimal. That is, a match between mid and high vowels (e.g. English [ɛ] → SM [i] and that between mid and low vowels (e.g. English [ɔ] → SM [ɑ]) can be found, but high vowels are rarely matched with low vowels. A rounding mismatch is most likely to occur in adapting mid central/back vowels (e.g. English [ɚ] → SM [ou, wo] and English [ɔ] → SM [ɑ, ɤ]). Lin adopts Yip's Mimic constraints to account for these adaptation patterns. She argues that MIMIC-BACK dominates MIMIC-HIGH, MIMIC-LOW and MIMIC-ROUND given that the front-back dimension is more faithfully retained than height and rounding in SM loanword phonology. This indicates that the preservation of vowel backness is crucial in the vowel adaptation process. As for the mapping of English mid central vowels, it is argued that they can be matched with either front or back vowels in SM due to the fact that central vowels are unspecified for backness in the native phonology, resulting in a much greater degree of variation in the adaptation. The author concludes that the grammar of the borrowing language prioritises which aspects of vowels will be replicated in the loanword adaptation process.

Lin (2008b) still makes vowel adaptation the focus of her study. Unlike in the previous research (Lin 2008a), this study aims to provide quantitative evidence for SM vowel adaptation

and examines a larger corpus consisting of more than 4200 proper names for places and people drawn from a dictionary corpus. The results in this study confirm the general patterns found in Lin (2008a). The author attributes variation in vowel adaptation to perception. English non-central vowels are more faithfully replicated in SM while English mid central vowels have the most variable matches in terms of height, backness, and/or roundness. The author argues that perceptual factors crucially influence the SM adaptation of vowels in English loanwords. Non-peripheral vowels, such as mid central vowels, have more variable matches than peripheral vowels due to the fact that the non-peripheral vowels have relatively poor perceptual contrasts and saliency. She concludes that the input to the adaptation process is more likely to depend on auditory perception.

Dohlus (2005) examines the adaptation of the German and French mid front rounded vowels [œ] and [ø] which have different realisations in Japanese. The German mid front rounded vowels are realised as [e], while the French ones are mapped to [u]. She argues that the adaptation to [e] in German borrowed-words is phonologically grounded; on the other hand, the adaptation to [u] in French loans is attributed to Japanese speakers' perception of the vowels. A perceptual experiment was conducted to examine which Japanese vowel Japanese listeners perceived as the German [œ] and [ø]. The results showed that they tended to perceive these German vowels as Japanese [u]. Based on the results of the experiment, the author claims that the realisation of the two German vowels as the Japanese [e] is phonologically driven. The distinctive features for vowel height and frontness, [-high] and [coronal], are maximally preserved in the borrowing language, but the feature [+labial] is lost. As for the adaptation of the French mid front rounded vowels to the Japanese high back vowel [u], the author argues that this mapping cannot be explained by the phonological view since the [-high] and [coronal] features of the French input are lost but the [labial] feature which is redundant in Japanese is preserved. The author compares the formant frequencies for French vowels with those for Japanese vowels. It is found that the French [œ] and [ø] are perceived as the Japanese [u] because the Japanese vowel is acoustically closer to the French vowels in terms of F2 values. She points out that this divergence in the adaptation process can be explained by different channels of borrowing. German loanwords have entered Japanese mainly via written language, given that most of them are scientific terms. Adapters determine the source phoneme from the spelling. In contrast, French loanwords are likely to be introduced into Japanese via spoken language due to the fact that most of them are words from the field of fashion, French cuisine, dancing, art, and military.

Kentowicz (2012) provides an OT account of vowel adaptations in Cantonese loans. He argues that the adaptations are constrained by the attested VC combinations in the native phonological system. Four VC rime constraints that restrict the possible combinations of nuclear vowels and coda consonants in Cantonese are *OP (a constraint excluding a rime composed of a labial vowel with a labial coda), *ET (a constraint banning a combination of a front non-high vowel and an anterior coda), *oT (a constraint barring a sequence of close [o] followed by an anterior consonant), and *IK (a constraint prohibiting a rime containing a high vowel followed by a dorsal consonant). It is found that the constraints *OP, *oT, and *IK are strictly enforced in the loans while *ET is demoted in some cases. With respect to repairs that bring English loanwords in line with the four phonotactic constraints, Cantonese speakers modify either the nuclear vowel or the coda consonant. For a change of vowel, the vowel quality of the input segment is more faithfully replicated than vowel height. In terms of vowel quality, vowel backness is more important than vowel height and roundness. The results of the study confirm Yip's (2006) finding that faithfulness for vowel quality dominates faithfulness for vowel length.

To sum up, it can be seen that the Thai nativisation of vowels in English loanwords is less well studied, given that the majority of previous studies focus on phonological modifications made to consonants, syllable structure, and the prosodic system. Moreover, they rarely examine what factors are involved in the adaptation process. The present study fills this gap. The behaviour of vowels in loanwords has also been less explored in other languages. Evidence from previous studies reveals that not only do phonology and perceptual factors play a role in vowel adaptations, but orthography also has an influence on the adaptation of vowels in loanwords. It appears that the Thai adaptation of vowels in English loanwords drawn from dictionaries and other sources are determined by both linguistic and non-linguistic factors. The present study aims to provide evidence that a variety of factors, including phonetic, phonological and orthographic are involved in determining how English vowels are realised in borrowed words.

2.7 Theoretical framework

This section lays out the theoretical framework that is employed to analyse the phonological adaptation of vowels in English loanwords in the present study. An overview of Optimality Theory is first presented in Section 2.7.1. Section 2.7.2 considers how the constraint-based

approach can capture the behaviour of loanwords. The last section focuses on the position of loanwords in the lexicon.

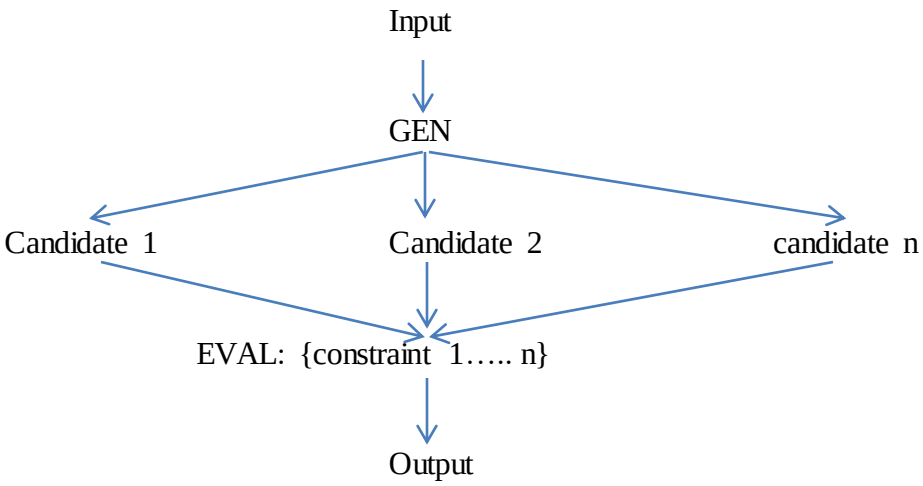
2.7.1 Optimality Theory

The theoretical framework that is adopted in this study is Optimality Theory (henceforth OT). OT is a constraint-based approach proposed by Prince and Smolensky (1993, 2004). The theory assumes that grammar imposes a set of restrictions on what are valid surface or output forms in any particular language. Such restrictions are formalised in terms of constraints. In OT, it is assumed that constraints are universal and that all languages share exactly the same set of constraints and there are no language-specific constraints. Despite the fact that all constraints exist in the grammars of all languages, the ranking of constraints varies from one language to another. Specific patterns found in languages are derived from different rankings of the same set of constraints. Apart from the assumption that constraints are ranked, the theory maintains that they can be violated and are not strictly obeyed in all languages. That is, there is no output form that satisfies all constraints, but violation must be minimal. The violation of a higher-ranked constraint is more fatal than the violation of a lower-ranked constraint. It follows that an output having the fewest violations of high-ranked constraints is selected as the most harmonic output of a grammar.

2.7.1.1 Components of an OT Grammar

Like other models of phonology, OT maintains that there are phonological relationships between underlying forms and surface forms. In derivational-based phonology (Chomsky and Halle 1968), it is assumed that the output is derived from the input through the application of ordered phonological rules. However, in OT, there are no rules and the relationship between input and output is captured by two formal mechanisms: GEN (a generator function) and EVAL (an evaluator function) (Archangeli 1997). For a given input, GEN produces an infinite set of possible output candidates. This set of candidates is then submitted to EVAL which contains a set of hierarchically ranked constraints (CON). All candidates are then evaluated and the optimal candidate is selected. The most harmonic candidate selected by EVAL is the one which best satisfies the ranked constraints. In other words, the candidate that is optimal incurs the fewest violations of high-ranked constraints. The diagram in (8), taken from Uffmann (2007: 17), demonstrates how the components of an OT grammar interact.

(8) Phonological derivations in Optimality Theory



A candidate evaluation is conventionally represented in a tableau as illustrated in (9).

(9)

Input	CONSTRAINT 1	CONSTRAINT 2	CONSTRAINT 3
Candidate a	*!		
☞Candidate b			**
Candidate c		*!	*

The candidates are listed in the left-hand column in random order. The top row lists the constraints in a descending ranking from left to right; thus, the leftmost constraint is highest-ranked and the rightmost one is lowest-ranked. The symbol '*' in the cells represents a constraint violation incurred by each candidate. To find the optimal output, all competing candidates are first evaluated with respect to the highest ranked constraint, which is constraint 1. As candidate (a) violates constraint 1, which is ranked high, it is ruled out, and this is indicated by an exclamation mark next to the violation asterisk. Candidates (b) and (c) are favoured by constraint 1, so they are passed on for evaluation by the next high-ranked constraints, constraint 2. In this round, candidate (c) fatally violates constraint 2 while candidate b satisfies it. Candidate b, which is the remaining candidate in the competition, is therefore selected as the optimal output, indicated by the pointing finger symbol '☞'. Despite the fact that it incurs two violations of constraint 3, candidate b is optimal as it is favoured by the highest ranked constraints. In OT, given that violation of a higher ranked constraint is more serious than that of a lower ranked constraint, any candidates violating a highly ranked constraint will be excluded. The most harmonic or optimal output form is the one that survives the longest and best satisfies the overall constraint hierarchy.

2.7.1.2 Types of Constraints

This section presents the main types of constraints which determine the surface structure of a language. OT recognises two major types of constraints referring to markedness and faithfulness constraints (Kager 1999).

Markedness constraints evaluate the well-formedness of output candidates. They require output forms to be unmarked and prohibit any marked forms from appearing on the surface. They may be positively or negatively stated, as shown below.

(10) a. Syllables must have onsets.
b. Sonorants must be voiced.
c. Syllables must not have codas.

(Kager 1999: 9)

Faithfulness constraints, on the other hand, require outputs to preserve the properties of their inputs. In other words, the input form should match the output form; no changes are allowed.

(11) a. The output must preserve all segments present in the input.
b. Output segments must have counterparts in the input.
c. Output segments and input segments must share values for [voice].

(Kager 1999: 10)

These two types of constraints are intrinsically in conflict. While markedness constraints demand that output forms should be maximally unmarked, faithfulness constraints require the input and the output to be identical regardless of how marked the input is structurally. To resolve conflicts between these constraints, they are ranked with respect to each other. If a markedness constraint dominates the relevant faithfulness constraint, the marked phonological structure will not appear in surface forms. On the other hand, if the faithfulness constraint overrides the markedness constraint, the input will surface faithfully. The interaction between markedness and faithfulness constraints determines the surface structure of a language (Prince and Smolensky 1993, 2004). Individual languages differ in how conflicts between markedness and faithfulness constraints are resolved (Kager 1999: 8). The markedness and faithfulness constraints which are relevant to the present analysis are introduced in Chapters 3 and 4.

The next section discusses how this constraint-based model can capture phonological changes made in loanwords.

2.7.2 OT and loanword phonology

Archangeli (1997: 30) claims that OT can capture the behaviour of loanwords. The expectation under OT is that the input to the adaptation process is the output of the borrowed word in the source language. GEN produces possible output forms in the borrowing language and then the borrowing language's constraint hierarchy evaluates a set of candidates produced by GEN. EVAL selects a candidate which best matches the ranked constraints as the optimal output.

As far as loanword phonology is concerned, the types of analysis that most studies of loanword adaptation propose have been couched within an OT framework ever since Prince and Smolensky introduced this approach (e.g. Yip 1993, 2006; Adler 2006; Kenstowicz 2007, 2012; Rungruang 2008; Boersma and Hamann 2009; Chang 2009; Cohen 2013). While a rule-based approach maintains that loanword phonology is comprised of rules which the borrowing language lacks (Silverman 1992), Yip (1993) argues that no extra phonological rules need to be added to the grammar of the borrowing language to account for the nativisation of loanwords and that speakers of the borrowing language do not perceive all the same distinctions as native speakers of the source language. The adaptation results from the constraint ranking of the borrowing language which is not specific to loanword phonology but is independently motivated in the native host language. Yip's claim that a constraint-based model of loanword phonology can account for phonological changes made in loanwords without extra machinery is strongly supported by Jacobs and Gussenhoven (2000). They posit that loanword phonology does not exist as a separate component of the grammar; the phonological differences between foreign forms and their native equivalents result from subjecting non-native words to the same constraint hierarchy that defines the native phonology. In other words, a language can take a foreign input and produce a well-formed output, which is one that conforms to the phonological system of the borrowing language. Kenstowicz (2007) also claims that the key notions of faithfulness and markedness constraints within an OT framework are well suited to capture the behaviour of loanwords. This is due to the fact that, in adapting a foreign word, the speaker attempts to preserve the input information as much as possible and produces a surface form that satisfies the phonological constraints of the borrowing language.

In OT, it is assumed that a language has a single constraint ranking and that the interaction between markedness and faithfulness constraints determines the surface structure of

the language. When it comes to borrowed words, faithfulness constraints require the output form to remain faithful to the input form in the source language. Markedness constraints, on the other hand, impose requirements on the structural well-formedness of the output form in the borrowing language. Non-native words are subject to the same constraint ranking that defines well-formed native words (Yip 1993). Nevertheless, in the case of English loanwords in Thai, there is a situation where native constraints are relaxed in loanwords. It can be argued that there is a possibility of distinct rankings for native words and English loanwords in Thai. This is evidenced by the preservation of non-native phonotactic sequences in loanwords as observed in previous studies (e.g. Nacaskul 1979; Rungruang 2008). Thai allows complex onsets but not all combinations of consonants can occur in the onset. Thai onsets are restricted to a sequence of a voiceless stop followed by a liquid or a glide; that is /pr/, /p^{h}r/, /pl/, /p^{h}l/, /tr/, /kr/, /k^{h}r/, /kl/, /k^{h}l/, /kw/, and /k^{h}w/. It is reported in the literature that certain non-native consonant clusters are imported into Thai without adaptation. They are /br/, /bl/, /dr/, /fr/, and /fl/ as in 'break' [brèk], 'blond' [blɔn], 'draft' [drá:p], 'free' [fri:] and 'flat' [flæ̀t]. This suggests that constraints on segmental sequences are relaxed and ranked lower than relevant faithfulness constraints in loanwords. In the present study, vowel lengthening is a phenomenon which occurs only in English loanwords to satisfy the bimoraicity requirement, and this phenomenon is explored in Chapter 3. By contrast, in native words, Thai employs glottal stop epenthesis to create heavy syllables. Such differences in repair strategies for native lexical items and borrowed words also provide evidence that Thai native words and English loanwords differ in the relative ranking of the faithfulness constraints DEP-IO (C) and IDENT-IO (μ), which determines the phonological change serving as a repair of light syllables. In the native phonology, IDENT-IO (μ) is ranked above DEP-IO (C) whereas IDENT-IO (μ) is dominated by DEP-IO (C) in loanwords.

To account for different repair strategies for native and foreign words, I assume (following Itô and Mester 1995a, 1995b, 1999) that the Thai lexicon is divided into different strata and each stratum has a distinct ranking. The position of loanwords in the lexicon is considered in the following section.

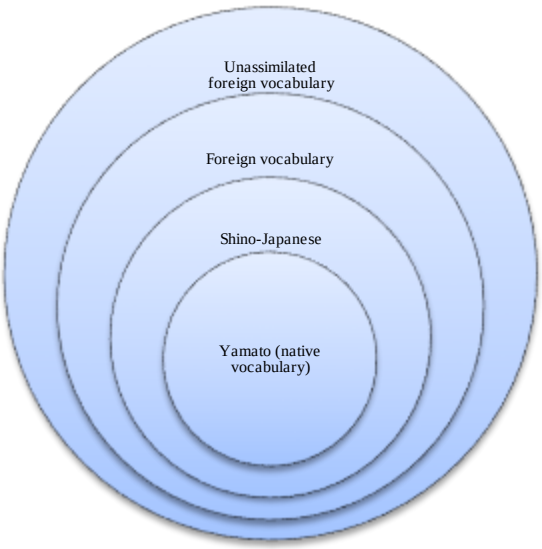
2.7.3 Loanwords and the lexicon

The issue of the nativisation of loanwords has been discussed in terms of a core-periphery organisation of the lexicon (Itô and Mester 1995a, 1995b, 1999). This model proposes that the lexicon of a language has internal stratification. Lexical items in the core obey all structural constraints that define syllable well-formedness while those in the periphery such as proper names, onomatopoetic words and loanwords are allowed to violate constraints that are enforced

in the core. Although peripheral items may violate constraints that are active in the core, they fulfill fundamental constraints which determine the basic syllable canons of the language. With respect to loanwords or words of foreign origin, some may eventually become part of the core vocabulary and are not perceived as foreign given that they satisfy all of the constraints of the borrowing language.

Within the OT framework, lexical stratification results from the reranking of faithfulness constraints. Itô and Mester provide evidence from the Japanese lexicon which is traditionally divided into four distinct lexical strata. These overlap substantially as demonstrated in Figure 2.1:

Figure 2.1: Core-periphery organisation of the Japanese lexicon adapted from Itô and Mester (1995b)



The authors point out that these strata result from different rankings of the same constraints. Certain constraints are strictly obeyed by the core vocabulary but are allowed to be violated by lexical items in more peripheral strata. The model proposes that constraints holding in the periphery also hold in the core, but not vice versa. The constraints that are operative in the lexicon of Japanese and their rankings are as follows:

(12)

a. SYLLSTRUC:	Basic syllable structure constraints of Japanese (e.g. *Complex and CodaCond)
b. NOVOICEDGEM (No-DD):	No voiced obstruent geminates (e.g. *bb, *dd, *gg, etc.)

c. NOVOICELESSLAB (No-P): No singleton-p: a constraint against nongeminate *p*

d. NONAS͡ VOICELESS (No-NT): Post-nasal obstruents must be voiced (e.g. *nt, *mp, *ŋk, etc.)

(Itô and Mester 1999: 66)

(13) Constraint ranking: SYLLSTRUC >> No-DD >> No-P >> No-NT

(Itô and Mester 1995b: 186)

The core vocabulary fulfills all markedness constraints in (12). Moving towards the Shino-Japanese stratum consisting of early Chinese loans, lexical items in this stratum are subject to all markedness constraints except for No-NT. The next stratum moving away from the core is the assimilated foreign stratum where only SYLLSTRUC and No-DD are enforced. Most loans from European languages are included in this stratum. The unassimilated foreign vocabulary, which is the most peripheral stratum, obeys SYLLSTRUC but violates the other three markedness constraints. It can be seen that the basic syllable structure constraints of Japanese are enforced in all lexical strata. Itô and Mester point out that violation of the markedness constraints in peripheral strata results from the relevant faithfulness constraints being ranked above the relevant markedness constraints. The model of a core-periphery organisation of the lexicon proposes that there is a possibility of distinct rankings for native vocabulary items and loanwords due to the reranking of faithfulness constraints.

Considering the preservation of the non-native consonant clusters as well as different repair strategies in native lexical items and English borrowed words, the Thai lexicon can also be described in terms of a core-periphery organisation of the lexicon. It is reported in the literature (Suthiwan and Tadmor 2009) that Thai has borrowed words from several languages, including Sanskrit, Pali, Chinese, Mon-Khmer, Malay, English and French. Borrowings from the Indic languages, Chinese, Mon-Khmer, and Malay are fully nativised and well established in Thai due to the fact that they are not perceived as foreign by native Thai speakers. Thus, apart from native lexical items, its core vocabulary includes words of Indic origin as well as early loans from Chinese, Mon-Khmer, and Malay. Loanwords from English entered the Thai language after those previously mentioned loans (Suthiwan and Tadmor 2009: 601); most of them in the loan corpus in the present study are fully assimilated into Thai and subject to all well-formedness constraints. Peripheral loanwords, by contrast, violate some constraints that are active in the core; however, they fulfill all fundamental constraints defining the basic syllable canons of Thai such as ONSET and *COMPLEX^{COD}. With the model of a core-

periphery organisation of the lexicon, it makes sense to argue for different rankings for native words in the core and loanwords in the periphery.

2.8 Conclusion

This chapter has explored the fundamental aspects of the Thai and English phonologies, including their phonemic inventories and syllable structures as well as the prosodic system and speech styles of the borrowing language. It has outlined the phonological aspects of borrowed words which are generally modified to fit the phonological system of the borrowing language. It can be seen that previous studies on loanword adaptation seek to answer questions concerning whether adaptation takes place during perception or production. Findings from previous research have shown that category preservation and phonetic approximation can both be found, even in the same language. Moreover, it has been shown that orthography appears to play a role if borrowers know the spellings of loanwords in the source language. However, previous studies on Thai loanword phonology have rarely examined the roles of perception and orthography in adaptation. The behaviour of vowels in loanwords has also been less studied in Thai; hence providing the motivation for this study. With respect to the theoretical framework, OT is adopted to capture the behaviour of loanwords, given that the interaction between markedness and faithfulness constraints can explain the ways in which adapters deal with information present in the input and how they produce a surface form that conforms to the phonological system of the borrowing language. The present study argues for distinct rankings for native words and loanwords in Thai given the existence of different repair strategies for ill-formed syllable structures. The following chapters report on vowel patterns indentified in the loan corpus together with an OT analysis.

Chapter 3

Adaptation of English Monophthongs

3.1 Introduction

This chapter considers the Thai adaptation of English monophthongs occurring in stressed syllables. Schwa in English, [ə], which is restricted to unstressed position, is examined in Chapter 5. I first outline the adaptation patterns of English monophthongs which are typically replaced with their phonetically closest segment in the native inventory in Section 3.2. Section 3.3 considers the constraints relevant to the OT analysis presented in the following section. In Section 3.5, adaptation patterns based on the phonetic characteristics of the input in the source language are examined. Section 3.6 focuses on the behaviour of short vowels in open syllables which is conditioned by Thai speech styles. Recall that I assume British English vowels as the basis for discussion, but the possible influence of other English dialects is pointed out when relevant.

3.2 English-Thai monophthong correspondences

The Thai adaptation of English monophthongs in English monosyllabic loanwords and in stressed position occurring in the loan corpus shows that both vowel quality and length of the English input vowel are maximally preserved in the output. If the English vowel has its correspondent in Thai, it is mapped to that Thai vowel. English monophthongs that have a direct counterpart in Thai are the two front vowels (/iː/ and /æ/) and two back vowels (/uː/ and /ɔː/), as illustrated in (14). In the loan corpus, vowel tokens of English /iː/, /uː/, and /ɔː/ are faithfully replicated in loan forms, preserving both vowel quality and length. As for English /æ/, it surfaces as either a Thai short vowel [æ] or a Thai long vowel [æː] in loan forms. In this case, the adaptation appears to be conditioned by the phonetic characteristics of the English input. As the behaviour of the English TRAP vowel is different from that of other English monophthongs, the adaptation of this phoneme is discussed in Section 3.5.

(14)

English			Thai	
/iː/	‘team’	[tʰiːm]	/iː/	[tʰiːm]
	‘scene’	[siːn]		[siːn]
/uː/	‘boot’	[buːt]	/uː/	[búːt]
	‘zoom’	[zuːm]		[suːm]
/ɔː/	‘form’	[fɔːm]	/ɔː/	[fɔːm]
	‘chord’	[kʰɔːd]		[kʰɔ̀ːt]

(15)

English			Thai	
/ɪ/	‘click’	[kʰlɪk]	/i/	[kʰlík]
	‘link’	[lɪŋk]		[líŋ]
/ʊ/	‘foot’	[fʊt]	/u/	[fút]
	‘hook’	[hʊk]		[húk]
/ɛ/	‘set’	[sɛt]	/e/	[sét]
	‘tent’	[tʰɛnt]		[tén]
/ɜː/	‘hurt’	[hɜːt]	/ɤː/	[hɤ́ːt]
	‘serve’	[sɜːv]		[sɤ̀ːp]
/ʌ/	‘plum’	[pʰlʌm]	/a/	[pʰlam]
	‘club’	[kʰlʌb]		[kʰlàp]
/ɒ/	‘bomb’	[bɒm]	/ɔ/	[bɔm]
	‘shock’	[ʃɒk]		[cʰɔ́k]
/ɑː/	‘bar’	[bɑː]	/aː/	[baː]
	‘farm’	[fɑːm]		[faːm]

The Thai adaptations occurring in the loan corpus reveal that English monophthongs that do not have a direct counterpart in Thai are typically replaced with their closest phonetic match in the borrowing language as seen in Figure 3.1. English monophthongs that do not have correspondents in Thai are /ɪ/, /ɛ/, /ɜː/, /ʌ/, /ʊ/, /ɒ/, and /ɑː/. They are adapted to Thai vowels that share the same quality as shown in (15). For example, English high back rounded lax vowel /ʊ/ and mid central tense vowel /ɜː/ are matched with Thai high back rounded short vowel /u/ and mid central long vowel /ɤː/.

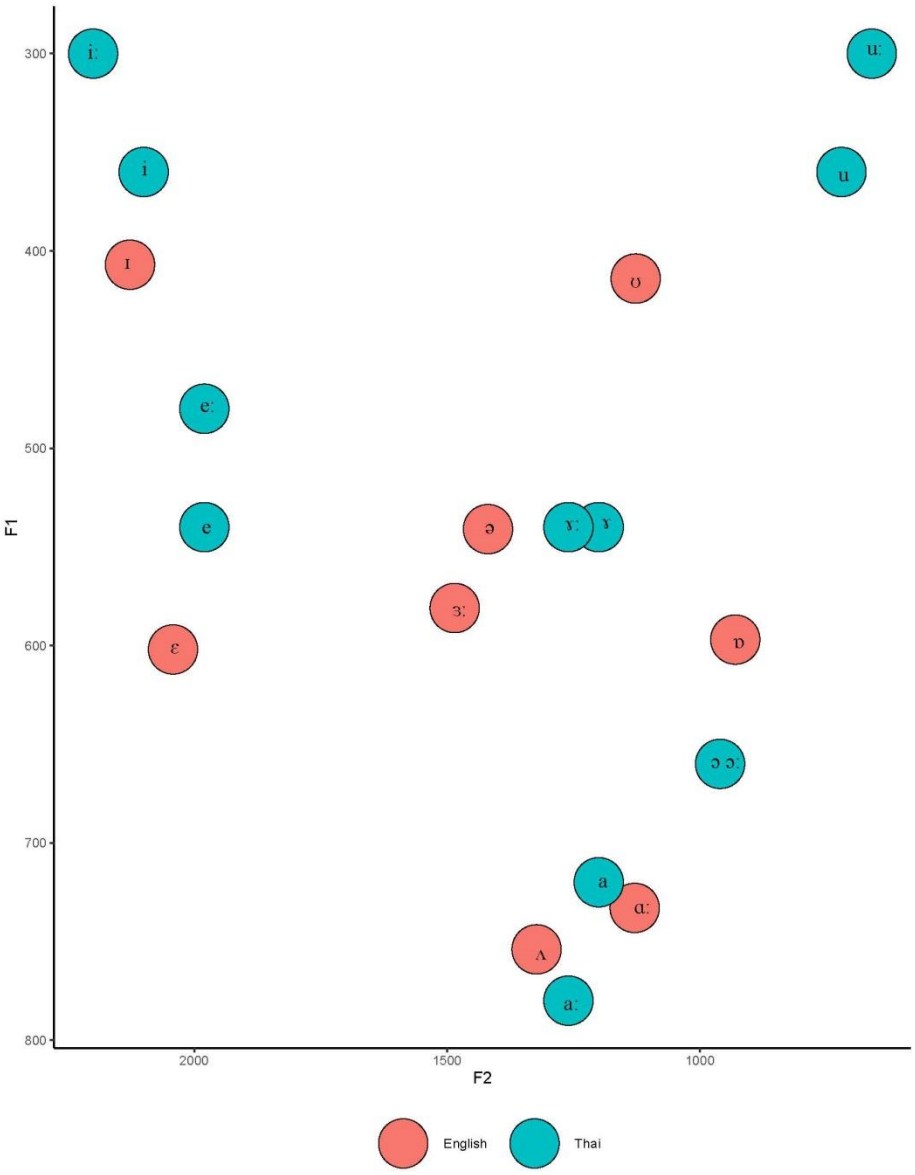


Figure 3.1: English monophthongs which are not present in Thai and Thai monophthongs[12]

It can also be observed that the tense-lax distinction in English is interpreted as a length distinction in Thai. This adaptation suggests that Thai adapters are sensitive to the relative duration of English lax and tense vowels. Given that lax vowels are phonetically shorter than tense vowels, the former are mapped to Thai short vowels while the latter are replaced with Thai long vowels. Considering only location in the vowel chart above, English /ɪ/, for example, could in principle be replaced with either /i/ or /iː/ in Thai as it is acoustically closer to both Thai vowels. Nevertheless, the former is selected to be the best match, since it preserves both

[12] See Appendix B for the first and second formants of the English and Thai monophthongs in Figure 3.1.

the quality and length of the English input. Thus, it can be argued that the Thai adaptation of vowels is largely based on the phonetic representation of the source word and the phonological structure of the borrowing language. Assuming Iverson and Lee's (2006) principle of phonological perception, the subphonemic details of the source language are interpreted according to the contrastive features of Thai as formalised in Section 3.4.

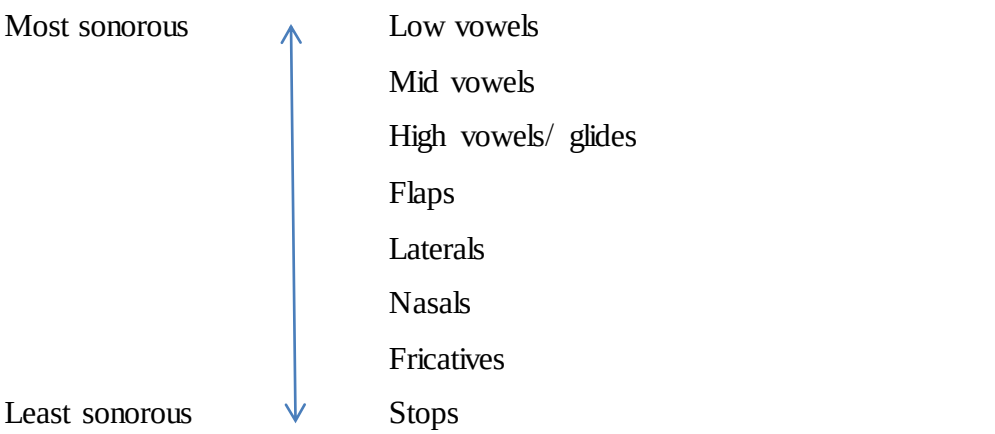
The next section presents relevant markedness and faithfulness constraints which can capture the adaptation of English monophthongs in Thai loan forms.

3.3 Constraints needed for the model

3.3.1 Markedness constraints

As far as syllable structure is concerned, it is claimed that a language builds a syllable consisting of segments which tend to increase in sonority as one proceeds from the margin of the syllable towards the nucleus or peak. All things being equal, the most sonorous sounds are selected as syllable peaks. It is typically the case that vowels occupy the nucleus of a syllable, since they are more sonorous than consonants, as observed in a wide range of literature (e.g. Steriade 1982; Selkirk 1984; Clements 1990; Zec 1995). Considering the following diagram showing the relative sonority of different segment types, it can be seen that low vowels are the most sonorous of all vowels, followed by mid vowels and high vowels. This indicates that low vowels are in some sense 'better' than mid vowels to occupy the nucleus of a syllable, and mid vowels are better than high vowels to function as syllable nuclei. It follows that high vowels appear to be less suitable than low and mid vowels in occurring in the peak position.

(16) Sonority hierarchy



(Adapted from Burquest and Payne 1993: 100)

The markedness of vowel height can be expressed in optimality theoretic terms, as in Beckman (1998:64), given in (17).

(17) *HIGH: * [+high, -low] (No high vowels)
*MID: * [-high, -low] (No mid vowels)
*LOW: * [-high, +low] (No low vowels)

In Thai, there are 18 monophthongs and all of them are allowed to occur in monosyllabic words and stressed position (Nacaskul 2013). This is shown in Chapter 2 and repeated here in (18)

(18) Thai vowel system

	Front	Central	Back
High	i iː	ɯ ɯː	u uː
Mid	e eː	ɤ ɤː	o oː
Low	æ æː	a aː	ɔ ɔː

Given that low, mid and high vowels are present in the Thai vowel inventory and all of them can function as the nucleus of a syllable as shown below, I argue that the three markedness constraints proposed in (17) are equal and ranked low in the constraint hierarchy in the Thai grammar. Hence, low, mid, and high vowels are perfectly able to occupy syllable peaks in Thai.

(19) High vowels

/sìp/	→	[sìp]	'ten'	/piːn/	→	[piːn]	'to climb'
/fùk/	→	[fùk]	'to practice'	/tʰɯː/	→	[tʰɯː]	'to carry'
/rúŋ/	→	[rúŋ]	'rainbow'	/pʰûːt/	→	[pʰûːt]	'to speak'

(20) Mid vowels

/kʰem/	→	[kʰem]	'salty'	/lêːk/	→	[lêːk]	'number'
/ŋɤn/	→	[ŋɤn]	'money'	/rɤː/	→	[rɤː]	'to burp'
/mót/	→	[mót]	'ant'	/kròːt/	→	[kròːt]	'angry'

(21) Low vowels

/bǽŋ/	→	[bǽŋ]	'to share'	/mæːw/	→	[mæːw]	'cat'
/klaj/	→	[klaj]	'far'	/saːj/	→	[saːj]	'late'
/kɔ̀/	→	[kɔ̀ʔ]	'island'	/c^hɔ̂p/	→	[c^hɔ̂p]	'to like'

Other markedness constraints are introduced later when they are relevant to the analysis. The following section deals with a set of faithfulness constraints which impose requirements on input-output identity in vowel height specifications and other vowel features.

3.3.2 Faithfulness constraints

The set of faithfulness constraints that is adopted has its source in Correspondence Theory proposed by McCarthy and Prince (1995). These authors argue that each candidate produced by GEN includes an output representation and a relation between the input and that output. Such a relation is called a 'correspondence relation'. Correspondence constraints are violated if there are disparities between the input and the output. The following is the definition of correspondence:

(22) Correspondence

> Given two strings S_1 and S_2, correspondence is a relation $\Re$ from the elements of S_1 to those of S_2. Elements $\alpha \in S_1$ and $\beta \in S_2$ are referred to as correspondents of one another when $\alpha \Re \beta$.
>
> (McCarthy & Prince 1995: 262)

Basically, correspondence is a relation between corresponding elements in two strings. Therefore, correspondence constraints are adopted to evaluate the relation between vowels in the input (the source language) and output (the borrowing language).

Given that Thai nuclei are always occupied by vowels, the Thai adaptation patterns of English monophthongs show that the input vowel is never deleted in the surface representation. The input information is maximally preserved in the output form. The constraint family under Correspondence Theory that will play a leading role in the analysis is the IDENT (F) constraint family which is defined as follows.

(23) IDENT (F)

Correspondent segments have identical values for the feature F. If x $\Re$ y and x is [γF], then y is [γF].

(McCarthy & Prince 1995: 264)

To capture the adaptation of the English monophthongs in English loanwords in Thai, the IDENT (F) constraint family is employed to evaluate featural faithfulness. This constraint family is necessary to monitor how faithfully the features of the input vowels surface in the output forms.

As outlined in Section 3.2, the adaptation patterns of English monophthongs displayed in the loan corpus show that specific aspects of the vowel quality of the input vowel are faithfully preserved in the output vowel. The following constraints[13] are needed to regulate exactness of input-output identity in vowel quality.

(24) Vowel height

IDENT-IO (high)

Correspondent segments in the input and output have identical values for the feature [high]

IDENT-IO (low)

Correspondent segments in the input and output have identical values for the feature [low]

(25) Vowel frontness

IDENT-IO (front)

Correspondent segments in the input and output have identical values for the feature [front]

[13] IDENT-IO (F) in this chapter is relabelled as IDENT-IO$_{V1}$ (F) in Chapter 4 in order to evaluate a correspondence relation between the first vocalic element of an English diphthong in the input and its corresponding output segment.

(26) Vowel roundness

IDENT-IO (round)

Correspondent segments in the input and output have identical values for the feature [round]

In addition to the constraints monitoring faithfulness to vowel quality, a constraint evaluating input-output identity in vowel length is also relevant to the analysis, as the length of the input vowel appears to be maintained in the actual output form. As vowel length is distinctive in Thai, the following constraints require short and long vowels to surface as such.

(27) Vowel length

IDENT-IO (μ)

Correspondent vowels in the input and output have identical weight.

The following section presents an analysis of the Thai adaptation of English monophthongs in English monosyllabic loanwords.

3.4 OT analysis

I will first present an OT account of the adaptation of English monophthongs which are not present in Thai, followed by the adaptation of English monophthongs having direct Thai correspondents.

3.4.1 Adaptation to the closest phonetic match

This section examines how Thai deals with English loanwords having segments which for Thai are unlicensed as syllable nuclei. The English monophthongs which lack a direct counterpart in Thai are /ɪ/, /ʊ/, /ɛ/, /ɜː/, /ʌ/, /ɒ/, and /ɑː/. They are typically mapped to their closest phonetic match in the native inventory, as in [kʰlík] 'click', [fút] 'foot', [sét] 'set', [hɤ́ːt] 'hurt', [pʰlam] 'plum', [bɔm] 'bomb', and [baː] 'bar'. As English /ɑː/ is the only illicit segment that is not mapped to a Thai segment which shares the same feature in terms of backness, I first examine how Thai deals with this phonological change.

As shown in (15) and repeated here in (28), the tokens of English /ɑː/ in English loanwords are mapped to a Thai central vowel /aː/. The feature [-front] of the input vowel is maintained in the surface form of this English vowel. In fact, a low back vowel /ɔː/ is available in Thai but it is not the best match. This is due to the fact that the English low back vowel /ɑː/ and the Thai low back vowel /ɔː/ are not featurally identical in terms of roundness. This indicates that IDENT-IO (round) favours the Thai unrounded central vowel rather than the Thai rounded back vowel. As this English vowel is mapped to a Thai low central long vowel, IDENT-IO (low), IDENT-IO (front), and IDENT -IO (μ) are also active in selecting a winning candidate. As the English vowel and its Thai correspondent are low vowels, the *LOW markedness constraint must be ranked lower than the featural faithfulness constraints to allow the English low vowel to surface as a Thai low vowel.

(28)	English			Thai	
	/ɑː/	'bar'	[bɑː]	[aː]	[baː]
		'farm'	[fɑːm]		[faːm]

As argued by Yip (1993), foreign words borrowed into a language are evaluated by a set of ranked constraints that define well-formed native words in the borrowing language. Differences between word forms in the source language and their equivalents in the borrowing language result from turning a non-native input into a well-formed output with respect to the ranked constraints that characterise syllable well-formedness in the native phonology. Given that Thai does not have unrounded back vowels, a markedness constraint militating against unrounded back vowels is needed to capture the adaptation to the unrounded central vowel.

(29)	*BACK/UNROUNDED	Unrounded back vowels are not allowed in syllables.

(Miglio 2005)

With respect to the core-periphery organisation of the lexicon mentioned in Chapter 2, loanwords which are peripheral items are allowed to violate constraints that are active in the core. Having said that, they fulfill fundamental constraints which determine the basic syllable canons of the language. I propose that this markedness constraint is part of the fundamental constraints as it is also enforced in the periphery. It must be undominated to impose a structural requirement on surface representation. Thus, the ranking is argued to be

*BACK/UNROUNDED, IDENT-IO (low), IDENT-IO (front), IDENT-IO (μ) >> IDENT-IO (round)[14], *LOW as demonstrated in Tableau (30).

(30)

/bɑː/ 'bar'	*BACK/ UNROUNDED	IDENT (low)	IDENT (front)	IDENT (μ)	IDENT (round)	*LOW
a. [bɑː]	*!					*
☞ b. [baː]						*
c. [ba]				*!		*
d. [bæː]			*!			*
e. [bɔː]					*!	*
f. [bɤː]		*!				

Tableau (30) shows that there is no relative ranking of *BACK/UNROUNDED, IDENT-IO (low), IDENT-IO (front), and IDENT -IO (μ) as they do not conflict over the choice of the winning candidate. They all favour the winner. Candidates that violate any of these constraints are excluded. The faithful candidate [bɑː] is ruled out immediately as it fatally violates the high-ranked constraint * BACK/UNROUNDED which prohibits unrounded back vowels from occupying a syllable nucleus. Candidates (30b-f) are favoured by the high-ranked markedness constraint as the vowels are licit in Thai. Candidate (30f) is excluded from the competition, for it incurs a fatal violation of IDENT-IO (low). The vowel [ɤː] is [-low] while the input vowel /ɑː/ is [+low]. Candidates (30c) and (30d) fatally incur violations of IDENT-IO (μ) and IDENT-IO (front) respectively. The input vowel is a back tense vowel having two moras; however, the vowel [a] in candidate (30c) is a short vowel having one mora and the vowel [æː] in candidate (30d) is a front vowel. Both of the two remaining candidates (30b) and (30e) satisfy the high-ranked constraints and incur one violation of *LOW. However, Candidate (30e) loses out to candidate (30b) because it also violates IDENT-IO (round). Thus, candidate (30b) is the most harmonic output with respect to the ranked constraints.

[14] Adaptation of English monophthongs does not provide evidence that IDENT-IO (round) is dominated by the other featural faithfulness constraints as they do not conflict over the choice of the winning candidate. However, IDENT-IO (round) is violated by the actual output form of English diphthongs in Thai adapted forms, indicating that it is ranked below the other featural faithfulness constraints in the Thai phonology. This ranking is demonstrated in Chapter 4.

The other English monophthongs which cannot function as syllable peaks in Thai are mapped to Thai segments which share the same vowel quality and length as shown in (15) and repeated here in (30).

(31)

English			Thai	
/ɪ/	'click'	[kʰlɪk]	/i/	[kʰlík]
	'link'	[lɪŋk]		[líŋ]
/ʊ/	'foot'	[fʊt]	/u/	[fút]
	'hook'	[hʊk]		[húk]
/ɛ/	'set'	[sɛt]	/e/	[sét]
	'tent'	[tʰɛnt]		[tén]
/ɜː/	'hurt'	[hɜːt]	/ɤː/	[hɤ́ːt]
	'serve'	[sɜːv]		[sɤ̀ːp]
/ʌ/	'plum'	[pʰlʌm]	/a/	[pʰlam]
	'club'	[kʰlʌb]		[kʰlàp]
/ɒ/	'bomb'	[bɒm]	/ɔ/	[bɔm]
	'rock'	[ɹɒk]		[rɔ́k]

Given that these English segments are illicit in Thai, constraints militating against the marked segments are formulated to impose a structural requirement on surface representation in order to prevent the illicit segments from occupying the nucleus of a syllable. The following markedness constraints must be undominated in all strata of the Thai lexicon, since no surface forms ever violate them.

(32)

*ɪ	[ɪ] is not allowed in syllables.
*ʊ	[ʊ] is not allowed in syllables.
*ɛ	[ɛ] is not allowed in syllables.
*ɜː	[ɜː] is not allowed in syllables.
*ʌ	[ʌ] is not allowed in syllables.
*ɒ	[ɒ] is not allowed in syllables.

To conform to the segmental restrictions in Thai, these marked vowels are substituted with Thai segments which share the same features. For example, English /ɪ/, a high front unrounded lax vowel, is mapped to Thai /i/, a high front unrounded short vowel; English /ɛ/, a mid front unrounded lax vowel, is adapted to Thai /e/, a mid front unrounded short vowel; and English /ɒ/, a low back unrounded lax vowel, is replaced with Thai /ɔ/, a low back unrounded short

vowel. The inputs /k^{h}lɪk/ ‘click’ and /sɛt/ ‘set’, for example, surface as [k^{h}lík] and [sét]. IDENT-IO (μ) is needed in this analysis as the input vowels have one mora. Candidates with long vowels are not favoured by IDENT-IO (μ). This is because the output vowels have two moras but their input correspondent has one mora. The ranking arguments are illustrated in Tableaux (33-34).

(33)

/k^{h}lɪk/ ‘click’	*ɪ	IDENT (high)	IDENT (front)	IDENT (μ)	*HIGH
a. [k^{h}lík]	*!				*
☞b. [k^{h}lík]					*
c. [k^{h}lí:k]				*!	*
d. [k^{h}lúk]			*!		*
e. [k^{h}lúk]			*!		*
f. [k^{h}lék]		*!			
g. [k^{h}læk]		*!			

(34)

/sɛt/ ‘set’	*ɛ	IDENT (high)	IDENT (low)	IDENT (front)	IDENT (μ)	*MID
a. [sét]	*!					*
☞b. [sét]						*
c. [sé:t]					*!	*
d. [sɤ́t]				*!		*
e. [sót]				*!		*
f. [sít]		*!				
g. [sæt]			*!			

In these tableaux, it can be observed that the segmental markedness constraints which are *ɪ, and *ɛ are undominated. Ranked high, they prohibit the marked segments from occuring in the surface representation. Candidates (33a) and (34a) are ruled out immediately as they incur a fatal violation of one of these markedness constraints. The other candidates survive as none have [ɪ] and [ɛ] as a syllable peak. However, five out of the remaining candidates in each tableau

fail to be selected as the optimal candidate as they fatally violate the faithfulness constraints requiring correspondent vowels in the input and output to have identical values for the features [high], [low], [front] and [round], and the faithfulness constraint on the moraic content, i.e. the length, of the vowels. Let us first consider the remaining candidates in Tableau (33). Candidates (33f) and (33g) are ruled out since the height of the input vowel is not retained in the output correspondents [e] and [æ]. The input /ɪ/ is [+high], but the outputs are [-high]. Candidates (33d-e) are excluded because they do not satisfy IDENT-IO (front); the input vowel is [+front] but the output vowels in these candidates are [-front]. Candidates (33b-c) could potentially be selected as winning candidates as the height and frontness of the input vowel are preserved in the corresponding output segments. Nevertheless, candidate (33c) loses out to candidate (33b) due to the fact that the length of the output vowel is not identical to that of the input vowel, fatally violating IDENT-IO (μ). The input /ɪ/, which is a lax vowel, shows up as a Thai long vowel. Thus candidate (33b) is selected as the winning candidate as it best satisfies the ranked constraints.

As for the input 'set' in Tableau (34), the syllable peak is occupied by a mid vowel. Both IDENT-IO (high) and IDENT-IO (low) are needed to enforce the identity of vowel height features between corresponding segments in the input and output. Without these two constraints, candidates containing high and low vowels would not be ruled out. The input vowel is [-high] and [-low]. Candidate (34f) has the segment [i] which is [+high], fatally violating IDENT-IO (high); the output vowel in candidate (34g) is [+low], incurring a fatal violation of IDENT-IO (low). Candidates (34d-e) are excluded because the value for the feature [front] of the output vowels is not identical to that of the input vowel. That is, the [ɤ] and [o] are [-front] while the /ɛ/ is [+front]. Consider the remaining candidates (34b-c). Both incur a violation of *MID because they are mid vowels. However, candidate (34b) is more harmonic than candidate (34c) due to the fact that candidate (34c) also violates the high-ranked constraint, IDENT-IO (μ). That is why [sét] is selected to be the optimal output.

With respect to English /ɒ/, some tokens of this vowel which are followed by fricatives in the source language appear to show up as a long vowel [ɔː] in Thai, as in 'boss' [bɔ́ːt], 'moss' [mɔ́ːt], 'soft' [sɔ́ːp], and 'lip gloss' [líp.klɔ́ːt]. Presumably, such English loanwords have /ɔː/ rather than /ɒ/ in the source language. As noted in Section 2.2.2, English words with fricative codas which have /ɒ/ in modern RP take /ɔː/ in older RP (Wells 1982b:281). Thus it might be the case that the words mentioned above, except for 'lip gloss', are early loanwords due to the fact that English borrowings have entered the Thai lexicon since 1824. The word 'lip gloss', on

the other hand, might have been borrowed from GenAm rather than RP. This type of make-up was first commercially introduced in 1932 by Max Factor, a cosmetics company in the US (Sharma n.d.). English words with /ɒ/ followed by fricatives in RP also have /ɔː/ in GenAm (Wells 1982a; Cruttenden 2001). It follows that the input vowels to the adaptation process are English /ɔː/. This English phoneme surfaces faithfully in the loan form because it is also present in the Thai phonemic inventory. A ranking argument accounting for English monophthongs having their direct counterpart in Thai is demonstrated in the next section.

The proposed ranking arguments reveal that the Thai grammar does not allow English loanwords which have illicit vowels as syllable nuclei to surface. The nuclear vowels have to undergo segmental substitution to comply with the phonological system of Thai. The next section deals with the English monophthongs which exist in the Thai vowel inventory.

3.4.2 Mapping to Thai correspondents

English monophthongs in English loanwords in Thai have faithful surface forms if they have a direct counterpart in the Thai phonemic inventory, as shown in (14) and repeated here in (35).

(35)

English			Thai	
/iː/	‘team’	[tʰiːm]	/iː/	[tʰiːm]
	‘scene’	[siːn]		[siːn]
/uː/	‘boot’	[buːt]	/uː/	[búːt]
	‘zoom’	[zuːm]		[suːm]
/ɔː/	‘form’	[fɔːm]	/ɔː/	[fɔːm]
	‘chord’	[kʰɔːd]		[kʰɔ̀ːt]

Due to the fact that the phonemes /iː/, /uː/, and /ɔː/ exist in the Thai vowel inventory, these vowels in English loanwords do not undergo segmental adaptation; they are perceived faithfully and mapped to their direct counterpart. However, some tokens exhibit exceptional behaviour. They surface as short vowels rather than long vowels, such as ‘pizza’ [pít.sâː], ‘fluke’ [flúk], and ‘chalk’ [cʰɔ́k]. To account for this faithful mapping, the English loanwords containing the vowels /iː/ and /uː/ can be taken as an example. The following tableaux demonstrate the realisation of English /iː/ and /uː/ in Thai.

(36)

/siːn/ 'scene'	IDENT (high)	IDENT (front)	IDENT (μ)	IDENT (round)	*HIGH
☞a.[siːn]					*
b.[sin]			*!		*
c.[sɯːm]		*!			*
d.[suːn]		*!		*	*
e.[seːn]	*!				
f.[sæːn]	*!				

(37)

/buːt/ 'boot'	IDENT (high)	IDENT (front)	IDENT (μ)	IDENT (round)	*HIGH
☞a. [búːt]					*
b. [bút]			*!		*
c. [bʉ́ːt]				*!	*
d. [bíːt]		*!		*	*
e. [bóːt]	*!				
f. [bɔ́ːt]	*!				

As shown in Tableaux (36) and (37), the markedness constraint militating against high vowels is ranked lower than the faithfulness constraints, so the input vowels /iː/ and /uː/ surface as such. Consider the input /siːn/ 'scene'. Candidates with unfaithful output vowels are ruled out as they do not satisfy featural faithfulness constraints. Candidates (36e-f) incur a fatal violation of IDENT-IO (high) as the height of the input vowel is not preserved in the output vowels. Although the other losing candidates are favoured by the faithfulness constraint prohibiting changes in values for the feature [high], they violate another high-ranked faithfulness constraint. Candidate (36b), which is faithful to the input in terms of vowel quality, is ruled out due to the fact that it violates IDENT -IO (μ); the input vowel shows up as a short vowel instead of a long vowel. Candidates (36c-d) also fail to surface as they incur a serious violation of IDENT-IO (front); the output vowels in these candidates have the feature [-front] while the input vowel is [+front]. Hence, it follows that candidate (36a) is the most harmonic output, for it is favoured

by the high-ranked constraints. Although it is the optimal candidate, it also has a violation of *HIGH. Such violation, however, is not serious since the markedness constraint *HIGH is ranked low.

With respect to English /uː/, I observe that its tokens which occur after /Cj-/ sequences are likely to surface as a Thai labial-velar glide, rather than their Thai direct counterpart, and the English palatal glide is adapted to a Thai high front vowel as shown in (38).

(38)

English			Thai	
/uː/	‘cue’	[kʰjuː]	/w/	[kʰiw]
	‘fuse’	[fjuːz]		[fiw]
	‘music’	[mjuːzɪk]		[miw.sìk]
	‘tulip’	[tʰjuːlɪp]		[tʰiw.lîp]
	‘producer’	[pɹədjuːsə]		[proː.díw.sɤ̂ː]

As mentioned in Section 2.2.2.2, the Thai glide in a vowel plus glide sequence occurs in the coda position and it cannot be followed by any other consonants. Foreign words entering Thai appear to comply with this restriction. It can be seen that the loanword ‘fuse’ in (38) shows up as [fiw] without a following consonant. The final consonant in the source language is deleted in the loan form.

Now let us turn to constraints relevant to an analysis of the adaptation of /Cjuː/ as follows. Tableau (40) demonstrates the adaptation of the input ‘cue’.

(39) *[Cj A sequence /Cj/ is not allowed to occur in the onset.

*iu A diphthong [iu] is not allowed in syllables.

(40)

/kʰjuː/ ‘cue’	*[Cj	*iu	IDENT (high)
a. [kʰjuː]	*!		
b. [kʰiu]		*!	
c. [kʰia]			*!
☞d. [kʰiw]			

The tableau shows that the two markedness constraints are relavant to a set of high-ranked constraints as no surface forms ever violate them in Thai. As a result, candidate (40a) is ruled out immediately, as it fatally violates a markedness constraint militating against a /Cj-/ sequence. Candidate (40b) satisfies *[Cj as the palatal glide in the input is replaced with a high front vowel in the output, forming a diphthong [iu]; however, this diphthong is illegal in Thai, incurring a fatal violation of *iu. The candidate [k^{h}iu], thus, fails to surface. Of the two remaining candidates, the syllable nucleus in candidate (40c) is filled with [ia] which is attested in Thai, but the height of the input vowel is not preserved in its corresponding output segment. The input /uː/ is [+high] but its output correspondent [a] is [-high]. Candidate (40d), on the other hand, is favoured by IDENT (high), a faithfulness constraint requiring identity of height between the input and output correspondents. It can be seen that the input vowel /uː/ and its output correspondent [w] are [+high]. Hence, candidate (40d) is selected as a winning candidate due to the fact that it is favoured by all high-ranked constraints.

There are some loanwords with /Cjuː/ in RP which are not realised as a [Ciw] in Thai, such as 'Youtube' and 'nude'. They surface as [juː.t^{h}úːp] and [núːt] respectively. I assume that such words have been borrowed from GenAm rather than RP. In American English, the palatal glide /j/ does not occur after coronal consonants, as in 'tune' [t^{h}uːn], 'duke' [duːk], 'new' [nuː], and 'suit' [suːt] (Wells 1982a: 247; Davis and Hammond 1995: 163). That is why the loanwords 'tune' and 'nude' do not surface as *[ciw] and *[niw] in Thai.

It can be seen that the adaptation of English monophthongs occurring in loanwords appears to be based on the phonetic input, given that vowel length in loanwords is determined on the basis of the phonetic length of the source vowel. Moreover, the native phonology plays an important role in the adaptation process. Non-native vowels cannot surface faithfully due to the dominance of the markedness constraints prohibiting the marked segments. They, thus, undergo substitution. The length of the input is faithfully preserved in the adapted form due to the fact that vowel length is distinctive in Thai.

The following section deals with the adaptation of English /æ/, which tends to be conditioned by the phonetic characteristics of the English input.

3.5 Adaptation of English /æ/

This section deals with the different adaptation patterns of English /æ/ which is categorised as a lax vowel but it behaves differently from the other British English lax vowels. As examined

in the previous sections, the British English lax vowels, including /ɪ/, /ɛ/, /ʌ/, /ʊ/, /ɒ/, are typically mapped to Thai short vowels given that they are phonetically short. Unlike the other lax vowels, English /æ/ is not consistently mapped to Thai phonemic short vowel /æ/. It is matched to either short /æ/ or long /æː/ in Thai loan forms. It appears that the Thai adaptation patterns of this English vowel are governed by the phonetic characteristics of the English input. That is, English /æ/ with short duration surfaces as a short vowel [æ] in Thai loan forms, while the vowel tokens with longer duration are realised as a long vowel [æː]. However some tokens exhibit exceptional behaviour. They are realised as [a] or [aː], as in 'barrel' [baː.rew] and 'atom' [ʔaʔ.tɔm]. These two adapted forms are likely to be influenced by the orthography of the source vowel, given that English /æ/ is usually represented by <a>.

The following sections explore the behaviour of /æ/ in different phonetic environments in two main varieties of Modern English which gives rise to their different adapted forms, and examine the adaptation patterns emerging in the loan corpus followed by an OT analysis.

3.5.1 Phonetic descriptions of English /æ/

/æ/ lengthening is a phenomenon that occurs in both Br and Am and it has been extensively explored in many studies (e.g. Fudge 1977; Labov *et al*. 2006; Labov 2007; Kettig 2015, 2016). Although British vowels are used as the basis for discussion in this study as the vowels in English loans in Thai are more similar to Br vowels than Am vowels, some words having /æ/ in the loan corpus might have Am origins. This is due to the fact that words having /æ/ in Br also contain /æ/ in Am (Wells 1982a; Carr 2013). The following sections describe the behaviour of English /æ/ in different phonetic environments in the two varieties of English.

3.5.1.1 Lengthening of British English /æ/

In several phonetic descriptions of Br /æ/, it has been noted that the traditionally short /æ/ is lengthened noticeably in certain words, especially those containing postvocalic /d/. Jones (1975: 235) and Wells (1982b: 288-289) report that some RP speakers have the bad-lad split which is a phonemic split of the short vowel phoneme /æ/ into a short /æ/ and a long /æː/. The length distinction is found in pairs such as 'bad' [bæːd] vs 'pad' [pæd], 'glad' [glæːd] vs 'lad' [læd]. Both authors argue that the length of /æ/ is contrastive in pre- /d/ environments. That is, monosyllabic adjectives ending in /d/ have a long [æː] whereas monosyllabic nouns with a final /d/ have a short [æ]. The lengthening of /æ/ is also likely to occur before other voiced consonants, as in 'jam' [dʒæːm] and 'jazz' [dʒæːz]. As outlined in (Cruttenden 2001: 111),

English /æ/ generally has longer duration than the other short vowels /ɪ, e, ʌ, ɒ, ʊ/ in RP. It tends to be as long as a long vowel when it occurs in the context of a following voiced consonant, as in 'cab', 'bag', 'bad', 'badge' and 'man'. On the other hand, it remains short when following consonants are voiceless, as in 'cap', 'back', and 'mat'.

In addition to these general descriptions of /æ/-lengthening in RP, Fudge (1977), a native RP speaker, recorded his own speech in order to find patterns of his own use of the long [æː] and short [æ]. His /æ/ was always short not only in monosyllabic words ending in voiceless consonants but also in words having final nasals or lateral+voiceless stop clusters, such as 'alp', 'lamp' and 'tank'. While the general descriptions of /æ/ maintain that this vowel is likely to be lengthened in the context of voiced consonants, he found that all final voiced consonants and other clusters appeared to allow both short [æ] and long [æː] in his own speech, as in 'tab' [tʰæb], 'add' [æd], 'tag' [tʰæg], 'slam' [slæm], 'plan' [pʰlæn], 'fab' [fæːb], 'bad' [bæːd], 'bag' [bæːg], 'jam' [dʒæːm], and 'man' [mæːn]. However, one exception is that /æ/ never gets lengthened before a velar nasal /ŋ/. He also noted that there were a number of words where he was not certain whether they had short or long /æ/, such as flab, ham, and fan.

A recent experimental study of /æ/-lengthening in British English was carried out by Kettig (2015, 2016). The author examined the duration of /æ/ in Southern Standard British English (henceforth SSBE). The participants were 21 native SSBE speakers who were asked to read sentences containing monosyllabic and disyllabic words with stressed /æ/. All of the target words always appeared sentence-finally. He found that the voicing and manner of articulation of the following consonant significantly affected vowel duration. That is, the duration of /æ/ before voiced consonants was longer than its duration before voiceless consonants. Its length before fricatives was also longer than before stops, nasals, and affricates. As far as final voiced stops are concerned, it was found that place of articulation seemed to affect the length of /æ/. The bilabial voiced stop appeared not to encourage lengthening, as opposed to /g/ and /d/. In his observation, it turned out that words with a final /b/ and a final /p/ did not significantly differ in vowel duration.

Given that /æ/-lengthening also occurs in Am, the following section discusses the phenomenon in this variety of English.

3.5.1.2 /æ/-tensing in American English

/æ/-tensing is a phenomenon that occurs in many varieties of Am. In some varieties, tense and lax forms of /æ/ are considered to be allophones of the single phoneme, whereas in certain varieties the historical short-a class is split into two separate phonemes—lax and tense classes. The term 'tense' is used to denote 'a complex association of phonetic features: raising, fronting, lengthening, and the development of an inglide' (Labov 2007: 353). The short-a vowels in such words as 'cab', 'bad', 'half', 'man', 'past', are realised as a tense variant in certain environments. The vowel /æ/ has two main allophones—tense and lax— in many Am dialects (Boberg and Strassel 2000: 109). The tense category varies from [æə] to [ɛə] to [eə] to [ɪə], depending on the speaker's regional accent (Boberg and Strassel 2000, Nagy and Roberts 2008, Gordon 2008a,b). It is usually fronted and raised to a mid or high position and is often produced with an inglide. Meanwhile, the lax variant [æ] remains in the position of a low-front vowel. In some cases, the distribution of lax and tense variants is generally governed by phonetic environments; in others, phonological, grammatical, and lexical conditions also play a role (Labov *et al.* 2006, Labov 2007).

As for tensing environments, Labov (1971: 427) proposes a lengthening hierarchy which is ordered from most to least favourable environments as follows:

(41)

m, n > f, θ, s > d > b > ʃ > g > v, z > p, t, k > l

The implicational hierarchy in (41) shows that the most favourable environment for the tensing of /æ/ in Am is before front nasals, and the least favourable is before voiceless stops and liquids. As pointed out by Labov (1981: 284), the historical short-a is frequently raised and tensed before /m, n/, as in 'hand', 'man', and 'ham' in all dialects of Am. Although the nasal environment mostly encourages tensing in all Am varieties, the extent to which the other favourable environments encourage raising and lengthening varies across dialects (Labov *et al.* 2006).

Recall that GenAm is one of the two varieties of the English language to which Thai speakers are exposed. Let us look at the behaviour of /æ/ in accents which are categorised as GenAm. Accents spoken in the Inland North together with the rest of Midwest and West represent GenAm (Gordon 2008a, b). In the Inland North, the short-a is tensed not only before front nasals but also in the other environments triggering tensing in (41). As for the West and

Midwest accents, the tensing of /æ/ is common in the context of a following nasal and in the other favouring environments such as /d/, but short-a tokens before voiceless stops and in words with obstruent-liquid onsets are lax and remain in low front position (Labov 2007). The other short-a system found in many regions of North America is called the nasal system; here, the short-a is tense in the context of a following nasal and lax elsewhere.

It can be seen that the most favoured tensing environment for /æ/ found in the accents representing GenAm appears to be before front nasals. The tense variant regularly occurs before front nasals, as in 'man', 'ham', 'dance', and 'lamb'. Apart from nasals, voiceless fricatives and voiced stops also encourage tensing, as in 'last', 'half', 'bad', and 'bag'. This short vowel, on the other hand, is less likely to be tensed before voiceless stops and liquids, as in 'cat', 'black', and 'pal'.

The next section examines the Thai adaptation patterns of /æ/ found in the loan corpus.

3.5.2 Thai adaptation patterns of /æ/

The Thai adaptations of English /æ/ displayed in the loan corpus show that the vowel quality of the English input vowel is faithfully preserved in the Thai output, given that the English vowel has its direct counterpart in Thai. However, the length of the input vowel is not maintained in some output forms. English has one low front lax vowel, /æ/, and its length appears to be determined by segmental contexts in which it occurs; by contrast, Thai has two low front vowels that differ in length, short /æ/ and long /æː/. In the loan corpus, English /æ/ which is a short vowel in the source language is variably mapped to either Thai short /æ/ or long /æː/. The realisation of English /æ/ as Thai [æː] is apparently unexpected, due to the fact that Thai also has this phoneme in the native inventory, giving rise to phonetic approximation. The patterns observed appear to be conditioned by the segmental environment in the source language. That is, it shows up as Thai short [æ] when it is followed by stops (with the exception of /d/), voiceless affricates, and nasal+voiceless stop clusters, and it is mapped to Thai long [æː] when following consonants are front nasals, fricatives, and nasal+voiced stop clusters. Examples are given below.

(42) Adaptation to a Thai short segment

English			Thai	
/æ/	'rap'	[ɹæp]	/æ/	[ráp]
	'flat'	[flæt]		[flàt]
	'pack'	[p^hæk]		[p^hák]
	'tag'	[t^hæg]		[t^hàk]
	'lab'	[læb]		[làp]
	'match'	[mætʃ]		[màt]
	'wax'	[wæks]		[wák]
	'bank'	[bæŋk]		[báŋ]
	'calcium'[15]	[k^hæɬ.si.əm]		[k^hæn.siam], [k^hæw.siam]

(43) Adaptation to a Thai long segment

English			Thai	
/æ/	'ban'	[bæn]	/æː/	[bæːn]
	'jam'	[dʒæm]		[jæːm]
	'brand'	[bɹænd]		[bræːn]
	'gas'	[gæs]		[gáːt]
	'jazz'	[dʒæz]		[cáːt]
	'sad'	[sæd]		[sáːt]
	'dance'	[dæns]		[dáːn]
	'cast'	[k^hæst]		[k^háːt]

The patterns displayed in the loan corpus give rise to the role of phonetic characteristics of the input in the source language on loanword adaptation. They support the phonetic view which maintains that a given phoneme of the source language can have different adapted forms in the borrowing language depending on its phonetic characteristics in different segmental environments in the source language (Kang 2011). Certain patterns of consonant adaptation in English loanwords in Thai are also attributed to the subphonemic details of English input segments as mentioned in Section 2.4. The Thai adaptation of English voiceless stops in different contexts reported in Kenstowicz and Suchato (2006) shows that Thai speakers are sensitive to the phonetic realisation of English input segments. English voiceless stops are likely

[15] English words with /æ/ in the context of a following /l/ that Thai has borrowed are polysyllabic words. The final English /l/ is realised as either [n] or [w] in Thai, depending on the Thai speaker's knowledge of English.

to surface as Thai aspirated stops in word-initial position, but as unaspirated after /s/. Note that Thai has aspiration contrasts in voiceless stops. This suggests that if the subphonemic details of the English input are phonological in Thai, they are likely to be realised as such in Thai adapted forms. As for the adaptation of English /æ/ illustrated in (42) and (43), it can be observed that the English input vowel is realised differently in different segmental contexts. It is assumed that the adaptation is based on the phonetic characteristics of the input vowel in the source language. Recall that this English short vowel is lengthened considerably in certain environments, particularly in the context of voiced consonants; it remains short in the context of voiceless consonants.

The mapping of English /æ/ to Thai /æ/ and /æː/ is also attributed to the Thai listener's perception of the output of /æ/ in the source language. In English, as noted in Section 3.5.1, although some RP speakers have the bad-lad split, a considerable difference in length between the vowel tokens of /æ/ in such words as 'cat', 'tap', 'bad', and 'man' made by most English speakers depends on the context in which the vowel occurs (Cruttenden 2001). This suggests that although 'cat' and 'bad' are pronounced with short [æ] and long [æː] respectively, the relative duration of the vowels in these words cannot be perceived by native speakers of English who do not have a contrast between short /æ/ and long /æː/. This is due to the fact that they do not distinguish between [æ] and [æː]. By contrast, vowel length contrast is phonemic in Thai. Recall that Thai makes a distinction between short and long vowels and that native Thai listeners rely on relative vowel duration as the main perceptual cue for the length distinction (see Section 2.2.2.1). Vowels with short duration are perceived as short vowels by Thai listeners while those with long duration are categorised as long vowels. I assume that Thai listeners also make use of their native language experience when they encounter foreign vowels. As argued by Iverson and Lee (2006), perception is as phonological as production. They assume that the subphonemic details of the source language are interpreted according to the contrastive features of the borrowing language. Boersma and Hamann *(*2009*)* also argue for phonological perception. They point out that many loanword phenomena are attributed to first-language phonological perception and can be explained by the behaviour of listeners in their native language.

With respect to the Thai perception of the English sound [æ], I assume that Thai listeners will interpret the phonetic details of the vowel in terms of the salient perceptual categories of the native language. Due to the fact that Thai listeners have native language experience with the use of relative vowel duration for vowel length contrasts, they will perceive English [æ]

with longer duration, as in 'man', 'sad', and 'jazz', as Thai long /æː/ and the one with shorter duration in words like 'back', 'rap', and 'match' as Thai short /æ/. In other words, English /æ/ is represented as /æ/ or /æː/ in the input for the adaptation, depending on whether it is short or long in the surface representation in the source language. Take the words 'pack' and 'ban' as examples. The inputs to the Thai adaptation would be /p^hæk/ and /bæːn/ respectively. The next section presents an OT account of the Thai adaptation of English /æ/.

3.5.3 OT analysis

This section presents an analysis of the Thai realisation of English /æ/ in three contexts: lax environments, lengthening environments, and the context of following voiced stops.

3.5.3.1 Thai realisation of /æ/ in lax environments

Recall that environments which do not encourage lengthening of English /æ/ are following voiceless stops, voiceless affricates, nasal+voicless stop clusters, and laterals. Thai adapters deal with English /æ/ in such contexts in the same way; that is, its tokens are categorically mapped to a Thai short vowel /æ/ as illustrated in (42). Given that they are not lengthened, Thai listeners interpret vowel tokens with short duration as a short vowel in terms of the L1 distinctive features. Thus, I argue that the input to adaption in these environments is the phonetic form of this English vowel, which is short [æ].

It appears that once Thai adapters perceive a token of English /æ/ as Thai phonological short vowel /æ/, they will produce it as such. Take the words 'pack' and 'rap' as examples. These two words are realised as [p^hǽk] and [rǽp] respectively in Thai, as shown in Tableaux (44) and (45). To ensure that the vowel duration of the input vowel shows up faithfully in the output vowel, IDENT-IO (μ) is needed to enforce the identity between the input and output vowels in terms of length. The quality of the input vowel is also faithfully preserved in the Thai surface representation; thus, the featural faithfulness constraints requiring the preservation of input vowel quality must be ranked high as well, except for IDENT-IO (round) which is ranked lower than the other featural faithfulness constraints in the Thai phonology. Thus, the ranking argument which has been proposed to account for the adaptation of English low vowels still holds true here.

(44)

/pʰæk/ 'pack'	IDENT (low)	IDENT (front)	IDENT (μ)	IDENT (round)	*LOW
☞a. [pʰǽk]					*
b. [pʰǽːk]			*!		*
c. [pʰék]	*!				
d. [pʰɔ́k]		*!		*	*

(45)

/ɹæp/ 'rap'	IDENT (low)	IDENT (front)	IDENT (μ)	IDENT (round)	*LOW
☞a. [rǽp]					*
b. [rǽːp]			*!		*
c. [ré́p]	*!				
d. [rɔ́p]		*!		*	*

As argued in the analysis of the English monophthongs which have their Thai direct counterpart in Section 3.4.2, they do not undergo adaptation because they are legal vowels in the native inventory. The faithful output candidates [pʰǽk] and [rǽp] are selected as winning candidates as they are favoured by the faithfulness constraints. Candidates (44c-d) and (45c-d) are excluded because the vowel quality of the input vowels is not preserved in the output vowels. Candidates (44c) and (45c) incur a fatal violation of IDENT-IO (low), as the height of the input vowels is not preserved in the output vowels. Candidates (44d) and (45d) cannot surface because they are not favoured by the high-ranked constraint IDENT-IO (front). The input vowels are front vowels, while the Thai correspondents in these candidates are back vowels. As for candidates (44b) and (45b), they are less harmonic than the winning candidates (44a) and (45a) due to the fact that these losing candidates fatally violate IDENT-IO (μ); the weight of the input vowels is not identical to that of the output correspondents. The input vowels are monomoraic, but the output vowels are bimoraic.

3.5.3.2 Thai realisation of /æ/ in lengthening environments

This section examines how Thai adaptors deal with English /æ/ in environments encouraging lengthening which include following nasals, fricatives, and nasal+voiced stop clusters. In the loan corpus, the tokens of English /æ/ in these environments are mapped to a Thai long vowel [æː] as shown in (43). This adaptation can be explained by the way Thai listeners interpret the phonetic characteristics of English /æ/ in the environments in question. As pointed out by several authors, RP /æ/ is likely to be lengthened if the following consonant is voiced (e.g. Jones 1975; Wells 1982b; Cruttenden 2001). With respect to the manner of following consonants, /æ/ tokens before fricatives are longer than those before stops, nasals, and affricates (Kettig 2015, 2016). In the case of final clusters, it is reported that /æ/ before clusters with a voiced stop like /nd/ is more likely to be longer than before clusters with a voiceless stop such as /nt/ and /mp/ (Kettig 2015, 2016). Cruttenden (2001) notes that the surface form of /æ/ in lengthening environments tends to be as long as a long vowel. As far as the Thai adaptation of the English long vowels /ɑː, iː, ɔː/ is concerned, they are mapped to the Thai long vowels [aː, iː, ɔː] as examined in Section 3.4. Therefore, it is not surprising that Thai listeners perceive English tokens of /æ/ with relatively long duration as long /æː/ and faithfully produce it. Take the English loanwords 'fan', 'jazz', and 'brand' as examples[16]. They are realised as [fæːn], [cǽːt], and [bræːn] respectively, indicating that the adaptation of /æ/ is predominantly based on phonetic input. I assume that the input vowel to the adaptation of the three words is long /æː/, as shown in Tableaux (46)-(48).

(46)

/fæːn/ 'fan'	IDENT (low)	IDENT (front)	IDENT (μ)	*LOW
☞a. [fæːn]				*
b. [fæn]			*!	*
c. [fiːn]	*!		*	
d. [faːn]		*!	*	*

[16] Given that the analysis focuses on the adaptation of the input vowel, the phonological modifications made to illegal consonants and ill-formed syllable margins are not evaluated in here.

(47)

/dʒæːz/ 'jazz'	IDENT (low)	IDENT (front)	IDENT (μ)	*LOW
☞a. [cǽːt]				*
b. [cǽt]			*!	*
c. [cíːt]	*!		*	
d. [cáːt]		*!	*	*

(48)

/bræːnd/ 'brand'	IDENT (low)	IDENT (front)	IDENT (μ)	*LOW
☞a. [bræːn]				*
b. [bræn]			*!	*
c. [briːn]	*!		*	
d. [braːn]		*!	*	*

The tableaux show that with the same set of ranked constraints established previously, candidates (46b), (47b), and (48b) are ruled out immediately since the syllable nuclei are occupied by short vowels instead of long vowels, fatally violating IDENT-IO (μ). Even though the other losing candidates are favoured by IDENT-IO (μ), they are less harmonic than the winning candidates because the output vowels are not identical to the input vowels in terms of quality. Candidates (46c), (47c), and (48c) incur a fatal violation of IDENT-IO (low), as the output vowels are high vowels. As for candidates (46d), (47d), and (48d), the syllable nuclei are filled with a low central vowel [aː] instead of a low front vowel [æː], incurring a fatal violation of IDENT-IO (front). Hence, candidates (46a), (47a), and (48 a) that are faithful to the English input in terms of vowel length and quality are the most optimal.

Now let us turn to the realisation of /æ/ in words that undergo tensing in GenAm. In the loan corpus, two English loanwords are obviously borrowed from this variety of English; they are 'dance' and 'cast'. It is noted that these two words have /ɑː/ in RP but /æ/ in GenAm. The nucleus of the words shows up as [æː] in Thai, indicating that they have been borrowed from GenAm. It can be seen that the tokens of /æ/ in the two words are followed by /n/ and /s/. Recall that front nasals and voiceless fricatives are favourable environments for /æ/ tensing in GenAm

(Labov 1971, 2007). The tense allophone varies from [æə] to [ɛə] to [eə] to [ɪə], depending on the speaker's regional accent (Boberg and Strassel 2000; Gordon 2008a,b; Nagy and Roberts 2008). The question arises as to which one is the input to the adaptation. GenAm is the accent which Thai learners of English are exposed to. As the variant [æə] is a common tense variant in GenAm (Wells 1982c: 477), I assume that [æə] is the input to the adaptation of GenAm /æ/ in tensing environments. Thus the input to the adaptation of the words 'dance' and 'cast' must be /dæəns/ and /kʰæəst/ respectively. Given that the diphthong [æə] is a falling diphthong which is not present in Thai, it is monophthongised to a Thai long vowel [æː]. The pattern found here is similar to the way Thai deals with English /eɪ/, /oʊ/, and /ɛə/, which are also illicit in the borrowing language; they are all mapped to Thai long vowels, preserving the length of the English input. The behaviour of English diphthongs is examined in Chapter 4; therefore, the simplification of GenAm [æə] is also discussed in that chapter.

3.5.3.3 Adaptation of English /æ/ in the context of voiced stops

The behaviour of English /æ/ before voiced stops does not pattern in the same way in Thai loan forms. Vowel tokens followed by /b/ and /g/ are categorically mapped to a Thai short vowel [æ]. With respect to /æ/ in the context of following /d/, its tokens in adjectives ending in /d/ are realised as a Thai long vowel [æː], while the others in this context surface as a short vowel [æ].

(49) Adaptation in the context of /d/

Loanwords	RP	Thai
'sad'	[sæd]	[sǽːt]
'bad[17] boy'	[bæd.bɔɪ]	[bǽːt.bɔːj]
'iPad'	[aɪ.pʰæd]	[ʔaj.pʰæ̀t]
caddie/caddy	[kʰæ.di]	[kʰǽt.dîː]
cadmium	[kʰæd.mi.əm]	[kʰǽt.mîam]
badminton	[bæd.mɪn.tən]	[bæ̀t.min.tân]

[17] Thai has borrowed ˙bad˙ as part of the noun phrase ˙bad boy˙; it is not used on its own in Thai conversations.

(50) Adaptation in the context of /b/ and /g/

Loanwords	RP	Thai
'lab'	[læb]	[læ̀p]
'tab'	[tʰæb]	[tʰæ̀p]
'jab'	[dʒæb]	[jǽp]
'tæg'	[tʰæg]	[tʰæ̀k]
'gag'	[gæg]	[kǽk]
'tablet'	[tʰæ.blət]	[tʰǽp.let]
'zigzag'	[zɪg.zæg]	[sík.sǽk]
'magazine'	[mæ.gə.ziːn]	[mǽk.ka.siːn]
'magnesium'	[mæg.niː.zi.əm]	[mǽk.niː.sîam]

Recall that English /æ/ in monosyllabic adjectives ending in /d/ is fully long in RP, as in 'sad' and 'bad', but it is short in nouns with postvocalic /d/, as in 'pad' and 'lad' (Jones 1975; Wells 1982b). Looking at its realisations in the loan forms in (49), the vowels in the adjectives 'sad' and 'bad' show up as a long vowel [æː] in the loan forms. The adaptation of /æ/ in the adjectives ending in /d/ suggests that the input to the adaptation process must be a lengthened vowel, as illustrated in Tableau (51).

(51)

/sæːd/ 'sad'	IDENT (low)	IDENT (front)	IDENT (μ)	*LOW
☞a. [sǽːt]				*
b. [sǽt]			*!	*
c. [síːt]	*!			
d. [sáːt]		*!		*

Tableau (51) reveals how the actual output is selected as a winning candidate. Given that the faithfulness constraints override the markedness constraint against low vowels, and the vowel /æː/ is present in the Thai phonemic inventory, candidate (51a) with a faithful output vowel is more harmonic than the other three candidates that have an unfaithful output vowel, incurring a fatal violation of a faithfulness constraint.

Turning to the other tokens before /d/ in words which are not adjectives, we can see that they are mapped to a short vowel [æ]. Wells (1982a: 130) notes that the lengthening of /æ/ does

not apply to every word which ends in consonants that trigger this phenomenon. As far as disyllabic words are concerned, syllables closed by inflectional boundaries, such as 'tabbing' and 'badges', have a lengthened vowel, while words like 'tabby' and 'badger' have a short vowel (Wells 1982c: 477). Hence, the initial vowels in 'caddie' and 'cadmium' are not lengthened, as these words do not contain a morpheme boundary. Meanwhile, although the word 'badminton' is not a disyllabic word, I assume that the initial vowel in this word is not longer than the initial vowels in those two words. Consider the word 'iPad'. The final vowel in this proper name is realised as a short vowel in Thai. This might be due to the fact that the noun 'pad' is usually pronounced with short [æ] by English speakers. Recall that nouns having /æd/ sequences usually have short [æ]. Presumably the final vowel in 'iPad' has the same realisation. Therefore, the input to the adaptation of such words is a short vowel.

With respect to the realisation of English /æ/ before /b/ and /g/, it behaves in the same way in such environments. The data in (50) show that it surfaces as a short vowel [æ] in the Thai loan forms despite the fact that voiced stops are mentioned as lengthening environments in English by several authors. Thai listeners are expected to perceive /æ/ in these two environments as a long vowel /æː/ in their native phonology. Although descriptions of /æ/-lengthening note that the voicing of following consonants generally affects the duration of /æ/, Kettig (2015,2016) argues that the /æ/ tokens before /b/ produced by his participants are not considerably longer than the tokens before /p/ in Southern British English. As far as final voiced stops are concerned, he found that place of articulation affects the length of /æ/. The bilabial voiced stop appears not to encourage lengthening as opposed to /g/ and /d/. If this is the case, Thai listeners will perceive English /æ/ before /b/ and /p/ as Thai phonological short vowel /æ/ and produce it as such. Labov *et al*. (2006) also mention the effects of place of articulation of voiced stops on the tensing of /æ/ in American English. The general pattern is that /b/ and /g/ have less effect on the tensing of /æ/ than /d/ does, suggesting that apical voiced stops are more likely to encourage the lengthening of the preceding /æ/ than labial and velar voiced stops. It follows that the input to the adaptation in the contexts of /b/ and /g/ must be short /æ/.

Take the words 'lab' and 'tag' as examples. As /æ/ is less likely to be lengthened before /b/ and /g/ in the source language (Labov *et al*. 2006), the input to the adaptation must be /læb/ and /t^hæg/, as illustrated in Tableaux (52-53). With the established ranking of constraints, candidates (52a) and (53a) are more harmonic than candidates (52b-d) and (53b-d) due to the fact that the input vowels are faithfully replicated in the output correspondents. The losing

candidates fatally violate a high-ranked constraint enforcing the identity between the input and output vowels.

(52)

/læb/ 'lab'	IDENT (low)	IDENT (front)	IDENT (μ)	*LOW
☞a. [læ̀p]				*
b. [læ̀:p]			*!	*
c. [lì:p]	*!		*	
d. [là:p]		*!	*	*

(53)

/tʰæg/ 'tag'	IDENT (low)	IDENT (front)	IDENT (μ)	*LOW
☞a. [tʰæ̀k]				*
b. [tʰæ̀:k]			*!	*
c. [tʰì:k]	*!		*	
d. [tʰà:k]		*!	*	*

The behaviour of English /æ/ in loanwords suggests that adaptation is likely to be based on phonetic input, given that it has different adapted forms in Thai. Its realisation as Thai [æ] or [æ:] depends on the phonetic characteristics of the input vowel in different segmental environments in the source language and is also attributed to the role of perception in loanword adaptation. The Thai adapter interprets the allophonic details of the input vowel according to the contrastive categories of the native language. That vowel length is contrastive in Thai leads him to map English /æ/ with phonetically short and long duration to Thai short /æ/ and long /æ:/ respectively.

The following section focuses on the realisation of lax vowels in open syllables in disyllabic and polysyllabic loanwords.

3.6 Adaptation of lax vowels in disyllabic and polysyllabic English loanwords

This section considers how Thai deals with English lax vowels in open syllables in loanwords having more than one syllable.

3.6.1 English lax vowels in open syllables

The adaptation patterns emerging in the loan corpus have shown that the majority of vowels in English monosyllabic loanwords appear to be faithful to their corresponding vowel in the source language in terms of quality and length. With respect to vowel length, an English lax vowel which has short duration phonetically is mapped to a Thai short vowel, while an English tense vowel which has longer phonetic duration is matched with a Thai long vowel. English lax vowels in open syllables in disyllabic and polysyllabic loanwords, by contrast, behave differently from those in monosyllabic words. The English loanwords in the corpus reveal that a lax vowel in an open syllable in the source language shows up as a short vowel in a closed syllable in the Thai loan form, as shown in (54-55), or gets lengthened in an open syllable as illustrated in (56-57).

As far as English syllabification is concerned, how words like 'better'and 'happy', are divided into syllables is debatable (Roach 2009). Assuming the Onset Maximisation Principle, some phonologists propose that the medial consonants [t] and [p] are assigned to the right-hand syllable, giving [bɛ.tə] and [hæ.pi]. Some argue that the intervocalic consonant is syllabified as the coda of the left-hand syllable to prevent a short vowel from occurring at the end of a syllable, giving [bɛt.ə] and [hæp.i]. Others propose that the word-medial consonant belongs to both syllables. That is, it functions both as the coda of the first syllable and as the onset of the second syllable. In the present study, the Onset Maximisation Principle is adopted for the syllabification of the English source words in (54-58) on the grounds that an intervocalic element in a VCV sequence is cross-linguistically syllabified as the onset of the following syllable, i.e. V.CV, rather than the coda of the preceding syllable, i.e. VC.V (Zec 2007:165).

Considering the data in (54), it can be observed that the lax vowel in the non-final CV syllable is mapped to a Thai short vowel in the adapted form if the following medial consonant in the source word is realised as a geminate consonant, regardless of whether or not the preceding vowel is stressed. If the word-medial consonant is a legitimate coda in Thai, it is realised as a geminate; that is, it is adapted as both the coda of the preceding syllable and the onset of the following syllable, as in 'happy' [hǽp.pîː], 'tennis' [tʰen.nít], and 'lottery'[lɔ́t.tɤ̀ː.rîː]. The data in (55) reveal that if it is not allowed to occur in the Thai coda, the preceding CV syllable will be closed by a legitimate Thai coda which is homorganic with the onset of the following syllable, as in 'lobby' [lɔ́p.bîː], 'pudding' [pʰút.dîŋ], and 'collagen'

[kʰɔn.laː.cên]. It is worth noting that these patterns illustrated in (54-55) are restricted to non-final CV syllables.

(54) Adaptation to a short vowel with a geminate consonant

Loanwords	English	Thai
'happy'	[hæ.pi]	[hép.pîː]
'jacket'	[dʒæ.kɪt]	[cék.két]
'dinner'	[dɪ.nə]	[din.nɤ̂ː]
'tennis'	[tʰɛ.nɪs]	[tʰen.nít]
'comment'	[kʰɒ.mɛnt]	[kʰɔm.mén]
'lottery'	[lɒ.tə.ɹi]	[lɔ́t.tɤː.rîː]

(55) Adaptation to a short vowel with a sequence of homorganic consonants

Loanwords	English	Thai
'lobby'	[lɒ.bi]	[lɔ́p.bîː]
'pudding'	[pʰʊ.dɪŋ]	[pʰút.dîŋ]
'support'	[sə.pʰɔːt]	[sáp.pʰɔ̀ːt]
'effect'	[ɪ.fɛkt]	[ʔép.fèk]
'fossil'	[fɒ.sl̩]	[fɔ́ːt.sîw]
'collagen'	[kʰɒ.lə.dʒən]	[kʰɔn.laː.cên]

The other pattern emerging in the loan corpus is that short vowels become lengthened, as shown in (56-57). It can be observed that vowel lengthening occurs in both non-final and final CV syllables. In the loan corpus, I observe that short vowels in final CV syllables in English are adapted as long vowels in Thai.

(56) Vowel lengthening in non-final CV syllables

Loanwords	English	Thai
'cement'	[sɪ.mɛnt]	[siː.men]
'column'	[kʰɒ.ləm]	[kʰɔː.lâm]
'credit'	[kʰɹɛ.dɪt]	[kʰreː.dìt]
'fashion'	[fæ.ʃn̩]	[fæː.cʰân]
'guitar'	[gɪ.tʰɑː]	[kiː.tâː]
'debit'	[dɛ.bɪt]	[deː.bìt]
'bodyguard'	[bɒ.di.gɑːd]	[bɔː.dîː.kàːt]

(57) Vowel lengthening in final CV syllables

Loanwords	English	Thai
'party'	[pʰɑː.ti[18]]	[paː.tîː]
'rugby'	[ɹʌg.bi]	[rák.bîː]
'sexy'	[sɛk.si]	[sék.sîː]
'taxi'	[tʰæk.si]	[tʰǽk.sîː]
'selfie'	[sɛɬ.fi]	[séw.fîː]
'poppy'	[pʰɒ.pi]	[pɔ́p.pîː]

With respect to loanwords with non CV final syllables, some of them exhibit exceptional behaviour. That is, they surface with an epenthetic glottal stop as seen in (58). This pattern mainly occurs when the short vowel is English /ɪ/. Some tokens of English /æ/ in CV syllables are also realised as a Thai short vowel with an epenthetic glottal stop. It can be seen that the Thai surface form of this English vowel is likely to be influenced by the English orthography, as it is mapped to [a] instead of [æ].

(58) Adaptation to a short vowel with an epenthetic glottal stop in non-final position

Loanwords	English	Thai
cigar	[sɪ.gɑː]	[sîʔ.kâː]
linen	[lɪ.nɪn]	[lîʔ.nin]
physics	[fɪ.sɪks]	[fîʔ.sìk]
carat	[kʰæ.ɹət]	[kaʔ.rát]
salad	[sæ.ləd]	[saʔ.làt]

The following section will discuss why monomoraic syllables in English loanwords are realised as bimoraic ones in Thai.

3.6.2 Adaptation conditioned by Thai speech styles

As outlined in the previous section, an English CV syllable surfaces as a CVC or a CVː. The short vowel remains short if it is followed by a geminate consonant, a consonant homorganic with a following consonant, or an epenthetic glottal stop; on the other hand, it becomes

[18] RP traditionally has lax /ɪ/ in this position (Wells 1982a). It has been increasingly replaced by /iː/ and now it is claimed to be a well-established change in mainstream RP (Cruttenden 2001). This vowel is transcribed as /i/ without a length mark by major English pronunciation dictionaries (e.g. Wells 2000; Jones 2011). The symbol /i/ is used to indicate that the distinction between /ɪ/ and /iː/ is neutralised in final open syllables (Jones 2011). As it occurs in weak syllables, it is often shorter than /iː/ elsewhere (Cruttenden 2001).

lengthened if the syllable in which it occurs remains open in the adapted form. The question then arises as to why light open syllables in polysyllabic English loanwords surface as heavy syllables in Thai. It seems that such adaptation is conditioned by the Thai speech style referred to as isolative style.

Following Henderson (1949), Surintramont (1973), and Bennett (1995), I assume that Thai has three main speech styles: isolative, combinative, and rapid combinative. Each style of speech conditions the realisation of Thai monosyllabic and polysyllabic words, as shown in (6) in Section 2.2.5 and repeated in (59).

(59)

Words	Underlying	Isolative	Combinative	Rapid combinative
'country'	/prat^{h}e:t/	[prà?.t^{h}ê:t]	[pra.t^{h}ê:t]	[pra.t^{h}ê:t]
'rubbish'	/k^{h}aja/	[k^{h}à?.jà?]	[k^{h}a.jà?]	[k^{h}a.jà?]
'watch'	/na:lika:/	[na:.lí?.ka:]	[na:.li.ka:]	[na.li.ka:]
'manner'	/kirija:/	[kì?.rí?.ja:]	[ki.ri.ja:]	[ki.ri.ja:]

(Bennett 1995)

Recall that every syllable is heavy in the isolative speech style. With respect to the Thai adaptation of CV syllables in English loanwords as illustrated in (54-58), they are realised as heavy syllables in all syllable positions because the English loanwords are rendered in the isolative speech style. Henderson (1949) notes that this style of speech is commonly used for the deliberate pronunciation of words having more than one syllable and is found in dictionaries.

Based on the data in (59), I assume (following Bennett 1995, Tumtavitikul 1997, and Morén and Zsiga 2001) that the final glottal stop is not in the underlying representation and is inserted to create a heavy syllable in Thai. Morén and Zsiga (2001) note that all final consonants are moraic in the language under discussion. When it comes to the nativisation of CV syllables in English loanwords, the native requirement for all syllables to be bimoraic in the isolative speech style is satisfied by three different strategies, as outlined in Section 3.6.1. Kenstowicz (2005) refers to this phenomenon as divergent repairs. This is a situation in which a repair strategy emerging in loanword adaptation differs from the one employed in the native grammar. Conflicts between loanword adaptations and native alternations have been observed not only in Thai but also in some other languages such as Maori (Yip 2002), Korean (Boersma and Hamann 2009), and Malayalam (Mohanan & Mohanan 2003). Peperkamp *et al.* (2008) point out that different strategies in native lexical items and loanwords appear to avoid violation of the same

restrictions in the native phonology. For example, in Maori, excess consonants are deleted in its native phonology, as in /hopuk/ → [hopu] 'catch', but they are retained in English loanwords through vowel epenthesis, as in [kirimi] 'cream' (Yip 2002). Korean employs nasalisation to avoid a sequence of an obstruent + nasal in native words, as in /kuk+min/ → [kuŋmin] 'nation' and deletion to repair consonant clusters, as in /kɑps/→ [kɑp] 'price', but epenthesis is a preferred repair strategy for English loanwords with obstruent-nasal sequences and consonant clusters, as in [pʰikʰɨnik] 'picnic' and [pʰolsʼɨ] 'false' (Boersma and Hamann 2009). Different strategies in native and foreign words are also reported in Malayalam (Mohanan & Mohanan 2003). In this language, intervocalic voiceless stops are realised as geminates in loanwords, as in [pæːkkɐt] 'packet', but they surface as voiced in native words, as in /waatam/ → [waadam] 'paralysis'. In the case of English loanwords in Thai, Thai speakers prefer vowel lengthening and consonant gemination to avoid violation of the bimoraicity restriction in English loanwords, but they employ glottal stop epenthesis in native words. However, there are at least 29 English loanwords undergoing the insertion of a glottal stop in the loan corpus.

Different repair strategies for light open syllables in Thai native words and English loanwords are also reported in Kenstowicz and Suchato's (2006) study of English loanwords in Thai. The authors report that glottal stop epenthesis is preferred in native words while vowel lengthening and gemination are found in loanwords. They resolve different repair strategies in English loanwords and Thai native words by allowing constraints demanding perceptual similarity to apply in the case of loanword adaptations only. They claim that loanwords and native lexical items satisfy the same markedness constraints but the adapter exercises power over the native grammar to choose a strategy that produces an output which closely resembles the source word. They propose output-output faithfulness constraints which specifically evaluate a correspondence relation between the surface form of the loanword in the source language and its output form in the borrowing language. In native phonology, they argue that DEP-IO (C), an input-output constraint against consonant insertion, is dominated by *VV, a constraint banning long vowels. The input /pʰra/ 'monk', for instance, surfaces as [pʰraʔ] instead of *[pʰraː]. When it comes to loanwords, faithfulness to the surface form of the foreign word is modelled as an output-output faithfulness constraint. They argue that vowel lengthening, which is a favoured repair strategy for light open syllables in English loanwords, is motivated by ranking an output-output constraint against an insertion of a consonant above the constraint against long vowels, as illustrated by the adaptation of 'coma' in the following tableau (Kenstowicz and Suchato 2006: 15).

(60)

/kʰoːmə/	OO-Dep-C	*VV
a. [kʰoːməʔ]	*!	
☞b. [kʰoːməː]		*

As for the preference for gemination over glottal stop epenthesis in word-medial position in loanwords, this is modelled by ranking OO-Dep-C over *GEM, a constraint against gemination (Kenstowicz and Suchato 2006: 15).

(61)

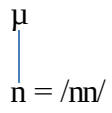
/kʰɔpi/	W-to-S	OO-Dep-C	*GEM
a. [kʰɔpii]	*!		
☞b. [kʰɔppii]			*
b. [kʰɔʔpii]		*!	

They also report that the adapter prefers glottal stop epenthesis to gemination if the medial consonant in the source word is not allowed to occur syllable-finally in Thai, as in 'gorilla' [kɔː.riʔ.laː]. As a native Thai speaker, this English loanword is actually pronounced as [kɔː.rin.laː] not *[kɔː.riʔ.laː]. In my loan corpus, the adapters, however, prefer consonant gemination if the source word has an orthographic geminate, as shown in (54). Of 83 loanwords with orthographic geminates, 76 undergo consonant gemination. If the geminate is not allowed to occur syllable-finally, the first part of the geminate is replaced with a legitimate Thai coda which is homorganic with the onset of the following syllable, as seen in (55).

In the present study, Itô and Mester's (1995a,b; 1999) model of a core-periphery organisation of the lexicon is adopted to capture different strategies in native lexical items and loanwords. As mentioned in Chapter 2, this model proposes that loanwords are peripheral items which are allowed to violate constraints that are active in the core. Nevertheless, constraints that determine the basic syllable canons of the grammar of borrowing languages are always satisfied by foreign words. With this model, we can explain why some loanwords undergo glottal stop epenthesis, which is a native strategy, and why the others undergo vowel lengthening which is a loanword-specific strategy.

With respect to gemination, Kenstowicz and Suchato (2006) treat this strategy as a loanword-specific adaptation strategy for turning a light syllable into a heavy one. It is worth noting that geminate consonants are in fact allowed in Thai (Masuko and Kiritani 1991) and they are mainly found intervocalically (Rungruang 2008: 111), as in [sòk.kaʔ.pròk] 'dirty', [bèt.taʔ.lèt] 'miscellaneous', [sàp.paʔ.rót] 'pineapple', [c^{h}an.naʔ.tùʔ] 'scalp infection', and [kam.maʔ.jiː] 'velvet' (Bee 1975: 19). However, to the best of my knowledge, gemination in Thai is less well-studied and gemination as another strategy that Thai employs to create heavy syllables is not documented in the literature. As a Thai native speaker, I pronounce the Thai words given above with geminate consonants. The first part of the geminate closes the first syllable and the second part begins the next syllable. Following Hayes (1989) and Davis (1994, 1999, 2003), I assume that geminate consonants are underlyingly moraic, as shown in (62) (where µ indicates a mora). Consider the Thai word for 'dirty'. Its underlying representation must be /sòkkapròk/ and this shows up as [sòk.kaʔ.pròk] in the isolative style. The first syllable closed by the first part of the gemination is heavy. The second syllable is a light open syllable; as a result, a glottal stop is inserted to satisfy the bimoraicity requirement.

(62) Moraic representation of geminates (Hayes 1989: 257)



Let us now turn to gemination in loanwords. It has been reported in the literature that this phenomenon is very common cross-linguistically (Repetti 2009). A singleton consonant in the donor language is realised as a geminate consonant in the borrowing language. Repetti (1993) points out that if the stressed syllable in the borrowing language is required to be bimoraic, gemination is a means of satisfying this requirement. Guba (2016) notes that medial and final gemination in English loanwords in Ammani Arabic is mainly invoked to satisfy bimoraicity and other prosodic factors. It appears that the word-medial geminates and sequences of homorganic segments found in the present study are likely to be motivated by the English orthography, as the loanwords in (54-55) obviously have orthographically doubled consonants in the source language. However, I observe that some English loans with singleton consonant spellings show up with geminates, as in 'copy' [kɔ́p.piː], 'cookie' [khúk.kîː], 'booking' [búk.kîŋ], and 'poker' [pôːk.kɤ̂ː]. It might be the case that the gemination in 'booking' is triggered by a prohibition against syllable-initial vowels rather than the bimoraicity requirement, due to the fact that this word consists of two morphemes, i.e. book + -ing. As an

onset is obligatory in Thai, the medial consonant /k/ is geminated to avoid an onset-less syllable. If it surfaced as *[búː.kîŋ], it would violate IDENT-IO (μ) which is ranked high in the Thai grammar. As for the word 'poker', it is a monomorphemic word and the vowel in the first syllable is a diphthong surfacing as a long vowel in Thai. It might be the case that the Thai adapter mistakenly treats '-er' in such a word as a suffix; and that would be why the medial consonant is geminated in the loan form. Moreover, the adapted vowel in the first syllable is bimoraic; this provides evidence that gemination in this word is not motivated by the creation of a heavy syllable. This could apply to the adaptation of the words 'copy' and 'cookie' as well. The adapter might also have treated –y and –ie as suffixes; that is why we get gemination in these two words. Yip (1993) argues for gemination in loanwords as the result of the need for a bimoraic syllable and the need for an onset.

Cross-linguistically, it is argued by Otaki (2013) that word-medial geminates in loanword adaptation are largely influenced by geminate spellings in the source language. For example, in Japanese, English loanwords with geminate consonant spellings are realised with geminate consonants, while those without orthographic geminates show up with a single consonant, as in 'happy' [happiː], 'copy' [kopiː], 'battery' [batteriː] and 'city' [ɕitiː]. The preservation of orthographically doubled consonants is also found in English loanwords in Italian, as in 'zipper' [ʤippa], 'paper' [pepa], 'cracker' [krekka], and 'maker' [meka] (Repetti 2006, 2009).

When we consider the loanwords without geminate spellings in (56), it appears that vowel lengthening is the dominant repair option employed for English loanwords with orthographic single medial consonants. The majority of short vowels in non-final CV syllables are likely to undergo vowel lengthening instead of glottal stop epenthesis, which is a native strategy, so as to satisfy the bimoraicity requirement as in 'cement' [siː.men], 'credit' [kʰreː.dìt], 'fashion' [fæː.cʰân], and 'bodyguard' [bɔː.dîː.kàːt]. The lengthening of short vowels is also found in final CV syllables as seen in (57). This provides strong evidence that CV syllables in loanwords are predominantly repaired by vowel lengthening in loanword adaptations when orthographically doubled consonants are not present. Despite the fact that Thai prefers vowel lengthening in repairing underlying CV syllables in loanwords without orthographically doubled consonants, the data in (58) show that glottal stop insertion is favoured over vowel lengthening in certain loanwords. It might be the case that such loanwords are fully nativised and have become part of the core vocabulary.

We have seen that the adapter prefers gemination to repair a non-final CV syllable if the source word has orthographically doubled consonants. If it does not have a geminate spelling, the short vowel will be lengthened. This strategy also applies to CV syllables in the word-final position. The insertion of a glottal stop only occurs in non-final CV syllables with English /ɪ/ and English /æ/ spelled with <a>. The following section considers how Thai deals with CV syllables in English loanwords from an OT perspective.

3.6.3 An OT analysis

In light of the observations outlined in the previous section, let us now consider how the different repair strategies are encoded in constraint interaction. We start by observing constraints relevant to the analysis.

I have argued that consonant gemination and vowel lengthening occurring in English loanwords are invoked to satisfy bimoraicity. This is accomplished through the dominance of a constraint that requires syllables to be heavy as given in (63). Ranked high, this constraint prohibits light syllables from occuring in the isolative speech style.

(63) $\sigma_{\mu\mu}$ All syllables must be heavy (bimoraic).

One of the modification strategies that Thai employs to satisfy the bimoraicity requirement in English loanwords is gemination. As not all languages allow geminates (Davis 2011), a constraint prohibiting consonant gemination is proposed in (64). I have argued in the previous section that Thai also allows gemination in native words; thus, this constraint must be ranked low in the Thai grammar. The other strategy that Thai employs to render short, open syllables heavy is vowel lengthening. A constraint which is involved here is IDENT-IO (μ), as the vowel in the input is not identical to its corresponding output segment in terms of length.

(64) *GEMCON No geminate consonants (Repetti 2009)

However, in the native phonology, light CV syllables are made heavy by glottal stop insertion. As the epenthetic glottal stop does not have its correspondent in the input, it violates a faithfulness constraint DEP-IO (C) which militates against consonants in the output that do not have correspondents in the input.

(65) DEP-IO (C) Output consonant segments must have input correspondents.

Recall that Thai prefers glottal stop epenthesis to vowel lengthening to create a heavy syllable; this implies that IDENT-IO (μ) dominates DEP-IO (C) in the native phonology, as in /tè/ → [tèʔ], *[tè:] 'kick' and /kàtʰá/ → [kàʔtʰáʔ], *[kà:tʰá:] 'pan'. I assume that Thai favours glottal stop insertion over vowel lengthening because vowel length is contrastive in Thai. Underlying short and long vowels are always realised as such. With an epenthetic glottal stop, underlying short vowels in open syllables will remain short in the surface. When it comes to English loanwords, it appears that non-final and final CV syllables typically undergo vowel lengthening to satisfy the bimoraicity requirement. If the loanwords contain orthographically doubled consonants, consonant gemination is favoured over vowel lengthening. Kenstowicz and Suchato (2006: 14) point out that a repair strategy that diverges from the one employed in the native phonology results from the fact that 'the adapter chooses a repair strategy that he judges to yield an output that is more faithful to the foreign source' while still in line with the syllable well-formedness constraints of the borrowing language. Thus, for loanwords which are peripheral items, DEP-C should be ranked higher than IDENT-IO (μ), as the insertion of a glottal stop would yield an output with an epenthetic segment. Such output is less faithful to the input from the source language due to the fact that it contains a segment which is not present in the input.

As for the loanwords which show up with geminate consonants, I argue that the input to the adaptation contains a geminate consonant which is motivated by the geminate spelling in the source language. Given that the Thai adapters learn English at schools and universities, they must know the pronunciation and spelling of the loanwords in the source language. When they encounter English loanwords spelled with doubled consonants, the input to the adaptation process is likely to include a geminate consonant. To ensure that the geminate in the input surfaces as such, a constraint requiring a corresponding output segment to be faithful to the input geminate is proposed in (66) and it must be ranked higher than *GEMCON, a markedness constraint prohibiting consonant gemination.

(66) IDENT-IO (gem) Output correspondent of an input geminate is also geminate.
(Adra 1999; Btoosh 2006)

With respect to a medial singleton consonant in the input, it tends to surface as such in English loanwords due to the fact that the preceding vowel is lengthened. A constraint that enforces the identity between the input singleton and the corresponding output is formulated below.

(67) IDENT-IO (sing) Output correspondent of an input singleton is also singleton.

We have observed in the previous section that, if the input contains voiced geminates such as /dd/ and /bb/, they will surface as homorganic consonants, as in 'pudding' [pʰút.dîŋ] and 'lobby' [lɔ́p.bîː]. The sequences of homorganic consonants in English loanwords in (55) are motivated by the syllable well-formedness requirement that Thai codas are restricted to voiceless stops, nasals, and glides. Illicit codas in English loanwords are replaced with Thai segments that are allowed to occur in the coda position. To account for the substitution, CODA-AC, a constraint proposed by Hancin-Bhatt (2000: 213), is adopted. This constraint basically states that certain segments are more likely to appear as codas than others. Thus the constraint domination hierarchy is as follows:

(68) Voiced stops, affricates, /r/ >> fricatives, /l/ >> nasals, glides, simple stops

CODA-AC says that nasals, glides, and simple voiceless stops are more harmonic in the coda than fricatives and /l/, and that fricatives and /l/ are more harmonic in the coda than voiced stops, affricates and /r/. It can be seen that the place feature of the input geminate is preserved in the coda of the first syllable in English loanwords. IDENT-IO (place) is also relevant to the analysis. Ranked high, the first part of a voiced geminate which occurs in the coda of the preceding syllable will be replaced with a legitimate coda which is faithful to the voiced geminate in terms of place features.

(69) IDENT-IO (place) The specification for place of articulation of an input segment must be preserved in its output correspondent. (Kager 1999: 45)

It should be noted that combinations of homorganic consonants are allowed in Thai native words (Rungruang 2008: 112), as in [rúːp.pʰáːp] 'picture', [ŋɔ́ːk.ŋaːm] 'to grow', and [ban.daj] 'ladder'. With respect to the word-medial homorganic consonants seen in the examples, the coda of the first syllable is homorganic with the onset of the following syllable. The Thai words for 'pudding' and 'lobby' mentioned above also reveal that the coda of the first syllable and the onset of the second syllable share the same place features.

Let us first consider how an interaction of the proposed constraints determines the output form for the English loanwords with an epenthetic glottal stop. As seen in (58), glottal stop insertion is preferred over vowel lengthening in a small number of loanwords. Based on the lexical stratification proposed by Itô and Mester (1995a,b; 1999), I argue that English

loanwords which undergo the same strategy for native words are fully nativised and have become part of the lexical core. I assume that they have been introduced into Thai a very long time ago. As a result, they are subject to the same constraint ranking which defines well-formed Thai words, as demonstrated in the following tableau.

(70)

/sɪgɑ:/ 'cigar'	$\sigma_{\mu\mu}$	IDENT (sing)	IDENT (μ)	DEP-C
a. [sí.kâ:]	*!			
☞b. [síʔ.kâ:]				*
c. [sí:.kâ:]			*!	
d. [sík.kâ:]		*!		

Tableau (70) shows that Thai prefers consonant epenthesis to vowel lengthening, as IDENT-IO (μ) dominates DEP-C. IDENT-IO (sing) also remains undominated in the Thai grammar to ensure that a medial singleton consonant will not surface as a geminate. It can be seen that candidate (70a) is excluded immediately because it is not in line with $\sigma_{\mu\mu}$. This is due to the fact that the first syllable is monomoraic. The other candidates satisfy the markedness constraint against monomoraic syllables at the expense of the violation of faithfulness constraints. However, candidates (70c-d) incur a fatal violation of a high-ranked faithfulness constraint, and so they fail to surface. The former has an output vowel [i:] which is not faithful to the input /ɪ/ in terms of length and the latter contains a geminate while its correspondent input is a singleton. It follows that candidate (70b) with an epenthetic [ʔ] which violates the lowest-ranking faithfulness DEP-C is selected as a winning candidate.

Let us now turn to the adaptation of English loanwords with geminate consonant spellings. The data in (54-55) show that gemination is a favoured strategy for English loanwords containing orthographically doubled consonants in medial position. I assume that the input to adaptation is influenced by a doubled consonant in the orthography. Take the words 'tennis' and 'pudding' as example; /t^hɛnnɪs/ must be the input representation of the former and /p^hʊddɪŋ/ that of the latter as illustrated in Tableaux (72-73). Note that the /nn/ and /dd/ in the input are geminate consonants which are motivated by the orthographically doubled consonants <nn> and <dd>. Recall that I have pointed out in the previous section that consonant gemination is attested in Thai. Thus, loanwords undergoing gemination must also fulfill the constraint ranking that defines native words. The constraints CODA-AC, IDENT-IO (place), and IDENT-IO (gem)

are added to a set of constraints proposed in Tableau (70). We arrive at the following total ranking:

(71) $\sigma_{\mu\mu}$, CODA-AC, IDENT-IO (place), IDENT-IO (sing), IDENT-IO (μ) >> DEP-C, IDENT- IO (gem) >> *GEMCON

This ranking is illustrated by the following tableaux

(72)

/tʰɛnnɪs/ 'tennis'	$\sigma_{\mu\mu}$	CODA-AC	ID (sing)	ID (place)	ID (μ)	DEP-C	ID (gem)	*GEMCON
a. [tʰe.nit]	*!						*	
☞b. [tʰen.nit]								*
c. [tʰeː.nit]					*!		*	
d. [tʰeʔ.nit]				*!			*	

(73)

/pʰʊddɪŋ/ 'pudding'	$\sigma_{\mu\mu}$	CODA-AC	ID (sing)	ID (place)	ID (μ)	DEP-C	ID (gem)	*GEMCON
a. [pʰú.dîŋ]	*!						*	
b. [pʰúd.dîŋ]		*!						*
c. [pʰúː.dîŋ]					*!		*	
☞d. [pʰút.dîŋ]							*	
e. [pʰúʔ.dîŋ]				*!			*	

Tableaux (72) and (73) show that all highest-ranked constraints favour the winning candidates. Candidates that are not in line with one of these constraints cannot surface. Candidates (72a) and (73a) incur a fatal violation of $\sigma_{\mu\mu}$, as the first syllables are monomoraic. As a result, they are excluded from the competition. Candidate (73b) is ruled out because it contains a voiced geminate [dd] which is not allowed to occur in the Thai coda, fatally violating CODA-AC. Candidates (72c) and (73c) are also excluded, because the length of the input vowels is not preserved in their corresponding output segment. Consider the other two losing candidates in the two tableaux, (72d) and (73e). They lose out to the optimal candidates due to the fact that the coda [ʔ] is not faithful to the corresponding input segment in terms of place of articulation. The inputs /t/ and /d/ are [+coronal] but the output [ʔ] is [-coronal]. Hence,

candidates (72b) and (73d) are selected as the optimal outputs. Nevertheless, it can be seen that one of the lower-ranked constraints is violated by each of them to avoid violation of the higher-ranked constraints. Candidate (72b) incurs a violation of *GEMCON as it contains a geminate, and candidate (73d) violates IDENT-IO (gem) given that the input geminate is preserved in its corresponding output segment. In OT, violation of low-ranked constraints is less serious than that of high-ranked constraints. As a result, these two candidates, which are the actual outputs, are chosen as the winning candidates with respect to the ranked constraints.

In addition to glottal stop epenthesis and consonant gemination which occur in loanwords, vowel lengthening is another strategy that Thai employs to deal with CV syllables. It is treated as a loanword-specific strategy as it does not occur in native words. I argue that English loanwords that undergo vowel lengthening to satisfy the bimoraicity requirement have not become part of the lexical core but are in the periphery. As argued by Itô and Mester (1995a,b; 1999), changes in surface forms in loanwords result from the reranking of faithfulness constraints. Hence, for peripheral items, DEP-C is ranked over IDENT-IO (μ) as seen below.

(74) Constraint ranking for loanwords in the periphery

$\sigma_{\mu\mu}$, CODA-AC, IDENT-IO (place), IDENT-IO (sing), DEP-C >> IDENT-IO (μ), IDENT-IO (gem) >> *GEMCON

This ranking is illustrated by the following tableaux which contain input with a medial singleton consonant.

(75)

/dɛbɪt/ 'debit'	$\sigma_{\mu\mu}$	CODA-AC	ID (place)	ID (sing)	DEP-C	ID (μ)	ID(gem)	*GEMCON
a. [de.bit]	*!							
☞b. [de:.bit]						*		
c. [deb.bit]		*!		*				*
d. [deʔ.bit]					*!			
e. [dep.bit]					*!			

(76)

/sɪmɛnt/ ‘cement’	$\sigma_{\mu\mu}$	CODA-AC	ID (place)	ID (sing)	DEP-C	ID (μ)	ID (gem)	*GEMCON
a. [si.ment]	*!							
☞b. [si:.ment]						*		
c. [sim.ment]				*!				*
d. [siʔ.ment]					*!			

Tableaux (75) and (76) reveal that candidates (75d-e) and candidates (76d) which contain epenthetic consonants fail to surface as they fatally violate the high-ranked constraint DEP-C which prohibits consonant insertion. The other losing candidates are ruled out because they are not favoured by one of the high-ranked constraints. It can be observed that candidates (75a) and (76a) are ruled out immediately because they do not satisfy the constraint requiring syllables to be bimoraic. Candidate (75c) is not in line with CODA-AC and IDENT-IO (sing) as the coda of the first syllable is not licit in Thai and the medial singleton consonant in the input surfaces as a geminate. Meanwhile candidate (76c) fails to surface because it contains a geminate consonant, fatally violating IDENT-IO (sing). It follows that candidates (75b) and (76b) which undergo vowel lengthening are selected as optimal outputs with respect to the ranked constraints.

Turning to short vowels in final CV syllables, they always become lengthened in English loanwords so as to fulfil the bimoraicity requirement, as seen in (57). Tableau (77) shows the interaction of the constraints for CV syllables in word-final position. Take the word ‘taxi’ as an example. With the same ranking, it can be observed that the faithful candidate is ruled out immediately as it is not favoured by $\sigma_{\mu\mu}$. One of the strategies used to satisfy the bimoraicity requirement, as seen in candidate (77b), is the insertion of a glottal stop [ʔ]. However, this leads to a fatal violation of DEP-C. It follows that candidate (77a) which undergoes vowel lengthening is selected as an optimal candidate.

(77)

/t^hæksi/ 'taxi'	$\sigma_{\mu\mu}$	CODA-AC	ID (place)	ID (sing)	DEP-C	ID (gem)	ID (μ)	*GEMCON
a. [t^hæk.si]	*!							
b. [t^hæk.siʔ]					*!			
☞c. [t^hæk.si:]							*	

Tableaux (70) and (72-73) provide evidence that short and long vowels are contrastive in Thai. Thai employs consonant epenthesis and gemination to make heavy syllables; these strategies enable short vowels to surface as such. The same strategies have been applied for loanwords that are fully nativised. With respect to loanwords that are partially nativised, as illustrated in Tableaux (75-77), the adapter selects a strategy that enables him or her to produce a surface form that is more faithful to the input in the source language and that satisfies the markedness constraint $\sigma_{\mu\mu}$. This can be explained by the reranking of the faithfulness constraints DEP-IO (C) and IDENT-IO (μ).

This section has shown that Thai speech styles play a role in determining how CV syllables in loanwords are realised in Thai. They surface as heavy syllables to satisfy the bimoraicity requirement in the native phonology. English lax vowels in CV syllables remain short in loanwords if they are followed by an epenthetic glottal stop or a geminate consonant, but they get lengthened in open syllables. Different repair strategies result from the reranking of faithfulness constraints for peripheral loanwords. Loanwords that undergo glottal stop epenthesis, which is a native repair strategy, are argued to be part of the core vocabulary while vowel lengthening applies to loanwords in the periphery. Consonant gemination appears to be triggered by the orthography of the source language, suggesting that Thai borrowers also take the spelling of the source word into consideration.

3.7 Conclusion

This chapter has examined the adaptation of English monophthongs. Their behaviour in the loan corpus suggests that the adaptation is largely based on phonetic input and the phonological structure of Thai, given that the adapter attends to the phonetic details of the input segment as predicted by the phonetic view and interprets them in terms of the contrastive features of the borrowing language. The tense-lax distinction in English is generally maintained in loanwords

and treated as vowel length distinction in Thai; English lax and tense vowels are mapped to Thai short and long vowels respectively. Nevertheless, the behaviour of English /æ/ appears to differ from that of the other lax vowels. It has different adapted forms in different segmental contexts, indicating that the adaptation of this vowel is likely to be based on the phonetic characteristics of the source language. It is found that Thai adapters rely on the phonetic duration of this English vowel to determine its realisation in Thai, which signifies to the role of phonological perception in adaptation. In the native phonology, Thai listeners use relative vowel duration as the main perceptual cue for the length distinction; hence English /æ/ with short duration is perceived as a Thai short vowel, whereas that one with longer duration is interpreted as a Thai long vowel. In addition to the phonetic characteristics of the input which causes variation in adaptation, differences in adaptation found in the corpus could be attributed to a historic variety of the source language and origins in American English. With respect to the role of the native phonology in adaptation, the OT analysis has revealed that foreign vowels and unlicensed syllable structures (CV syllables) cannot surface faithfully in Thai due to the high ranking of markedness constraints. They must undergo phonological modification. Different repair strategies for light open syllables in Thai native words and English loanwords provide evidence for distinct rankings for native words and loanwords. It is concluded that loanwords that fulfil all constraints defining the native phonology are fully nativised and have become part of the core vocabulary whereas those violating some constraints active in the core are argued to be in the periphery. The next chapter examines the adaptation of diphthongs in English loanwords in Thai.

Chapter 4

Adaptation of English Diphthongs

4.1 Introduction

This chapter focuses on the Thai adaptation patterns of RP diphthongs emerging in the loan corpus. As observed in the previous chapter, English monophthongs which are illegal in Thai are replaced with Thai vowels which share the same phonetic features. English diphthongs are not available in Thai, as has been noted in Chapter 2. Their adapted forms displayed in the loan corpus show that Thai deals with them in various ways. The simplification strategies that Thai employs to modify them are explored in Section 4.2. The phonetic vowel duration of the input appears to play a role in certain patterns. An OT analysis of each pattern is then presented in Section 4.3.

4.2 Adaptation patterns

RP has a larger number of diphthongs than Thai. There are eight diphthongs in the RP phonemic inventory, namely /eɪ/, /aɪ/, /ɔɪ/, /əʊ/, /aʊ/, /ɛə/, /ɪə/, and /ʊə/ (Roach 2004), while Thai has only three phonemic diphthongs, namely /ia/, /ɯa/, and /ua/ (Nacaskul 2013). Note that the RP diphthongs are falling diphthongs, while the Thai ones are rising diphthongs. The following subsections discuss how Thai deals with the non-native diphthongs so that they conform to the native phonology.

4.2.1 Adaptation to monophthongs

Three out of the eight RP diphthongs which are adapted to Thai monophthongs are /eɪ/, /ɛə/, and /əʊ/, and these are replaced with /eː/, /æː/, and /oː/ respectively in the adapted forms as illustrated in (78). Recall that the diphthong [æə], which is a tense allophone of GenAm /æ/, is also adapted to a Thai monophthong [æː], as shown in (79). The monophthongisation of foreign diphthongs in loanword adaptation has been reported cross-linguistically, e.g. in Dholuo (Owino 2003), Akan (Adomako 2008), Hebrew (Cohen 2009), Tonga (Zivenge 2009), Shona (Kadenge and Mudzingwa 2011), Urdu and Panjabi (Hussain *et al.*, 2011), Persian (Kambuziya and Hosseinzadeh 2014), Ammani Arabic (Guba 2016), and Heritage Korean (Ryu 2017). It is documented in the literature that illicit diphthongs undergo monophthongisation through

simplification strategies such as glide formation, vowel deletion, and coalescence. The question arises of which strategy Thai employs to modify these four diphthongs to comply with the native phonological system and to preserve the features of the input vowel as much as possible. It is argued that these ill-formed diphthongs are repaired through coalescence involving the merger of the first vocalic element (V_1) and the second one (V_2) of the diphthongs to form a third vowel that shares features of both. Even though coalescence is a common form of hiatus resolution (Casali 1996, 2011; Picard 2003), the monophthongisation of foreign diphthongs through this strategy has been found in languages such as Dholuo (Owino 2003), Tonga (Zivenge 2009), Persian (Kambuziya and Hosseinzadeh 2014), and Chinese Korean (Ryu 2017). The first and second members of Mandarin diphthongs, for example, are merged to form a single vowel in Chinese Korean, such as /ai/ → [ɛ] and /ɑu/ → [o] (Ryu 2017). In Dholuo[19], the RP diphthong /əʊ/ also undergoes coalescence and is realised as [o] in loanword adaptation (Owino 2003).

(78)

English			Thai	
/eɪ/	'game'	[geɪm]	/eː/	[keːm]
	'cake'	[kʰeɪk]		[kʰéːk]
	'tape'	[tʰeɪp]		[téːp]
	'basic'	[beɪsɪk]		[beː.sìk]
	'update'	[ʌpdeɪt]		[ʔáp.dèːt]
/əʊ/	'vote'	[vəʊt]	/oː/	[wóːt]
	'code'	[kʰəʊd]		[kʰóːt]
	'foam'	[fəʊm]		[fŏːm]
	'protein'	[pʰɹəʊtʰiːn]		[proː.tiːn]
	'bonus'	[bəʊnəs]		[boː.nát]
/ɛə/	'share'	[ʃɛə]	/æː/	[cʰæː]
	'care'	[kʰɛə]		[kʰæː]
	'fair'	[fɛə]		[fæː]
	'aerobics'	[ɛəɹəʊbɪks]		[ʔæː.roː.bìk]
	'wheelchair'	[wiːɬtʃɛə]		[wiːw.cʰæː]

[19] A language spoken by the Luo people of Kenya

(79)	GenAm			Thai	
	/æ/	‘dance’	[dæəns]	/æː/	[dæːn]
		‘cast’	[k^hæəst]		[k^hǽːt]

As can be observed in (78) and (79), Thai long vowels rather than short ones are chosen to replace the English diphthongs in question. This can be explained in terms of syllable weight. The weight of vowels is normally predictable. Following Hayes (1985, 1989), I assume that short vowels are monomoraic and long vowels and diphthongs are bimoraic. Thus, adaptation to a long vowel enables the output vowel to remain faithful to the input vowel in terms of the moraic content of the vowel. However, as far as the diphthong /eɪ/ is concerned, I observe that in the corpus there are two loan tokens with final voiceless stops which exhibit exceptional behaviour. The vowels in the words *‘steak’* and *‘skate’* are realised as the short vowel [e] in their adapted forms. Meanwhile the diphthongs /əʊ/ and /ɛə/ are uniformly mapped to a Thai long vowel. Apart from the diphthongs /eɪ/, /əʊ/, and /ɛə/, which are mapped to Thai monophthongs, two tokens of English /aʊ/ in the corpus are monophthongised to [ɔː] in the loanwords ‘pound’ (the currency of the United Kingdom) and ‘ounce’ surface as [pɔːn] and [ʔɔːn] respectively. However, the majority of its tokens are realised as vowel-plus-glide sequences as discussed next.

4.2.2 Adaptation to vowel-plus-glide sequences

RP diphthongs that are adapted to vowels followed by glides are /aɪ, ɔɪ, aʊ/. As seen in (81), these three diphthongs surface as either a Thai short vowel followed by a glide (henceforth VG) or a Thai long vowel followed by a glide (henceforth V:G). The V_1 of the English diphthongs is likely to be mapped to a short vowel in loan forms if the English diphthongs occur in the environment of following voiceless obstruents in the source language, as in *‘strike’*, *‘choice’*, and *‘gout’*. If the following consonant is a sonorant or the syllable is open, it tends to be mapped to a long vowel followed by a glide, as in ‘pie’, ‘join’, and ‘foul’. It can be noticed that the Thai realisation of the V_1 of the diphthongs under discussion and that of English /æ/ involve similar patterns. That is, they are not uniformly mapped to their Thai correspondents /a/, /ɔ/, and /æ/. It appears that the mapping of English /a/ and /ɔ/, the first elements of /aɪ, ɔɪ, aʊ/, is likely to be determined by the phonetic contexts in which they occur. Cruttenden (2001:131) notes that the V_1 of an RP diphthong is phonetically longer in contexts of voiced consonants and open syllables, as in ‘tie’ [t^haːɪ] and ‘eyes’ [aːɪz], but it remains short before a following voiceless

consonant, as in 'tight' [tʰaɪt] and 'ice' [aɪs]. It seems that the phonetic duration of the input vowel plays a role in the adaptation of these diphthongs due to the fact that Thai listeners use vowel duration as the main perceptual cue for vowel length contrast, as mentioned in Chapter 3.

(80)

English			Thai	
/aɪ/	'strike'	[stɹaɪk]	/aj/	[sa.tráj]
	'lignite'	[lɪgnaɪt]	/aj/	[lík.náj]
	'pie'	[pʰaɪ]	/a:j/	[pʰa:j]
	'style'	[staɪɬ]	/a:j/	[sa.ta:j]
	'design'	[dɪzaɪn]	/a:j/	[di:.sa:j]
/ɔɪ/	'choice'	[tʃɔɪs]	/ɔj/	[cʰɔ́j]
	'join'	[dʒɔɪn]	/ɔ:j/	[cɔ:j]
	'spoil'	[spɔɪɬ]	/ɔ:j/	[sa.pɔ:j]
	'playboy'	[pʰleɪbɔɪ]	/ɔ:j/	[pʰle:.bɔ:j]
/aʊ/	'gout'	[gaʊt]	/aw/	[káw]
	'mouse'	[maʊs]	/aw/	[máw]
	'cutout'	[kʰʌt.aʊt]	/aw/	[kʰát.ʔáw]
	'foul'	[faʊɬ]	/a:w/	[fa:w]
	'download'	[daʊn.loʊd]	/a:w/	[da:w.lò:t]

However, when it comes to the behaviour of the diphthongs /aɪ, ɔɪ/ in the context of voiced obstruents[20], it seems that they are not consistently mapped to V:G sequences. The V_1 of /aɪ/ and that of /ɔɪ/ surface as either a short vowel or a long vowel, as illustrated in (81).

[20]In the loan corpus, none of the English /aʊ/ tokens are followed by voiced obstruents.

(81)

English			Thai	
/aɪ/	‘size’	[saɪz]	/aj/	[sáj]
	‘guide’	[gaɪd]	/aj/	[káj]
	‘slide’	[slaɪd]	/aj/	[sa.láj]
	‘offside’	[ɒfsaɪd]	/aj/	[ɔ́p.sáj]
	‘oxide’	[ɒksaɪd]	/aːj/	[ʔɔ́k.saːj]
	‘fluoride’	[flʊəɹaɪd]	/aːj/	[fluː.ʔɔː.raːj]
/ɔɪ/	‘turquoise’	[tʰɜːkʰwɔɪz]	/ɔj/	[tʰɤː.kʰɔ́j]
	‘steroid’	[stɪəɹɔɪd]	/ɔːj/	[sa.tia.rɔːj]
	‘typhoid’	[tʰaɪfɔɪd]	/ɔːj/	[tʰaj.fɔːj]
	‘thyroid’	[θaɪɹɔɪd]	/ɔːj/	[tʰaj.rɔːj]

With respect to the diphthong /aɪ/ in non-final open syllables of monomorphemic loanwords, I observe that it is typically realised as [aj] rather than *[aːj].

(82)

English			Thai	
/aɪ/	‘cyber’	[saɪbə]	/aj/	[saj.bɤ̂ː]
	‘idea’	[aɪdɪə]	/aj/	[ʔaj.dia]
	‘nylon’	[naɪlɒn]	/aj/	[naj.lɔ̂n]

Let us now consider the high vowels, which are the second elements of the diphthongs. It can be observed that they are realised as consonantal glides that share the same features. That is, the V_2 of /aɪ/ and that of /ɔɪ/ are replaced with [j], as these two segments are both [+ high] and [-round], and the V_2 of /aʊ/ is mapped to [w] as both are [+high] and [+round]. It has been established that glides are part of syllable margins in Thai (Ruangjaroon 2006*:* 3, Nacaskul 2013: 67), instead of constituting complex nuclei. This is evidenced by the fact that sequences like /aj, aːj, aw, aːw, ɔj, ɔːj/ are normally not followed by another consonant in the same syllable, as in (83), suggesting that glides in VG sequences always occupy the coda position.

(83)

/paj/	‘to go’	/jáːj/	‘to move’
/kàw/	‘old’	/kʰâːw/	‘rice’
/dɔ̂j/	‘inferior’	/lɔːj/	‘to float’

Considering the closed-syllable loanwords in (80) and (81), we can observe that no codas are realised in the Thai loans. Given that complex codas are forbidden in Thai, the glides

/j/ and /w/ in the loan forms already occupy the coda position, which leads to deletion of following consonants. If the English coda surfaced in the loan, the surface form of the English loanword would be ill-formed in Thai, as in *[sa.trájk] 'strike', *[cɔːjn] 'join', and *[káwt] 'gout'. The following section deals with the adaptation patterns of the other two RP diphthongs /ɪə/ and /ʊə/.

4.2.3 Adaptation to Thai diphthongs

In the previous sections, we have observed that Thai deals with foreign diphthongs in two different ways: monophthongisation and glide formation. The other two RP diphthongs /ɪə/ and /ʊə/, however, undergo substitution; that is, they are replaced with the Thai diphthongs /ia/ and /ua/ as shown in (84). This adaptation pattern preserves the quality of the V_1 of both English diphthongs in terms of height, backness, and roundness. Nevertheless, I observe that not all instances of these two RP diphthongs are mapped to the Thai diphthongs. Some tokens of these vowels are realised as monophthongs in Thai, as illustrated in (85). The differences in adaptation found in the corpus could be attributed to different input vowels. Recall that English /ɪə/ and /ʊə/ can be realised as [ɪː] and [ʊː] respectively in RP. Although these pronunciations are not yet typical of most RP speakers (Cruttenden 2001), they could serve as the input to the adaptation process for English loanwords realised with Thai /iː/ and /uː/ as shown in (85).

(84)	English	RP	Thai	
	'beer'	[bɪə]	/ia/	[bia]
	'clear'	[kʰlɪə]	/ia/	[kʰlia]
	'cashier'	[kʰæʃɪə]	/ia/	[kʰæt.cʰia]
	'steroid'	[stɪəɹɔɪd]	/ia/	[sa.tia.rɔːj]
	'tour'	[tʰʊə]	/ua/	[tʰua]
	'sure'	[ʃʊə]	/ua/	[cʰua]

(85)	English	RP	Thai	
	'hero'	[hɪːɹəʊ]	/iː/	[hiː.rôː]
	'serious'	[sɪːɹiəs]	/iː/	[siː.rîat]
	'cereal'	[sɪːɹiəɬ]	/iː/	[siː.rîaw]
	'fluoride'	[flʊːɹaɪd]	/uː/	[fluː.ʔɔː.raːj]
	'fluorine'	[flʊːɹiːn]	/uː/	[fluː.ʔɔː.riːn]
	'Euro'	[jʊːrəʊ]	/uː/	[juː.roː]
	'Europe'	[jʊːɹəp]	/u/	[ju.roːp]

As far as English /ʊə/ is concerned, there are only nine English loanwords having this vowel in the corpus, indicating that Thai has not borrowed many English words with /ʊə/. Two out of the nine are realised with [ua] in Thai; these words are shown in (84). The rest show up with [uː], except for the vowel token in [jʊəɹəp] 'Europe' realised as [u].

It has been shown in this section that Thai adopts three different strategies, including monophthongisation, glide formation, and substitution, in modifying the English diphthongs which are all ill-formed in the native phonology. The next section considers how an interaction between markedness and faithfulness constraints determines the surface form of the foreign diphthongs in Thai.

4.3 OT analysis

In light of the observations outlined in the previous section, this section examines the adaptation patterns from an OT perspective. Constraints relevant to an analysis of each adaptation pattern will be proposed first, followed by how the interaction of the constraints determines the Thai surface form of each diphthong.

4.3.1 Adaptation to monophthongs

As outlined in Section 4.2.1, the RP diphthongs /eɪ, əʊ, ɛə/ and the tense allophone of GenAm /æ/ do not surface faithfully in Thai due to the fact that falling diphthongs are illegal in the borrowing language. A markedness constraint which prohibits falling diphthongs from occupying the nucleus of a syllable is needed to enforce the well-formedness of the output form. This constraint must be undominated in the Thai grammar, as falling diphthongs are disallowed.

(86) *FALLDIPH (*FALL) Avoid diphthongs whose second element is less prominent than the first one.

Assuming that the monophthongisation of these ill-formed diphthongs results from coalescence, a general constraint that is violated by this repair strategy is UNIFORMITY (e.g. McCarthy and Prince 1995; Casali 1996, 1997, 2011) which prohibits a situation in which two distinct segments in the input are merged as a single segment in the output. It must be ranked low as it is violated by the actual output form.

(87) UNIFORMITY (UNIF) No element of the output has multiple correspondents in the input. **(**McCarthy and Prince 1995: 123**)**

Apart from UNIFORMITY, coalescence violates the faithfulness constraint IDENT-IO (F) which requires corresponding segments in the input and output to have identical specifications for a feature (F) (Casali 2011). This is due to the fact that this simplification strategy typically involves the merger of two segments to form a single segment that shares some features of both. In the present study, the diphthongs under discussion are monophthongised on the surface; thus, the Thai vowel in the output corresponds to both the V_1 and V_2 of the diphthong, such as in English /e$_1$ɪ$_2$/[21] → Thai [eː$_{1,2}$]. This example reveals that the Thai vowel [eː] bears some features of both vocalic elements, namely the height of the V_1 and the frontness and roundness of the V_2. Given that diphthongs consist of two vocalic elements and not all features of the two members of the diphthongs in the input are identical to those of the correspondent segments in the output, I argue that the set of IDENT-IO (F) constraints proposed in Chapter 3 are not fine-grained enough to capture the monophthongisation of the English diphthongs through coalescence, as there is a sequence of two vowels in the syllable nucleus. IDENT-IO$_{V2}$ (F) constraints which specifically evaluate a correspondence relation between the V_2 of the diphthong and its output correspondent are formulated in (89). As for the IDENT-IO (F) constraints proposed in Chapter 3, they are relabeled as 'IDENT-IO$_{V1}$ (F)' which is defined below. Thus, an interaction between IDENT-IO$_{V1}$ (F) and IDENT-IO$_{V2}$ (F) will determine which features of V_1 and V_2 are faithfully preserved in its output correspondent segment.

(88) IDENT-IO$_{V1}$ (F) The first element of the diphthong in the input and its corresponding segment in the output have identical values for feature (F).

(89) IDENT-IO$_{V2}$ (F) The second element of the diphthong in the input and its corresponding segment in the output have identical values for feature (F).

In addition to the constraints monitoring faithfulness to vowel quality, the faithfulness constraint IDENT-IO (μ) requiring the preservation of the length of the input vowel is relevant to the analysis as the English diphthongs surface as Thai long vowels, indicating that the weight of the input vowel appears to be maintained in the actual output form. This constraint must be

[21] The numbers 1 and 2 indicate that /e/ and /ɪ/ are the first and the second vocalic elements respectively of the diphthong /eɪ/.

ranked high to ensure that the length of the input vowel is faithfully preserved in the corresponding output vowel.

This raises the question of how the featural faithfulness constraints are ranked with respect to one another. We must consider what features of /V_1V_2/ in the input are likely to be retained in their corresponding segment in the output. Casali (1996:70) proposes that one type of vowel coalescence which frequently occurs is referred to as "height coalescence which applies only to sequences in which V_1 is non-high and V_2 is high (or, in some instances, a mid vowel which is nevertheless higher than V_1)". This type of coalescence always results in a non-high vowel preserving the feature [-high] of V_1 together with the frontness and roundness of V_2. Casali notes that height coalescence has two types. One of them which can apply to the diphthongs under discussion, and especially /eɪ/ and /əʊ/ comprising a non-high vowel followed by a high vowel, is referred to as "e-Coalescence" which involves the following realisations[22]:

(90) /a+i/ > [e] /a+u/ > [o]
/e+i/ > [e] /e+u/ > [o]
/o+i/ > [e] /o+u/ > [o]

Turning to the Thai realisation of the RP diphthongs /eɪ/ and /əʊ/ and the GenAm [æə], they surface as the non-high vowels [eː], [oː], and [æː] respectively, preserving the height of the first elements of the diphthongs. The adaptation reveals that the first elements of the three diphthongs and their Thai correspondents have identical values for the features [high] and [low]. To ensure that the height of V1 is maintained in the output, IDENT-IO_{V1} (high) and IDENT-IO_{V1} (low) must outrank IDENT-IO_{V2} (high) and IDENT-IO_{V2} (low).

With respect to the relation between the second vocalic elements and their Thai correspondents, it can be seen that the frontness and roundness of the Thai surface forms are identical to those of V_2 of the source diphthongs. Take RP /əʊ/ as an example. The V_2 of the diphthong and its corresponding output segment [oː] are [-front] and [+round]. This shows that IDENT-IO_{V2} (round) and IDENT-IO_{V2} (front) dominate IDENT-IO_{V1} (round) and IDENT-IO_{V1} (front). However, when the Thai surface form of GenAm [æə] is taken into consideration, we can see that it is a front vowel, not a central vowel, suggesting that its Thai correspondent preserves the [+front] specification of V_1 instead of the feature [-front] of V_2. If IDENT-IO_{V2} (front) outranks IDENT-IO_{V1} (front), the front vowel [æː] which is the actual output will not

[22] Casali (1996) notes that in some languages the input sequences /o+i/ and /e+u/ will surface as [we] and [yo] respectively; that is, they are realised with glide formation in addition to coalescence.

surface. This then raises the question as to whether or not the diphthong /əʊ/ will show up as the Thai back vowel [oː] if IDENT-IO$_{V2}$ (front) is dominated by IDENT-IO$_{V1}$ (front). It is argued that ranking IDENT-IO$_{V2}$ (round) over IDENT-IO$_{V1}$ (round) will force the output form to be faithful to the input in terms of frontness and roundedness of V_2 due to the fact that Thai back vowels are all rounded. Thus, the input /əʊ/ will show up as [oː] in Thai regardless of the relative ranking of IDENT-IO$_{V1}$ (front) and IDENT-IO$_{V2}$ (front) with respect to each other (See Tableau (92)).

As for the ranking of IDENT-IO (μ)[23], it is ranked high in the Thai grammar since vowel length is distinctive. The adaptation of the English diphthongs under discussion to the Thai long vowels provides evidence that the weight of the input vowel is preserved in the output. Thus the ranking for monophthongisation is argued to be *FALLDIPH, IDENT-IO$_{V1}$ (high), IDENT-IO$_{V1}$ (low), IDENT-IO$_{V2}$ (round), IDENT-IO$_{V1}$ (front), IDENT-IO (μ) >> IDENT-IO$_{V1}$ (round), IDENT-IO$_{V2}$ (high), IDENT-IO$_{V2}$ (low), IDENT-IO$_{V2}$ (front), UNIFORMITY as demonstrated in the following tableaux.

(91)

/kʰeɪk/ 'cake'	*FALL	ID$_{V1}$ (hi)	ID$_{V1}$ (lo)	ID$_{V2}$ (rnd)	ID$_{V1}$ (frt)	ID (μ)	ID$_{V1}$ (rnd)	ID$_{V2}$ (hi)	ID$_{V2}$ (lo)	ID$_{V2}$ (frt)	UNIF
a. [kʰéɪk]	*!										
☞b. [kʰéːk]								*			*
c. [kʰíːk]		*!									*
d. [kʰóːk]				*!	*		*	*		*	*
e. [kʰék]						*!		*			*
f. [kʰæːk]			*!					*	*		*

[23] IDENT-IO (μ) is not split into IDENT-IO$_{V1}$ (μ) and IDENT-IO$_{V2}$ (μ) because the length of both V1 and V2 is preserved in their corresponding output segment.

(92)

/fəʊm/ 'foam'	*FALL	IDV1 (hi)	IDV1 (lo)	IDV2 (rnd)	IDV1 (frt)	ID (μ)	IDV1 (rnd)	IDV2 (hi)	IDV2 (lo)	IDV2 (frt)	UNIF
a. [fəʊm]	*!										
☞b. [foːm]							*	*			*
c. [fuːm]		*!					*				*
d. [fɤːm]				*!				*			*
e. [fom]						*!	*	*			*
f. [fɔːm]			*!				*	*	*		*

Tableaux (91) and (92) show that candidates (91a) and (92a) with faithful vowels are ruled out immediately as their syllable nuclei are occupied by a falling diphthong, incurring a fatal violation of *FALLDIPH. The other remaining candidates contain a monophthong as a nuclear vowel, satisfying the constraint *FALLDIPH; however, they violate the correspondence constraint UNIFORMITY which bans a situation in which a single segment in the output has multiple correspondents in the input, as the vowels in candidates (91b-f) and (92b-f) correspond to both the first and second members of the input vowels. However, such violation does not exclude them from the competition as UNIFORMITY is ranked low. Candidates (91c) and (92c) are wiped out due to the fact that they are not faithful to the height of the V_1 of the diphthongs in the input, incurring a fatal violation of IDENT-IO$_{V1}$ (high). The V_1 of the diphthong /eɪ/ in Tableau (91) and that of the diphthong /əʊ/ in Tableau (92) are [-high] whereas the corresponding output vowels in candidates (91c) and (92c) are [+high]. As for candidate (91d), despite being faithful to the [-high] specification of V_1 in the input, the roundness of V_2 is not retained in the corresponding output vowel, fatally violating IDENT-IO$_{V2}$ (round). Turning to candidate (92d), it can be seen that the high-ranking constraint IDENT-IO$_{V2}$ (round) eliminates it from the competition as the second member of the input diphthong is [+round], but the corresponding output segment is [-round]. We arrive at the other two losing candidates in each tableau, i.e. candidates (e) and (f). Candidates (91e) and (92e) lose out to the optimal candidates (91b) and (92b) because the weight of the input vowels is not preserved in the corresponding output segments, incurring a fatal violation of IDENT -IO (μ). Candidates (91f) and (92f) are also less harmonic than the winning candidates because the output vowels and the corresponding input segments (V_1) do not have identical values for the feature [low], fatally violating IDENT-IO$_{V1}$ (low). Given the high ranking of this constraint, a candidate with a low vowel will not surface

if V_1 of the input diphthong is a mid vowel. Thus, candidates (91b) and (92b) are optimal as they incur no fatal violation of the high-ranking constraints.

With respect to the GOAT vowel, it is pronounced as [oʊ] by older RP speakers as mentioned in Section 2.2.2. Thus, early English loanwords found in *Far from Home* (Khongnakhorn 2011), such as 'show', 'soda', 'postcard', and 'oak', must have /oʊ/, rather than /əʊ/, in the input representation. With the same ranking, it appears that a candidate with [oː] is still selected as a winning candidate, as shown in Tableau (93).

(93)

/ʃoʊ/ 'show'	*FALL	IDV1 (hi)	IDV1 (lo)	IDV2 (rnd)	IDV1 (frt)	ID (μ)	IDV1 (rnd)	IDV2 (hi)	IDV2 (lo)	IDV2 (frt)	UNIF
a. [ʃoʊ]	*!										
☞b. [ʃoː]								*			*
c. [ʃuː]		*!									*
d. [ʃeː]				*!	*		*	*		*	*
e. [ʃo]						*!		*			*
f. [ʃɔː]			*!					*	*		*

Let us turn to the adaptation of the tense allophone of GenAm /æ/. Having mentioned earlier that the allophone [æə] in words like 'dance' and 'cast' is mapped to the Thai long vowel [æː], this realisation can also be captured by the interaction of the proposed constraints, as demonstrated in Tableau (94). The tableau shows that candidates which fatally violate the undominated constraints are ruled out immediately. Candidate (94a) with a faithful vowel cannot surface as it has a diphthong falling in prominemce as a nuclear vowel, fatally violating *FALL. Candidate (94c) fails to surface since the height and frontness of the output vowel do not match those of V_1 in the input; the Thai output vowel in (94c) is [-low] and [-front], but the corresponding input segment is [+low] and [+front]. Meanwhile candidate (94d) fatally violates IDENT-IO (μ), as the output vowel has one mora whereas the input diphthong is bimoraic. Candidates (94e) and (94f) lose out to the winning candidate (94b) due to the fact that the former is not faithful to V_1 in terms of the feature [low] and the latter does not preserve the [front] specification of V_1. Therefore, candidate (94b), which is the actual output, is selected as an optimal output with respect to the ranked constraints.

(94)

/dæən/ ‘dance’	*FALL	IDV1 (hi)	IDV1 (lo)	IDV2 (rnd)	IDV1 (frt)	ID (μ)	IDV1 (rnd)	IDV2 (hi)	IDV2 (lo)	IDV2 (frt)	UNIF
a. [dǽən]	*!										
☞b. [dǽːn]									*	*	*
c. [dɤ́ːn]			*!		*						*
d. [dǽn]						*!			*		*
e. [deːn]			*!							*	*
f. [daːn]					*!				*		*

When it comes to the adaptation of English /ɛə/ to [æː], it appears that height coalescence does not apply to this vowel sequence as V_2 is not higher than V_1. Given the kind of analysis developed so far based solely on features, we run into problems, as seen in the following tableau. It appears that candidate (95c), which is the actual output, is not optimal with respect to the featural constraints as it incurs a fatal violation of IDENT-IO $_{V1}$ (low). The sad face indicates an optimal candidate which should not be. It looks as though, in this case, an other effect is operating irrespective of these features.

(95)

/fɛə/ ‘fair’	*FALL	IDV1 (hi)	IDV1 (lo)	IDV2 (rnd)	IDV1 (frt)	ID (μ)	IDV1 (rnd)	IDV2 (hi)	IDV2 (lo)	IDV2 (frt)	UNIF
a. [fɛə]	*!										
☹b. [feː]										*	*
c. [fæː]			*!						*	*	*
d. [fiː]		*!						*		*	*
e. [fɤː]					*!						*
g. [fæ]			*!			*			*	*	*

This raises the question as to how the Thai adaptor determines the best match for this diphthong. The Thai perception of this vowel might be involved in the adaptation. Given that formant

values of vowels determine what vowels we hear[24], examining the formant values of the Thai vowels in the output candidates (95b-g) and those of the English vowel /ɛə/ might give some clues as to why the diphthong under discussion is realised as the Thai vowel [æː].

(96) Comparison of the first and second formants (F1 and F2) of English /ɛə/ and the Thai vowels /iː/, /eː/, /ɤː/, /æː/, and /æ/

	First vocalic element				Second vocalic element		
Eng /ɛə/	Male	Female	Average		Male	Female	Average
F1	536	691	614	F1	655	751	703
F2	1864	2210	2037	F2	1594	1883	1739
					(Cruttenden 2001)[25]		
Thai /iː/		Thai /eː/		Thai /ɤː/			
F1	300	F1	480	F1	540		
F2	2200	F2	1980	F2	1260		
Thai /æː/		Thai /æ/					
F1	720	F1	780				
F2	1800	F2	1800				
					(Abramson 1962)		

[24] It is well established that listeners rely primarily on F1 and F2 to distinguish vowels (e.g. Ladefoged and Disner 2012: 39, Ball and Rahilly 2013: 166)

[25] Cruttenden (2001) uses a different representation: /eə/. Average F1 and F2 acoustic values for English /ɛə/ are provided by the researcher and they are used in comparison to those for the Thai vowels to determine the best match for the English diphthong.

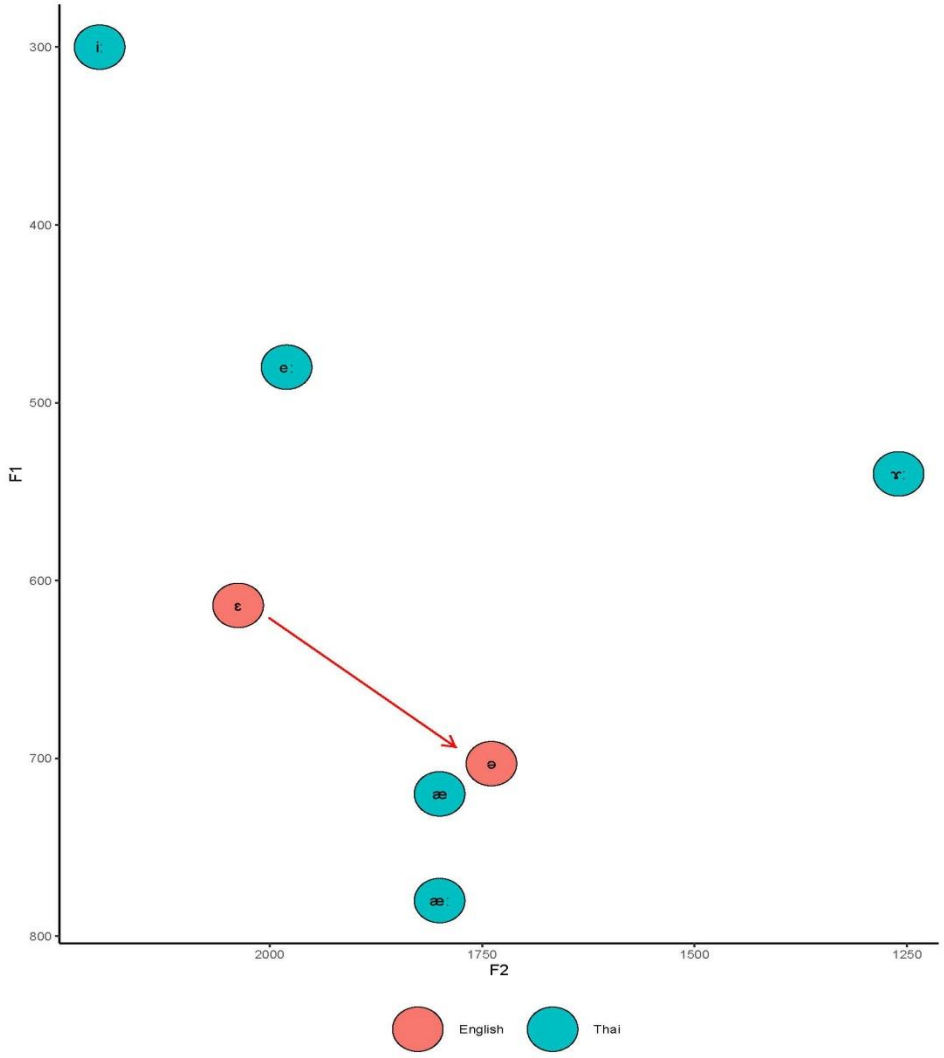


Figure 4.1: English /ɛə/ and Thai vowels /iː/, /eː/, /ɤː/, /æː/, and /æ/

As can be observed in (96) and Figure 4.1, according to the average formant values of F1 and F2 for English /ɛə/ and those for the Thai vowels, it is shown that the formants of V_1 of the English diphthong are closer to those of the Thai mid front vowel /eː/ than to the Thai high front vowel /iː/ and the Thai low front vowels /æː/ and /æ/. The Thai mid central vowel /ɤː/ is acoustically closer to V_1 in terms of F1. We can see that the formants of V_2 are closer to those of the Thai low front vowels than to the other Thai vowels. The acoustic measurements suggest that the realisation of English /ɛə/ as Thai [æː] is based on phonetic similarity. That is, it is adapted to an acoustically closer sound in Thai. It seems that the first two formants of the V_2 of the English diphthong is the determining factor in this case, as the Thai low front vowel is the best phonetic match. In other words, the Thai adapter relies on the F1 and F2 of V_2, rather than those of V_1, to determine the Thai surface form of /ɛə/. If the adaptation of this diphthong was based on the formant values of V_1, the Thai long vowel [eː] would be the best match. As far as

the formants of the Thai vowels [æː] and [æ] are concerned, we can observe that they are both acoustically closer to the V_2 of the English diphthong, as seen in Figure 4.1. This means that they can be a possible output form. Nevertheless, the Thai adapter selects the long vowel as the actual output to preserve the duration of the English diphthong. Phonetic similarity is also reported in the Thai adaptation of English /v/ (Kenstowicz and Suchato 2006). It is uniformly mapped to Thai /w/ despite the fact that its voiceless counterpart /f/ is available in the Thai inventory. Kenstowicz and Suchato point out that the voiced labio-dental /v/ has low frication, which makes /w/ the closest match. Although the proposed constraint ranking cannot account for the Thai adaptation of this diphthong, as it is conditioned by the acoustic characteristics of the English input, the analysis based on features can still capture the other two adaptation patterns.

4.3.2 Adaptation to vowel plus glide sequences

This section shows how Thai determines the best match for the diphthongs /aɪ/, /aʊ/, and /ɔɪ/. To capture the realisation of these three diphthongs as vowel-plus-glide sequences, two additional constraints are needed. One of them is *COMPLEX^{COD} which militates against codas consisting of two or more consonants. This markedness constraint is undominated in the native phonology, as no surface forms ever violate it. As we have seen in (81) and (82), the final consonants following /aɪ/, /aʊ/, and /ɔɪ/ in the English input do not surface in the Thai loan forms due to the fact that Thai allows at most one consonant in the coda and the Thai glides already occupy the coda position.

(97) *COMPLEX^{COD} *CC] (Codas are simple) (Kager 1999)

Recall that the VG sequences in Thai are normally not followed by another consonant in the same syllable, as in [paj] ‘to go’, [kàw] ‘old’, and [lɔːj] ‘to float’, suggesting that the glides in the sequences always occupy the coda position in the Thai syllable structure. The question then arises as to why RP /eɪ/ and /əʊ/ and GenAm /oʊ/ in which the second elements are also high vowels are monophthongised to [eː] and [oː] instead of being replaced with *[ej] and *[ow] respectively. This can be explained by restrictions on the co-occurrence of vowel-plus-consonant sequences in Thai; the palatal glide is not allowed to occur after front vowels and the labiovelar one cannot follow back vowels. Thus, adaptation to a vowel-plus-glide sequence is blocked.

The other constraint that is involved in the analysis is MAX-CODA, as Thai avoids complex codas by consonant deletion which is a violation of faithfulness. Given that this faithfulness constraint enforces the preservation of the input consonants in the output, it must be ranked low as the actual output violates it.

(98) MAX-CODA Input codas have output correspondents (Chang 2009)

It has been well documented in the literature (e.g. Nacaskul 1979; Rungruang 2008) that, Thai simplifies complex codas in English loanwords via segment deletion. Take the English loanwords 'bank' [bæŋk], 'silk' [sɪłk] and 'fax' [fæks] as examples. They are ill-formed in Thai as they have consonant clusters in the coda; it follows that one member of each cluster is deleted. Hence, they surface as [bǽŋ], [síw], and [fæ̀k] in Thai. The occurrence of consonant deletion in complex codas indicates that in Thai MAX-CODA is ranked below *COMPLEX^{COD} as demonstrated in the following tableau.

(99)

/bæŋk/ 'bank'	COMPLEX^{COD}	MAX-CODA
a. [bǽŋk]	*!	
☞b. [bǽŋ]		*

The glides in the Thai surface forms in (80) and (81) (e.g. [sáj] 'size', [sa.pɔ:j] 'spoil', [máw] 'mouse') correspond to the high vowels in the English input (e.g. [saɪz] 'size', [spɔɪł] 'spoil', [maʊs] 'mouse'). The high vowels in the input are part of the diphthongs, whereas the corresponding output segments occupy the coda position. This shows that the input segments and their corresponding output segments are different in terms of their position in the syllable. It has long been observed in the literature (e.g. Clements and Keyser 1983; Levin 1985) that high vowels and glides are featurally identical, and that the difference between them is determined by syllable structure. That is, high vowels occupy syllable nuclei while glides occur in syllable margins.

Recall that any characteristics of the input are based on the perception of the Thai speakers. The diphthongs in questions are realised as VG when they are followed by a voiceless consonant as seen in Tableaux (101-103) because Thai speakers perceive these diphthongs as short diphthongs. They surface as V:G when the following consonant in the source word is voiced or when they occur in open syllables as seen in Tableaux (104-107). I assume that Thai

speakers perceive these diphthongs in such environments as long diphthongs. That is why the input contains a length mark. In general, it is the weight of the coda that is important, yet here it revolves around vowel length in particular, specific to these diphthong adaptations. A constraint monitoring faithfulness to vowel length is thus proposed in (100). In the general cases, where IDENT-IO (μ) works well, the IDENT-IO (V-length) constraint would have no effect, but in the cases in question it could rule out an otherwise harmonic candidate.

(100) IDENT-IO (V-length) The length of correspondent vowels in the input and the output is identical.

Thus the ranking argument for adaptation to vowel plus glide sequences is demonstrated in Tableaux (101-103).[26]

(101)

/saɪt/ 'site'	*FALL	COMPLEX^{COD}	ID$_{V2}$ (rnd)	ID (μ)	ID(V-length)	MAX-CODA
a. [sáɪt]	*!					
b. [sájt]		*!				
☞c. [sáj]						*
d. [sáw]			*!			*
e. [sá:j]					*!	*

(102)

/gaʊt / 'gout'	*FALL	COMPLEX^{COD}	ID$_{V2}$ (rnd)	ID (μ)	ID(V-length)	MAX-CODA
a. [káʊt]	*!					
b. [káwt]		*!				
☞c. [káw]						*
d. [káj]			*!			*
e. [ká:w]					*!	*

[26] IDENT-IO$_{V1}$ (F) and IDENT-IO$_{V2}$ (F) constraints which are not relevant to the present analysis are not included here in the set of constraints.

(103)

/tʃɔɪs/ ‘choice’	*FALL	COMPLEX^{COD}	ID$_{V2}$ (rnd)	ID (μ)	ID(V-length)	MAX-CODA
a. [c^{h}ɔ́ɪs]	*!					
b. [c^{h}ɔ́js]		*!				
☞c. [c^{h}ɔ́j]						*
d. [c^{h}ɔ́w]			*!			*
e. [c^{h}ɔ́ːj]					*!	*

It can be seen that candidate (a) with a faithful vowel in each tableau is ruled out as it fatally violates the markedness constraint militating against falling diphthongs. Thai repairs these ill-formed diphthongs by replacing the high vowels (V_2) in the input with a glide that is featurally identical to its corresponding input segment. As discussed above, the final glides are assigned to the Thai coda; candidates (101b), (102b), and (103b) are therefore excluded from the competition as they incur a fatal violation of COMPLEX^{COD}. Given the dominance of COMPLEX^{COD} in the Thai grammar, any output forms having more than one consonant in the coda position will not surface. The three remaining candidates in each tableau satisfy the constraint requiring an output form to have a single consonant in the coda at the expense of the violation of the faithfulness constraint MAX-CODA that bans the deletion of the input coda, as the final consonants in the source words are not realised in these candidates. Among them, candidates (d-e) fail to surface. Let us consider candidates (d) first. They are ruled out because the glides in the output are not identical to their corresponding input segments (V_2) in terms of roundness, incurring a fatal violation of IDENT-IO$_{V2}$ (round). The glide in candidate (101d), for example, is [+round], but the high vowel which is its corresponding input segment is [-round]. Meanwhile candidates (e) fatally violate IDENT-IO (V-length) which requires the length of correspondent vowels in the input and output to be identical. As seen in Tableau (101), the first vocalic element in the input is short, but its corresponding output segment in candidate (101e) is long. Hence, candidate (101c) is selected to be a winning candidate.

There are some tokens of /aɪ/, /aʊ/, and /ɔɪ/ that are adapted to V:G sequences. As discussed in Section 4.2.2, such realisations occur in environments in which their first vocalic element is likely to be lengthened in the source language. It is longer in the context of a following voiced consonant and in a final open syllable. Take the words ‘wine’, ‘foul’, ‘join’, and ‘pie’ as examples. They are phonetically realised as [waːɪn], [fäːʊɬ], [dʒɔːɪn], and [p^{h}aːɪ]

respectively in the source language. In Chapter 3, I assume that the Thai adaptation of English /æ/ to [æ] and [æː] is largely attributed to the phonetic characteristics of the English input. When it comes to the adaptation of the English diphthongs in question, it also provides evidence that Thai adaptors are sensitive to the phonetic duration of English vowels. As Thai has V:G sequences such as /aːj/, /ɔːj/, and /aːw/ in the native phonology, it can be expected that they tend to perceive the first element of /aɪ/, /ɔɪ/, and /aʊ/ in the context where it is lengthened as a long vowel. Thus, the input to the adaptation of the exemplified loanwords must be /waːɪn/, /faːʊɬ/, /dʒɔːɪn/, and /pʰaːɪ/. The following tableaux illustrate how the ranked constraints determine the best match for each input.

(104)

/waːɪn/ 'wine'	*FALL	COMPLEX^{COD}	ID$_{V2}$ (round)	ID (μ)	ID(V-length)	MAX-CODA
a. [waːɪn]	*!					
b. [waːjn]		*!				
☞c. [waːj]						*
d. [waːw]			*!			*
e. [waj]					*!	*

(105)

/faːʊɬ / 'foul'	*FALL	COMPLEX^{COD}	ID$_{V2}$ (round)	ID (μ)	ID(V-length)	MAX-CODA
a. [faːʊɬ]	*!					
b. [faːwɬ]		*!				
☞c. [faːw]						*
d. [faːj]			*!			*
e. [faw]					*!	*

(106)

/ dʒɔːɪn / 'join'	*FALL	COMPLEX^{COD}	ID$_{V2}$ (round)	ID (μ)	ID(V-length)	MAX-CODA
a. [cʰɔːɪn]	*!					
b. [cʰɔːjn]		*!				
☞c. [cʰɔːj]						*
d. [cʰɔːw]			*!			*
e. [cʰɔj]					*!	*

(107)

/pʰaːɪ / ‘pie’	*FALL	COMPLEX^{COD}	ID$_{V2}$ (round)	ID (μ)	ID(V-length)	MAX-CODA
a. [pʰaːɪ]	*!					
☞b. [pʰaːj]						
c. [pʰaːw]			*!			
d. [pʰaj]					*!	

It can be seen that the first candidates in the above tableaux cannot surface in Thai, as their syllable nuclei are occupied by an ill-formed diphthong. The second candidates in (104-106) are also ruled out because they have an ill-formed syllable margin. That is, a consonant cluster occurs in the coda, fatally violating COMPLEX^{COD}. The remaining candidates in each tableau are favoured by the syllable well-formedness constraints *FALLDIPH and COMPLEX^{COD}. Nevertheless, candidates (d) in Tableaux 104-106 and candidates (c) in Tableaux 107 also fail to surface because the feature [round] of V_2 in the input is not maintained in the corresponding output segment. As for a candidate with a short vowel in each tableau, it is less harmonic than the winning candidate as the vowel in this candidate is not faithful to its corresponding segment in the input in terms of length, incurring a fatal violation of IDENT-IO (μ). The first vocalic element in the input has long duration whereas its corresponding segment in the output is a short vowel. The dominance of IDENT-IO (V-length) enforces the preservation of vowel length in the output. Hence, candidates (104-106c) and candidate (107b) are optimal with respect to the ranked constraints.

Although the majority of the tokens of the diphthongs in question in the context of a following voiced consonant are typically realised as V:G sequences in Thai, there are some exceptions. They may be mapped to either a VG sequence or a V:G sequence when they are followed by voiced obstruents in the source language, as in ‘size’ [sáj], ‘guide’ [káj], ‘slide’ [sa.láj], ‘oxide’ [ʔɔ́k.saːj], ‘steroid’ [sa.tiːa.rɔːj], and ‘typhoid’ [tʰaj.fɔːj][27]. Given that /z/ and /d/ are voiced, it is expected that the vowel tokens before them should be adapted to a V:G sequence since it is assumed that the phonetic surface form of the source word is the input. However, it is possible that not all English loanwords have been introduced into the Thai lexicon via spoken language, so the adapter abstracts away from the subphonemic details of the English source words. Thus, I assume that the input representations of ‘guide’, ‘size’, and slide’ are /gaɪd/,

[27] See more examples in (81).

/saɪz/, and /slaɪd/ respectively and that their surface representation is generated by the phonological system of the borrowing language as demonstrated in Tableaux 101-107. The next section presents an analysis of RP diphthongs which are mapped to Thai diphthongs.

4.3.3. Adaptation to Thai diphthongs

As outlined in Section 4.2.3, there are two RP diphthongs that are replaced with a Thai diphthong: /ɪə/ → /ia/ and /ʊə/ → /ua/. It can be observed that the feature [low] of the second element in the input is not preserved in the corresponding output segment. Although this constraint does not determine the outcome, it is included in a set of constraints to show that it is violated by the winning candidate. The following tableaux demonstrate how Thai deals with these two diphthongs.

(108)

/bɪə / 'beer'	*FALL	IDV1 (front)	IDV1 (round)	IDV2 (low)
a. [bɪə]	*!			
☞b. [bia]				*
c. [bua]		*!	*	*
d. [bɯa]		*!		*

(109)

/tʰʊə / 'tour'	*FALL	IDV1 (front)	IDV1 (round)	IDV2 (low)
a. [tʰʊə]	*!			
☞b. [tʰua]				*
c. [tʰia]		*!	*	*
d. [tʰɯa]			*!	*

It can be observed that candidate (a) in each tableau is ruled out immediately because they do not obey the markedness constraint. The remaining candidates satisfy the markedness constraints because the nuclear vowel in each candidate is well-formed in Thai. However, candidates (c) and (d) lose out to candidate (b) because the output diphthongs in the former are not faithful to V_1 in the input in terms of quality. Consider the output candidates [bua] and [bɯa] in Tableau 109. It can be seen that V1 in [bua] is [-front], but V1 in the input /bɪə/ is [+front]. Meanwhile candidate [bɯa] fatally violates IDENT-IO$_{V1}$ (front) due to the fact that V1

in the output and V1 in the input do not have identical values for the feature [front]. It follows that candidate (b) is selected as an optimal output. Although it incurs no violation of the high-ranked constraints, it has one violation of IDENT-IO$_{V2}$ (low) as the feature [low] of V_2 is not faithfully preserved in the output. Nevertheless, the violation of the low-ranked constraints is not fatal. Hence, candidate (b) is selected as a winning candidate with respect to the ranked constraints.

Turning to the adaptation to the long vowels /iː/ and /uː/, I assume that the [ɪː] and [ʊː] which are variants of the English /ɪə/ and /ʊə/ respectively serve as the input to the adaptation process. Hence, the input representations of the loanwords 'hero' and 'Euro', for example, are /hɪːɹəʊ/ and /jʊːrəʊ/ instead of /hɪəɹəʊ/ and /jʊərəʊ/. The vowels /ɪː/ and /ʊː/ in the words 'hero' and 'Euro' are realised as the Thai long vowels [iː] and [uː], preserving the height, backness, roundness as well as length of the input vowels.

4.4 Conclusion

This chapter has shown that phonological factors play an important role in determining how the majority of English diphthongs are realised in Thai. The OT analysis has demonstrated that the foreign diphthongs cannot surface faithfully due to the dominance of the markedness constraint against falling diphthongs, and that they are repaired minimally. The adapter attempts to preserve the features of both vocalic elements of the non-native diphthongs as much as possible by employing three different simplification strategies to deal with them: monophthongisation, glide formation, and substitution. The adapter decides on which strategy yields an output form that is most faithful to the input and also conforms to the native phonology. The OT analysis has revealed that IDENT-IO (F) constraints specifically evaluating a correspondence relation between each vocalic element of the diphthongs and its output correspondent are needed to capture monophthongisation through coalescence, given that the adapted form bears some features of both elements. The interaction between IDENT-IO$_{V1}$ (F) and IDENT-IO$_{V2}$ (F) determines which features of V_1 and V_2 are faithfully preserved in their corresponding segment in the output. It has been shown that the height of V_1 and the frontness and roundness of V_2 as well as the weight of the input vowel are faithfully preserved in the adapted form. In the case of the adaptation to vowel-plus-glide sequences, the analysis has shown that the phonetic duration of V_1 in different segmental contexts determines its realisation in loan forms, indicating that the phonetic characteristics of this input vowel are involved in the adaptation. The English diphthongs that undergo this strategy end in high vowels, and the glide in the

adapted form occupies the coda position. This is evidenced by the absence of the input coda in loan forms due to the high ranking of *COMPLEX^{COD}. Only two English diphthongs undergo substitution. Although the OT analysis based on features appears to be able to capture the behaviour of the majority of the diphthongs, it turns out that the best match for English /ɛə/ is likely to be determined on acoustic grounds. The behaviour of the English diphthongs examined in the present study suggests that both phonetic and phonological factors play a role in determining how the vowels are realised in the borrowing language. The next chapter focuses on the adaptation of English vowels in unstressed syllables, which appears to be conditioned by non-phonological factors.

Chapter 5

Adaptation of Unstressed Vowels

5.1. Introduction

This chapter considers how unstressed vowels in English loanwords[28] are dealt with in Thai. The vowels which are mainly discussed are English schwa and English /ɪ/. It appears that they are variably mapped to several Thai vowels. It is argued that orthography is a non-phonological factor which is involved in the variable adaptations of unstressed English vowels in Thai. In Section 5.2, adaptation patterns found in the loan corpus are examined. Section 5.3 discusses how the best Thai matches for the English schwa and /ɪ/ in unstressed syllables are determined. An OT analysis is then presented in Section 5.4.

5.2 Orthographically conditioned adaptation of vowels

This section outlines the adaptation patterns of the English schwa and /ɪ/ identified in the loan corpus.

5.2.1 Adaptation of English schwa

The behaviour of the English schwa is different from that of the other English monophthongs which occur in stressed syllables. As outlined in Chapter 3, the English monophthongs present in the Thai phonemic inventory are mapped to their direct Thai counterpart, such as English /iː/ → Thai /iː/, and English /uː/ → Thai /uː/. If they do not have a direct correspondent in Thai, the best match for each vowel is determined on phonetic grounds, such as English /ɪ/ → Thai /i/, and English /ɛ/ → Thai /e/. When it comes to English schwa, the adaptation of this vowel appears to exhibit orthographic effects, as it has more variation in matches which appears to be based on the English spelling. Given that English [ə] is acoustically closer to Thai /ɤ/ and /ɤː/ as seen in Figure 3.1, it would be expected to be mapped to either of them if the mapping was based on acoustic grounds. However, its tokens in the corpus may be mapped to a number of Thai vowels, i.e. /a/, /aː/, /e/, /eː/, /æ/, /æː/, /ɤ/, /ɤː/, /ɔ/, /ɔː/, /oː/, /ɯ/, /uː/, or /ia/, suggesting that

[28] Final unstressed syllables in such loanwords as 'fashion', 'lotion', 'cable', and 'signal' surface with syllabic consonants in the source language rather than a vowel. Given the absence of syllabic consonants in Thai, I leave the question of their adaptation in loanwords for future research.

the adaptation patterns are likely to be conditioned by the orthography of the source language rather than phonetic approximation.

Let us first consider the data in (110). When a token of English [ə] is spelled with <a>, the majority of the tokens are mapped to Thai low central vowels /a/ or /aː/. It is realised as short if it occurs in a closed syllable or with an epenthetic glottal stop. If it is represented by <a> with a following nasal, it is matched with /æ/ or /æː/. There is one token of <a> mapped to Thai /ɔ/; such a realisation occurs in the context of the following /l/ in 'balloon' [bɔn.luːn].

(110)

English			Thai	
<a>	lava	[lɑːvə]	/aː/, /a/	[laː.waː]
	soda	[səʊdə]		[soː.daː]
	magazine	[mægəziːn]		[mɛ́k.kaː.siːn]
	carat	[kʰæɹət]		[kaʔ.rát]
	bungalow	[bʌŋgələʊ]		[baŋ.kàʔ.loː]
<an/m>	slogan	[sləʊgən]	/æː/, /æ/	[saː.loː.kæːn]
	foreman	[fɔːmən]		[foː.mæːn]
	ammonia	[əməʊnɪə]		[ʔæm.moː.nia]
	Protestant	[pʰɹɒtɪstənt]		[proː.téː.tɛ́n]

When the schwa occurs in an open syllable and is represented by the grapheme <u>, it is likely to be matched with Thai /uː/ in an open syllable in the loan form, as shown in (111). Recall that vowel lengthening is one of the strategies employed in Thai to satisfy the bimoraicity requirement in loanwords. In the context of a following /s/ or /m/ in the source language, its token is consistently mapped to a Thai /a/. However, there is one exception. The vowel in the second syllable of 'serum' is replaced with /u/ rather than /a/. The other pattern is that if <u> is followed by /r/, it is mapped to /ɤː/ in Thai.

(111)	English			Thai	
	<u>	insulin	[ɪnsjəlɪn]	/uː/	[ʔin.suː.lin]
		calculus	[kʰæɬkjələs]		[kʰæn.kʰuː.lát]
	<us>	bonus	[bəʊnəs]	/a/	[boː.nát]
		virus	[vaɪɹəs]		[waj.rát]
	<um>	column	[kʰɒləm]	/a/	[kʰɔː.lâm]
		spectrum	[spɛktɹəm]		[sa.pék.trâm]
	<ur>	furniture	[fɜːnɪtʃə]	/ɤː/	[fɤː.niʔ.cɤ̂ː]
		tincture	[tʰɪŋktʃə]		[tʰiŋ.cɤːr]

The data in (113) show that when English schwa is spelled with <e>, it is likely to be mapped to a Thai /eː/ in open syllables. It is realised as a Thai /e/ in closed syllables. Nevertheless, when this grapheme co-occurs with <r>, it is rendered as /ɤː/ in the adapted forms.

(112)	English			Thai	
	<e>	celeb	[səlɛb]	/eː/, /e/	[seː.lép]
		ceramics	[səɹæmɪks]		[seː.raː.mìk]
		treatment	[tʰɹiːtmənt]		[tʰríː.mén]
		diet	[daɪət]		[daj.ʔèt]
		fitness	[fɪtnəs]		[fít.nèt]
		item	[aɪtəm]		[ʔaj.tʰêm]
	<er>	laser	[leɪsə]	/ɤː/	[leː.sɤ̂ː]
		order	[ɔːdə]		[ʔɔː.dɤ̂ː]
		bartender	[bɑːtɛndə]		[baː.tʰen.dɤ̂ː]

Let us now turn to the realisation of English [ə] spelled with <o> as shown in (113). It is typically mapped to Thai /oː/ when it occurs in an open syllable. If the following syllable begins with /r/, it is likely to be mapped to Thai /ɔː/. Moreover, it is matched with /ɔ/ when a following consonant in the source language is nasal. There is an exception. The loanword 'ribbon' is realised as [ríp.bîn], rather than *[ríp.bɔ̂n]. The other surface form of English [ə] spelled with <o> is a Thai [ɤː]; such a form occurs in a final syllable which is closed by /r/.

(113)	English			Thai	
	<o>	promote	[pɹəməʊt]	/oː/, /ɔː/	[proː.mòːt]
		innocent	[ɪməsn̩t]		[ʔin.noː.sén]
		corruption	[kəɹʌpʃn̩]		[kʰɔː.ráp.cʰân]
		calorie	[kʰælə.ɹi]		[kʰæː.lɔː.rîː]
	<on/m>	confirm	[kənfɜːm]	/ɔ/	[kʰɔn.fɤːm]
		bacon	[beɪkən]		[beː.kʰôn]
		commando	[kəmɑːndəʊ]		[kʰɔm.maːn.doː]
		atom	[ætəm]		[ʔa.tɔm]
	<or>	censor	[sɛnsə]	/ɤː/	[sen.sɤ̂ː]
		tractor	[tʰɹæktə]		[tʰráek.tɤ̂ː]

The other orthographic representation of English schwa found in the corpus is <ia>. This is mapped to Thai /ia/.

(114)	English			Thai	
	<ia>	Asia	[eɪʒə]	/ia/	[ʔeː.cʰia]
		Christian	[kʰɹɪsʃən]		[kʰrít.tian]

The following section deals with the adaptation of English /ɪ/ in unstressed syllables.

5.2.2 Adaptation of unstressed /ɪ/

In addition to the behaviour of English schwa, which exhibits orthographic effects in the loan corpus, the adaptation of some tokens of English /ɪ/ occurring in unstressed syllables also appears to be conditioned by the English spelling. Recall that English /ɪ/ in stressed syllables is typically mapped to the Thai short vowel /i/.

In the loan corpus, English /ɪ/ in unstressed syllables can be mapped to four different Thai vowels: /i/, /iː/, /e/, and /eː/. The majority of its tokens are mapped to /i/, as in 'credit' [kʰreː.dìt], and 'basic' [beː.sìk]. The adaptation to /iː/ occurs in open syllables as in 'delay' [diː.leː] and 'resort' [riː.sɔ̀ːt]. The mapping to /e/ and /eː/ is most likely to be attributed to orthographic effects. When it is spelled with <e> with a following /t/, it is mapped to Thai /e/ rather than /i/, as illustrated in (115). However, there is an exception. A token of /ɪ/ in the unstressed final syllable of the English loanword 'linen' is matched with Thai /i/, suggesting

that the adaptation of this token is not influenced by the English spelling. When it is represented by <a> in the context of a following /dʒ/, it is mapped to Thai /eː/ as shown in (116).

(115)	English			Thai	
	<e>	jacket	[dʒækɪt]	/e/	[cék.két]
		locket	[lɒkɪt]		[lɔ́k.két]
		racket	[ɹækɪt]		[ráek.kêt]
		trumpet	[tʰɹʌmpɪt]		[tʰram.pèt]
(116)	<age>	message	[mɛsɪdʒ]	/eː/	[mét.sèːt]
		image	[ɪmɪdʒ]		[ʔim.mèːt]
		package	[pʰækɪdʒ]		[pʰáek.kèːt]
		vintage	[vɪntɪdʒ]		[win.tʰèːt]

The following section examines how Thai speakers determine the best match for the English schwa and English /ɪ/ in unstressed syllables.

5.3 How is the adaptation determined?

In the previous section, the different realisations of English [ə] and [ɪ] in unstressed syllables are presented. One might attribute the variable surface forms observed in the previous section to phonetic approximation, given that these two English vowels are adapted differently in different segmental contexts. However, if we consider the behaviour of English [ə] in the context of a following sonorant, such as in 'slogan' [sa.loː.kæːn], 'column' [kʰɔː.lâm], and 'item' [ʔaj.tʰêm], it can be observed that its tokens are mapped to different Thai vowels even in the same segmental context. The data in the loan corpus show that the variation in the adaptation patterns of these two vowels is likely to be conditioned by orthography rather than the subphonemic details of the source vowels. It is argued that their adapted forms are largely based on stressed vowels in orthographically similar syllables rather than the one in unstressed position. The adapter identifies the vowel in unstressed syllables by analogy to syllables with the same spelling.

Let us first consider the behaviour of English schwa. With respect to the Thai data in (110), not all [ə] tokens spelled with <a> are mapped to /a/ or /aː/, as they would be if solely determined by orthography. Some are mapped to /æː/, as in 'slogan' and 'foreman'. This pattern occurs in the context of a following nasal. This raises a question as to how Thai determines the

best match. It appears that the adapter identifies the input sound by analogy with such words as 'man', 'fan', and 'jam' on the basis of orthography. The vowels in these words are likely to be realised as a long [æː] in the source language (see Chapter 3 for the realisation of English /æ/). As for the token in 'balloon', its realisation is based on the English vowel in the word 'ball', which surfaces as Thai [ɔ].

As for the data in (111), the English [ə] spelled with <u> in the context of a following obstruent and a following nasal is mapped to Thai /a/. The adaptation pattern is based on the vowel /ʌ/ represented with the same grapheme in such contexts in the source language. This English vowel is adapted to Thai /a/, as in 'bus' [bát], 'pub' [pʰàp], and 'plum' [pʰlam]. The input to the adaptation process for the loanwords 'virus' and 'column', for example, must be /vaɪɹʌs/ and /kʰɒlʌm/. When this grapheme is followed by <r>, the adaptation is based on the vowels in words like 'blur', 'hurt', and 'furniture'. Given that the sequence <ur> represents /ɜː/ which is typically mapped to Thai /ɤː/, the English schwa with the same orthographic representation is realised as the same Thai vowel.

Let us turn to the adaptation to Thai /e/ and /eː/ in (112). This is based on vowels represented by <e> in loanwords such as 'check', 'tent', 'tennis', and 'website'. They are English /ɛ/, which is matched with Thai /e/. However, when the following consonant is /r/, the token of English schwa is mapped to /ɤː/ in Thai. This mapping appears to be based on English loanwords with <er> sequences representing /ɜː/, as in 'fern', 'hertz', 'service' and 'version'. Therefore, the vowels /ɛ/ and /ɜː/, rather than the unstressed vowel [ə], are in the input representation of such loanwords as 'item' and 'laser',

As far as the data in (113) are concerned, it can be seen that the English [ə] with the same orthographic representation <o> may be variably mapped to four Thai vowels. The realisations are not random but are apparently based on English vowels represented by <o> in different segmental contexts. The first vowel in 'promote' is mapped to /oː/ following the adaptation of English /əʊ/ in words like 'protein', 'program', and 'proton'. Meanwhile adaptation to /ɔː/ occurs in the context of a following /r/. It appears that the adapter chooses the best match for [ə] in this context based on the stressed vowels in such loanwords as 'chorus', 'chlorine', and 'order'. In the context of a following nasal, it is mapped to Thai /ɔ/ by analogy to orthographically similar syllables in words like 'comment', 'concept', and 'concert'. The first vowels in the exemplified English loanwords are /ɒ/ which is mapped to Thai /ɔ/. Recall

that English [ə] in 'ribbon' surfaces as [i]. This might be a case of vowel harmony[29]. The adaptation reveals that the stressed vowel in the English input triggers harmony. That is, the English stressed vowel harmonises with a neighbouring vowel in the Thai output. The other pattern is adaptation to /ɤː/. This is limited to <or> sequences in final position. This raises a question as to why it is not mapped to /ɔː/. Presumably the adapter might have decided on the best match following loanwords that have final <r>, as in 'laser' and 'order'.

The other grapheme representing English [ə] found in the loan corpus is <ia> as illustrated in (114). A vowel token spelled with <ia>, as in 'Asia' and 'Christian' is mapped to Thai /ia/. If we consider English loanwords having the same spelling, as in 'bacteria', 'mafia', and 'lesbian', the grapheme <ia> in the final syllable represents /ɪə/ in the source language. This diphthong is replaced by Thai /ia/. Thus, the [ə] token spelled with the same grapheme is also expected to be mapped to the same Thai vowel, based on the assumption that the adapter relies on orthography to identify the input vowel when the adaptation is underdetermined by perceptual factors. It makes sense to assume that the vowel /ɪə/, rather than [ə], is in the input representation. That is why English schwa spelled with <ia> is mapped to the Thai /ia/.

When it comes to the adaptation of English /ɪ/ in unstressed syllables, the situation is no different from that of English schwa. It also shows sensitivity to the orthography of the source language. As for the adaptation to [e] in (115), it appears that the adapter identifies the input vowel based on orthographically similar words like 'set', 'get', 'jet', which have /ɛ/ in the input representation. It follows that tokens of English /ɪ/ in loanwords such as 'jacket' and 'locket' are matched with Thai /e/. However, it is mapped to /eː/ when it is represented by <a>. I assume that the adapter considers English words like 'page', 'cage', and 'wage' to determine the input vowels for the last syllables of the loanwords in (116). The syllable nuclei of the exemplified English words are occupied by /eɪ/, and this diphthong is monophthongised into /eː/in Thai. Hence, the input to adaptation must be English /ɛ/ and /eɪ/ as in 'trumpet' /tʰɹʌmpɛt/ and 'vintage' /vɪnteɪdʒ/ respectively rather than /ɪ/. That is why the unstressed English vowel /ɪ/ represented by <e> and <a> are realised as different Thai vowels.

[29] Vowel harmony is not native to Thai. In the loan corpus, only two loanwords exhibit vowel harmony, i.e. 'ribbon' [ríp.bîn] and 'captain' [kàp.tan]. There are some other cases where two consecutive identical vowels could be a case of orthographic effects. For example, the loanwords 'marathon' and 'parafin' are realised as [maː.raː.tʰɔn] and [pʰaː.raː.fin] respectively. The first two English vowels in these words are phonetically different, i.e. [æ] vs. [ə], but they are orthographically identical in the source language, i.e <a>. The adaptation is likely to be influenced by the English orthography rather than vowel harmony.

As noted by Daland *et al.* (2015), orthographic effects in loanword adaptation will be strongest when the adaptation is underdetermined by perceptual factors. It is not surprising that English schwa and the tokens of English /ɪ/ in question are variably adapted to several Thai vowels, given that they occur in unstressed position. It is noted that English unstressed syllables are relatively weak and least prominent (Kreidler 2004: 145). That is why the adaptation of unstressed vowels in loanwords is much more variable than for stressed vowels which have better perceptual contrast. Variations in the adaptation of English schwa have also been reported in the adaptation of English vowels in Mandarin (Lin 2008b). Lin argues that English schwa and other mid central vowels have variable matches in Mandarin due to their relatively poor perceptual contrast and saliency. This is not the case in Thai because the other English mid central vowel /ɜː/ is consistently mapped to a single Thai vowel. The variable matches for English [ə] in Thai are thus likely to result from the fact that it occurs in unstressed syllables where vowels do have poor perceptual contrast.

Kang (2009) points out that adapters need not possess a good knowledge of the source language and they are likely to resort to orthography, especially when the adaptation pattern is underdetermined by other factors. Accordingly, I assume that Thai adapters, whose native language is not a stress language, might have difficulties in perceiving vowels in unstressed syllables. Studies of second language acquisition of English stress patterns also report that Thai learners of English have difficulties in the perception and production of English stress (e.g. Wei and Zhou 2002; Sumdangdej 2007). They are likely to place equal stress on all syllables in words having more than one syllable when they are not certain which syllable should receive primary stress (Sumdangdej 2007). This suggests that weak syllables would be pronounced as if they were strong. Errors in stress placement in English made by Thai speakers are attributed to the transfer of prosodic units from their first language as tone. As Thai is a tonal language, words are not differentiated based on stress. When it comes to the adaptation of unstressed vowels, Thai adapters rely on the orthography of the source word in order to identify the input sound, as they might not be certain what vowel they are perceiving. In other words, they infer an English phonemic category from the English spelling by considering how other orthographically similar words or syllables are pronounced, and then maps that phoneme to its correspondent in the borrowing language.

The following section considers how OT can account for the adaptation of English schwa and /ɪ/ conditioned by the orthography of the source language.

5.4 OT analysis

In light of the observations outlined in the previous section, this section examines the adaptation patterns from an OT perspective.

5.4.1 Adaptation of English schwa

As outlined in Section 5.3, the majority of English schwa tokens are mapped to different Thai vowels due to the fact that the input to the adaptation is not [ə] but an English full vowel which is represented by the same grapheme in the same segmental context.

Take the words 'slogan', 'virus', 'tincture', 'fitness', 'promote', and 'confirm' as examples. It can be seen that the tokens of English schwa in these words have different orthographic representations. I argued in the previous section that the adaptation of the English [ə] in the exemplified words is based on English vowels having the same spelling. Thus, the inputs to the adaptation process must be /sləʊgæːn/, /vaɪɪʌs/, /tʰɪŋktʃɜː/, /fɪtnɛs/, /prəʊməʊt/, and /kʰɒnfɜːm/ respectively, rather than /sləʊgən/, /vaɪɪəs/, /tʰɪŋktʃə/, /fɪtnəs/, /prəməʊt/, and /kʰənfɜːm/. That is why the unstressed vowels in these words are realised as [æː], [a], [ɤː], [e], [oː], and [ɔ] in Thai. The following tableaux demonstrate the adaptation of the three loanwords 'virus', 'tincture', and 'confirm'. With the same constraint ranking as that developed in Chapter 4, the actual outputs [waj.rat], [tʰiŋ.cɤː], and [kʰɔn.fɤːm] are selected as winning candidates with respect to the ranked constraints[30].

(117)

/vaɪɪʌs/ 'virus'	*FALL	*ʌ	IDENT (low)	IDENT (front)	IDENT (round)
a. [waɪ.rʌt]	*!	*			
☞b. [waj.rat]					
c. [waj.rɤt]			*!		
d. [waj.ræt]				*!	

[30] Only constraints relevant to the analysis are presented.

(118)

/tʰɪŋk.tʃɜː/ ‘tincture’	*ɪ	*ɜː	IDENT (low)	IDENT (front)	IDENT (round)
a. [tʰɪŋ.cɜː]	*!	*			
☞b. [tʰiŋ.cɤː]					
c. [tʰiŋ.ceː]				*!	
d. [tʰiŋ.coː]					*!

(119)

/kʰɒnfɜːm / ‘confirm’	*ɒ	*ɜː	IDENT (low)	IDENT (front)	IDENT (round)
a. [kʰɒn.fɜːm]	*!	*			
☞b. [kʰɔn.fɤːm]					
c. [kʰon.fɤːm]			*!		
d. [kʰan.fɤːm]					*!

Tableaux (117-119) show that the surface form of English schwa is not present in the input representation of the three loanwords, but the input vowels in the unstressed syllables are /ʌ/, /ɜː/, and /ɒ/. Given that these English vowels are not allowed in Thai, they must undergo adaptation. Candidates (117a), (118a), and (119a) are ruled out immediately because they fatally violate the markedness constraints, as their syllable nuclei are occupied by vowels which are illegal in Thai. The remaining candidates are well-formed in Thai as they contain legitimate vowels. Nevertheless, candidates (c-d) in each tableau lose out to the winning candidate because the output vowels are not faithful to their corresponding input vowels, incurring a fatal violation of a faithfulness constraint. It can be seen that candidate (b) in each tableau maximally preserves the quality of the input vowel, satisfying all high-ranked faithfulness constraints. It follows that it is optimal with respect to the ranked constraints. The next section deals with an OT account of the adaptation of the unstressed English /ɪ/.

5.4.2 Adaptation of English /ɪ/ in unstressed syllables

The Thai surface form of the unstressed English /ɪ/ is not different from that of the English [ə], as it varies according to the spelling of the source word as outlined in Section 5.3. It is mapped to a Thai /e/ when it is represented with <e>. By contrast, it is adapted to Thai /eː/ when it is

represented by <a>. Take the words 'trumpet' and 'vintage' as examples. I argued in the previous section that the adaptation to /e/ in the former is based on the English vowel /ɛ/ in words like 'set' and 'get', and the adaptation to /eː/ in the latter is influenced by the English vowel /eɪ/ in such words as 'page' and 'cage'. Thus, the input to the adaptation for these two words must be /tʰɹʌm.pɛt/ and /vɪn.tʰeɪdʒ/, as demonstrated in Tableaux (120) and (121)

(120)

[tʰɹʌm.pɛt] 'trumpet'	*ʌ	*ɛ	IDENT (high)	IDENT (front)	IDENT (μ)	IDENT (round)
a. [tʰrʌm.pɛt]	*!	*				
☞b. [tʰram.pet]						
c. [tʰram.pit]			*!			
d. [tʰram.peː t]					*!	
e. [tʰram.pɤt]				*!		

(121)

[vɪn.tʰeɪdʒ] 'vintage'	*FALL	*ɪ	IDV1 (high)	IDV2 (round)	IDV1 (front)	ID(μ)	UNIFORMITY
a. [wɪn.tʰèɪt]	*!						
☞b. [win.tʰèː t]							*
c. [win.tʰíː t]			*!				*
d. [win.tʰét]						*!	*
e. [win.tʰóː t]				*!	*		*

Tableau (120) reveals that the faithful candidate is ruled out because it contains vowels which are illegal in Thai, violating the two markedness constraints *ʌ and *ɛ. The output vowels in the other candidates are licit in Thai but candidates (120c-e) are excluded from the competition because the vowels in the final syllables violate featural faithfulness. Candidate (120b) with [e], which is the actual output form, is selected as a winning candidate. This is because the output vowel [e] is faithful to the input vowel /ɛ/ in terms of vowel quality and length. Candidate (120e) could surface in Thai if the input vowel in the last syllable was /ə/. This is because the Thai vowel [ɤ], which is a mid central vowel, and the English [ə] are identical in terms of vowel quality.

Tableau (121) shows that the input vowel in the unstressed final syllable is English /eɪ/, rather than English /ɪ/, given that the actual output vowel is [eː]. This diphthong is illegal in Thai, fatally violating the markedness constraint against falling diphthongs, and so the faithful candidate is ruled out. Thai repairs it through coalescence as discussed in Chapter 4 and it is realised as the Thai long vowel [eː], preserving the feature [high] of the first element, the roundness and frontness of the second element and the weight of the input diphthong. Thus, candidate (121b) is selected as a winning candidate with respect to the ranked constraints.

5.5 Conclusion

This chapter has shown that the adaptation of unstressed vowels is less consistent than that of stressed vowels given that the mapping is not determined only on phonological or phonetic grounds. They are variably mapped to a number of Thai vowels. Such variation is largely conditioned by the orthography of the source language. Given that English unstressed syllables are weak and less prominent, the Thai adapter is not certain about what vowel he perceives and thus needs to rely on the spelling of the source word to determine how the vowel in unstressed position is realised in Thai. The adaptation patterns of English schwa and /ɪ/ found in the loan corpus reveal that the Thai adapter identifies the input vowel in unstressed syllables by analogy to orthographically similar syllables in stressed position. It follows that stressed vowels in orthographically similar syllables serve as the input to the adaptation process rather than the surface form of the unstressed vowels.

Chapter 6

Discussion and Conclusion

6.1 Introduction

The present study focuses on the adaptation of English monophthongs and diphthongs in English loanwords mainly drawn from standard Thai dictionaries. It aims to examine the phonological processes that are involved in the Thai adaptation of English vowels, to investigate how the best matches for non-native vowels are determined, and to explore the role of native phonology in vowel adaptation. The results reveal that loanword adaptation can be attributed to both perception and the phonology of the borrowing language. Phonetic details of the source language are interpreted according to the contrastive categories of the borrowing language. Orthography appears to play a role when adaptation is underdetermined by perceptual factors. The study also addresses four issues: the nature of the input to the adaptation process, how the borrowing language deals with unlicensed segments, the role of the native phonology in adaptation, and factors involved in variable adaptations. This chapter covers general adaptation patterns, a general discussion, the contributions and limitations of the study and recommendations for future research.

6.2 General adaptation patterns

This section summarises the general patterns of vowel adaptation found in the loan corpus as shown in the following tables[31]. The second research question exploring how Thai deals with unlicensed vowels and syllable structure is also addressed.

[31] Other realisations which are treated as exceptions are not included here.

Table 6.1: Adaptation of English monophthongs

English	Typical Thai mapping
/ɪ/	/i/, /iː/, /e/, /eː/
/iː/	/iː/
/ɛ/	/e/, /eː/
/æ/	/æ/, /æː/, /a/, /aː/
/ɜː/	/ɤː/
/ʌ/	/a/
/ʊ/	/u/, /uː/
/uː/	/uː/, /w/
/ɔː/	/ɔː/
/ɒ/	/ɔ/, /ɔː/
/ɑː/	/aː/
/ə/	/a/, /aː/, /e/, /eː/, /æ/, /æː/, /ɤ/, /ɤː/, /ɔ/, /ɔː/, /oː/, /u/, /uː/, /ia/

Table 6.2: Adaptation of English diphthongs

English	Typical Thai mapping	Simplification strategies
/eɪ/ /əʊ/ /ɛə/	/eː/ /oː/ /æː/	Monophthongisation
/aɪ/ /aʊ/ /ɔɪ/	/aj/, /aːj/ /aw/, /aːw/ /ɔj/, /ɔːj/	Glide formation
/ɪə/ /ʊə/	/ia/ /ua/	Substitution

Let us first consider the adaptation of English monophthongs as summarised in Table 6.1. It is found that English vowels which are available in Thai are faithfully mapped to their Thai counterparts, except for English /æ/ which is variably mapped to either /æ/ or /æː/ in Thai loan forms and English /uː/ which surfaces as a labial-velar glide in the context of the initial cluster /Cj/. The realisation of English /æ/ as Thai [æː] is unexpected given that the tense-lax

distinction in English is generally maintained in loanwords and interpreted as vowel length distinction in Thai based on the phonetic length of tense and lax vowels; the English lax and tense vowels are thus mapped to the Thai short and long vowels respectively. It appears that the variable adaptation of the English low front vowel is likely to be based on the phonetic characteristics of the input in different segmental contexts in the source language. This English vowel, which is phonologically short, tends to be lengthened in certain environments as in 'bad', 'man', and 'jazz'. It follows that a token with relatively longer duration is matched with the Thai long vowel /æː/ rather than the short one /æ/. This can be explained by the role of phonological perception (Iverson and Lee 2006; Boersma and Hamann 2009*)*. The Thai adapter interprets the allophonic details of the input vowel according to the contrastive categories of the native language. The fact that vowel length is contrastive in Thai leads him to match English /æ/ with phonetically short duration and long duration with Thai short /æ/ and long /æː/ respectively. The adaptation to /a/ and /aː/, as seen in Table 6.1, is likely be influenced by the English spelling, given that this English vowel is usually represented with <a>. As for English /uː/, all things being equal, it is typically mapped to its direct counterpart in Thai. Nevertheless, its token which is preceded by a /Cj-/ sequence is realised as a Thai [w] occupying the coda position, as in 'cue' [kʰiw] and 'fuse' [fiw]. Such mismatches with the English high vowel can be attributed to a native restriction on possible clusters in the onset position. Given that the cluster /Cj/ is ill-formed in Thai, a /Cjuː/ sequence is realised as the Thai /Ciw/, preserving the feature [high] of the input segments /j/ and /uː/.

Turning to the behaviour of non-native monophthongs, they all undergo substitution. It is found that they are typically replaced with their phonetically closest L1 segment, preserving the quality and length of the input vowels. For instance, the English low central lax vowel /ʌ/ and a mid central tense vowel /ɜː/ are matched with the Thai low central short vowel /a/ and mid central long vowel /ɤː/ respectively. However, considering the mapping of English /ɑː/ to Thai /aː/, the height and roundness of the input vowel are faithfully preserved in its output correspondent, with the exception of backness. In fact, a low back vowel is available in Thai but it is not selected as the best match for this English vowel due to the fact that it is rounded. Recall that Thai back vowels are rounded. This suggests that a rounding mismatch is not permissible in Thai loanword phonology.

Considering the behaviour of English lax vowels, except for English /ʌ/, they are mapped to either short or long vowels in Thai. It seems that such lax vowels and English /æ/ behave in the same way; that is, they are not consistently replaced with Thai short vowels.

However, the factors which influence a length mismatch in the adaptation of English /æ/ and the other lax vowels differ. As reported above, the realisation of the English low front vowel as a short or a long one in Thai is conditioned by the phonetic characteristics of the input vowel in the source language. Meanwhile the other lax vowels are generally mapped to Thai short vowels in a monosyllabic loanword and a closed syllable in the Thai loan. Adaptation to a long vowel usually occurs in an open syllable in the Thai loan, which is motivated by the native requirement for all syllables to be bimoraic. Recall that it is assumed that English loanwords are rendered in the isolative speech style, which requires every syllable to be heavy. In native words, given that vowel length is contrastive, an underlying CV syllable always undergoes glottal stop epenthesis to comply with the bimoraicity requirement and the vowel remains short in the surface representation. Thai speakers, by contrast, employ three different repair strategies for light open syllables in loanwords: glottal stop epenthesis ('cigar' [sí?.kâː]); consonant gemination ('tennis' [tʰen.nít]); and vowel lengthening ('column' [kʰɔː.lâm]). Consonant gemination is likely to be triggered by English orthography as the majority of loanwords which undergo this repair strategy obviously have orthographically doubled consonants in the source language. Vowel lengthening is treated as a loanword-specific strategy, as it does not occur in native words. CV syllables in the loan corpus are predominantly repaired by vowel lengthening when orthographically doubled consonants are not present. Thus, an English lax vowel in a CV syllable is realised as a Thai short one if this syllable is modified through glottal stop epenthesis or consonant gemination. If it surfaces in an open syllable, it is always lengthened, thus creating a mismatch with the short vowel in the English source word. As for English /ʌ/, it is consistently mapped to Thai short vowel /a/ given that it always surfaces in Thai closed syllables.

With respect to English diphthongs, they are all unlicensed in Thai because they fall in prominence. Given that Thai allows only diphthongs rising in prominence to occupy the nucleus of a syllable, English diphthongs need to undergo phonological modification to become a well-formed vowel in the borrowing language. Adapters attempt to preserve the features of both vocalic elements of the non-native diphthongs as much as possible by employing three different simplification strategies to deal with them as shown in Table 6.2: monophthongisation, glide formation, and substitution. They decide on which strategy yields an output form that is most faithful to the input and which also conforms to the native phonology. Only the two English diphthongs /ɪə/ and /ʊə/ are replaced with Thai diphthongs /ia/ and /ua/ respectively. The height and frontness of V1 of the English diphthongs are faithfully preserved in its corresponding output segment but the feature [low] of V2 is lost in the output. In the case of

the adaptation to vowel-plus-glide sequences, the phonetic duration of V_1 in different segmental contexts determines its realisation in loan forms, indicating that the phonetic characteristics of the input vowel are involved in adaptation. V1 with longer duration is mapped to a Thai long vowel while the one with short duration is matched with a Thai short one. The high vowels which are the second members of the English diphthongs /aɪ/, /aʊ/, /ɔɪ/ are realised as consonantal glides /j/ and /w/, which share the same features [high] and [round]. The other strategy that Thai adopts to deal with falling diphthongs is monophthongisation. Given that V1 and V2 of the diphthongs are merged into a single vowel, some of the features of V1 and some of those of V2 are preserved in their Thai correspondents. It is found that the diphthongs that undergo monophthongisation through coalescence surface as non-high vowels, preserving the feature [-high] of V_1 together with the frontness or roundness of V_2. This is expressed in Optimality-Theoretic terms by means of a constraint ranking that favours the preservation of the height feature of V1 over the height feature of V2. This confirms Casali's (1996) claim that height coalescence applies to vowel sequences in which V_1 is non-high and V_2 is high. When it comes to the adaptation of English /ɛə/, it appears that the best match /æː/ is likely to be determined on acoustic grounds rather than according to features. It is found that the first two formants of V_2 are the determining factor in this case because the adapted form is acoustically closer to V2 than V1.

It can be seen that the adaptation of English vowels involves both phonetic and phonological factors. However, the mapping of English schwa and some surface forms ([e, eː]) of English /ɪ/ in unstressed position is rather influenced by orthography, which results in variable matches as seen in Table 6.1. The adapter's sensitivity to graphemes representing unstressed vowels is argued to result from the fact that English unstressed syllables are relatively weak and less prominent. It follows that the adapter might not be certain about what vowel he/she perceives; he/she thus resorts to orthography to identify the input vowel. The different adapted forms of these two English vowels appear to be based on stressed vowels in orthographically similar syllables. That is, the adapter identifies the input to the adaptation process by analogy with syllables with the same spelling. English schwa and some tokens of English /ɪ/ in unstressed syllables are mistaken for English stressed vowels in orthographically similar syllables, as discussed in Section 5.3. For example, English schwa is replaced with Thai /a/ and /ɤː/ when it is spelled with <u>, as in 'virus' [waj.rát] and 'tincture' [tʰiŋ.cɤːr]. The adapter identifies the vowels in the unstressed syllables of 'virus' and 'tincture' by analogy with such English words as 'bus', 'pub', 'blur', and 'hurt'. Given that the grapheme <u> in the

contexts of an obstruent coda and a following /r/ represent English /ʌ/ and /ɜː/ respectively, the unstressed vowels in 'virus' and 'tincture' are mistaken for English /ʌ/ and /ɜː/ respectively. It follows that the unstressed vowels in 'virus' and 'tincture' are mapped to Thai /a/ and /ɤː/ because the two stressed vowels serve as the input to the adaptation process rather than the unstressed ones in the source words. Thus, it can be seen that orthography plays a crucial role in determining how unstressed vowels are realised in Thai loan forms.

In summary, the source vowels which are available in the borrowing language are generally mapped to their Thai correspondents. The mismatches are attributed to the phonetic characteristics of the source vowels and phonological factors. As for illicit monophthongs, they are generally replaced with their phonetically closest match, preserving the quality and length of the input. The adaptation patterns of English schwa and some tokens of English /ɪ/, by contrast, are influenced by a non-phonoloical factor, i.e. orthography, which results in variations in adaptation. Meanwhile English diphthongs, which are all ill-formed in Thai, are modified using three different strategies including monophthongisation, glide formation, and substitution. Thai borrowers decide on which strategy yields an output form that is most faithful to the input and which also conforms to the native phonology.

6.3 General Discussion

This section addresses the first, third and fourth research questions. The first question explores whether the input to adaptation is phonetic or phonological. The third question investigates to what extent the native phonology plays a role in adaptation, and the fourth question concerns what factors determine the variation in the Thai adaptation of vowels in English loanwords.

6.3.1 The input to the adaptation process

In loanword phonology, adaptations based on phonological or phonetic input are both attested as reviewed in Section 2.4. The majority of the adaptation patterns of the English vowels in the loan corpus, as summarised in the previous section, appear to be based on phonetic input given that perception plays a role in determining how English vowels are realised in Thai. The phonetic view assumes that loanword adaptation is influenced by the subphonemic details of the source language (e.g. Silverman 1992; Kenstowicz 2005, 2007; Kenstowicz and Suchato 2006; Peperkamp *et al.* 2008). This is evidenced by the mapping of English lax and tense vowels to Thai short and long vowels respectively. The adaptation suggests that the Thai adapter is

sensitive to the duration of English lax and tense vowels which is phonetic in the source language. Thus, English lax vowels which are phonetically short are mapped to Thai short vowels while English tense vowels which are relatively long are replaced with Thai long vowels. English /ʊ/, for example, could in principle be replaced with either Thai /u/ or /uː/ as they are both high back vowels. Nevertheless, the former is selected to be the best match since it preserves both the quality and length of the English input. This view also predicts that a certain phoneme of the source language can have different adapted forms in the borrowing language based on its phonetic characteristics in different segmental environments in the source language (e.g. Kang 2003; Adler 2006; Hsieh *et al*. 2009). This prediction is confirmed by the variable adaptation of English /æ/ to Thai /æ/ and /æː/ and that of English /aɪ/, /aʊ/, /ɔɪ/ to VG and V:G sequences which are conditioned by their surface forms in the source language.

Although the majority of adaptations of English vowels in Thai are largely based on the surface phonetic representation of the source vowels, the adapted forms of English schwa and some tokens of English /ɪ/ in unstressed position tend to be influenced by a non-phonological factor which is the orthography of the source language, given that they are mapped to a number of different Thai vowels. It is argued in the present study that Thai adapters, whose native language is not a stress language, might have difficulties in perceiving vowels in unstressed syllables due to the fact that English unstressed syllables are relatively weak and less prominent. Studies of the second language acquisition of English stress patterns also report that Thai learners of English have difficulties in English stress perception and production (Wei and Zhou 2002; Sumdangdej 2007). As noted by Kang (2009), adapters need not possess a good knowledge of the source language and they are likely to resort to orthography, especially when the adaptation pattern is underdetermined by other factors. Most studies which have reported the role of orthography in adaptation point out that the input to adaptation involves the orthographic representation of the source word (e.g. Smith 2006; Daland *et al.* 2015; Guba 2016; Hamdi 2017). However, in the case of the Thai adaptation of English unstressed vowels, it appears that the input to the adaptation process is determined by analogy with orthographically similar syllables. That is, English schwa and some tokens of English /ɪ/ in unstressed syllables are mistaken for English stressed vowels in syllables with the same spelling, as reported in Chapter 5. Their realisations are apparently not based on phonetic or orthographic representations of the unstressed vowels, but on the phonemic categories represented by the same graphemes. In other words, the Thai adapter infers the input vowel in unstressed position from the English spelling by considering how other orthographically similar

words or syllables are pronounced and then maps that phoneme to its correspondent in the borrowing language.

In the loan corpus, there are cases where adaptation is solely influenced by the orthographic representation of the source word. Consonant gemination, which Thai employs to deal with non-final CV syllables in English loanwords with orthographically doubled consonants such as 'tennis' [tʰen.nít], 'dinner' [din.nɤ̂ː], and 'happy' [hǽp.pî], is clearly triggered by the English spelling. Light open syllables in loanwords without orthographic geminates mostly undergo vowel lengthening. Different repair strategies for ill-formed syllable structures triggered by orthography are also found in Japanese. Smith (2006) reports that English loanwords containing illicit codas or consonant clusters usually undergo epenthesis in Japanese if the input is orthographic; however if the input is auditory, they usually undergo deletion. Cross-linguistically, it is argued by Otaki (2013) that word-medial geminates in loanword adaptation are largely influenced by geminate spellings in the source language. For example, in Japanese, English loanwords with geminate consonant spellings are realised with geminate consonants while those without orthographically doubled consonants show up with a single consonant, as in 'happy' [happiː], 'copy' [kopiː], 'battery' [batteriː] and 'city' [ɕitiː]. Otaki also notes that gemination in English loanwords in Italian (e.g. 'zipper' [ʣippa], 'paper' [pepa], 'cracker' [krekka], maker [meka]) as reported in Repetti (2006, 2009) is motivated by the English spelling.

6.3.2 The role of native phonology in adaptation

It is noted in the literature that adaptation patterns reflect the language-specific facts of the native phonology. In segmental adaptation, it has been proposed that the choice concerning which feature to preserve and which feature to sacrifice is determined by the status of the features in the native phonology (see Dohlus 2005; Rungruang 2008, among others). For example, final English voiced stops are realised as Thai voiceless stops, preserving the place and manner features of the input (Rungruang 2008). The voicing feature in the input is not retained, given that Thai does not have a voicing contrast in coda stops. German mid front rounded vowels /œ/ and /ø/ are realised as Japanese mid front unrounded vowel /e/, preserving the height and frontness of the input vowels (Dohlus 2005). The roundness is lost because it is redundant in the description of the Japanese vowel system. The adaptation patterns of English vowels found in the loan corpus reveal that the phonology of the borrowing language plays a crucial role in determining how English vowels are realised in Thai. The phonological features

of the input vowel which are underlyingly contrastive in the native phonology are maximally preserved in the output. Take the adaptation of English monophthongs as an example. As mentioned in Section 2.2.2, Thai and English monophthongs have three height distinctions: high, mid, and low vowels. With respect to the front/back dimension, there are three-way distinctions in both languages; that is, front, central, and back vowels. Front and central vowels are unrounded in these languages. All Thai back vowels are rounded; similarly, English back vowels are also rounded except for the low back vowel /ɑː/. Based on these facts, the height, frontness and roundness of the input vowel are maximally preserved in its corresponding output segment in Thai, as seen in Table 6.1. A mismatch in the front-back dimension occurs only in the adaptation of English /ɑː/, given that it is mapped to a Thai low central vowel instead of a low back vowel. Mapping this English vowel to a Thai back vowel would lead to a mismatch in roundness, suggesting that the rounding feature of the input vowel is important in the adaptation process in Thai. The adaptation of English /ɑː/ suggests that height and roundness are more faithfully preserved than the front-back dimension, which contrasts with Lin's (2008ab) and Kenstowicz's (2012) observation that backness is more faithfully retained than other vowel features in Standard Mandarin and Cantonese. With respect to the monophthongisation of English /eɪ/ and /əʊ/ through coalescence, the native grammar determines which features of V1 and V2 are preserved in their corresponding output segment through the interaction between IDENT-IO$_{V1}$ (F) and IDENT-IO$_{V2}$ (F). The OT analysis in Section 4.3.1 has demonstrated that the height of V1 and the frontness and roundness of V2 are retained in their adapted forms.

Loanword adaptation also reflects the segmental and phonotactic restrictions of borrowing languages, such as vowel epenthesis as a repair strategy for complex onsets in Japanese (Smith 2006) and in Tongan (Riggs 2014) and for complex codas in Korean (Kang 1996), Gĩkûyû (Mwihaki 2001), and Sesotho (Rose and Demuth 2006). The foreign input with a non-native segment or imperfect syllable structure undergoes adaptation to comply with the phonology of the borrowing language. Vowels in English loanwords are typically realised as vowels in Thai. Nevertheless, the realisation of high vowels as consonantal glides in the corpus is determined by the native phonology. This is evidenced by the adaptation of English /aɪ/, /ɔɪ/, and /aʊ/ to vowel-plus-glide sequences, as in 'strike' [sa.tráj], 'join' [cɔːj] and 'gout' [káw]. Glide formation brings English loanwords with diphthongs ending in high vowels in line with the native requirement that diphthongs falling in prominence are not allowed to occupy a syllable nucleus. The high vowels are thus replaced with consonantal glides occupying the coda

position. The coda in the source word which is deleted in the loan form also shows that complex codas are not allowed in the borrowing language. The English diphthongs /eɪ/ and /əʊ/, which also end in high vowels, are modified through monophthongisation rather than glide formation. This behaviour is attributed to phonotactic constraints banning combinations of a mid front vowel followed by a palatal glide and a mid central vowel followed by a labial velar glide. The inviolability of Thai phonotactics reflects the dominance of the native phonology and supports approaches to loanword which involve phonological grammar (e.g. Jacobs and Gussenoven 2000; LaCharité and Paradis 2005; Davis and Cho 2006; Smith 2006; Yip 2006, among others).

Vowel adaptation in English loanwords in Thai also provides strong evidence that the native phonology plays a role not only in production but also in perception. In Thai, vowel length is phonologically contrastive and vowel duration is the main cue used to distinguish between short and long vowels. English vowels, by contrast, are classified as tense and lax classes which differ primarily in quality and not in duration (Hillenbrand *et al*. 2000; Reetz and Jongman 2009). It is argued that English tense and lax vowels are generally mapped to Thai long and short vowels respectively in closed syllables based on the relative phonetic duration of tense and lax vowels in the source language (see Chapters 3 and 4 for how Thai interprets the tense-lax distinction in English vowels). This suggests that vowel duration in English, which is not the main perceptual cue to distinguish between tense and lax vowels, is perceptually salient in Thai given that vowel length is a contrastive category of the native phonology. An interpretation of the tense-lax distinction in English as a length distinction is also reported in Japanese (Kaneko 2006) and Ammani Arabic (Guba 2016) as the length contrast is phonemic in these two languages. The Thai adapter's sensitivity to the phonetic details of the English input which are phonemic in the native language supports Iverson and Lee's (2006) principle of phonological perception due to the fact that the phonetic representation of the source word is interpreted according to the salient perceptual categories of Thai (see Section 2.4.2.3 for details of the principle). However, it is not always the case that adapters will pay attention to non-distinctive allophonic information in a source word which is contrastive in their native language. Paradis and Tremblay (2009) report that English stop aspiration, which is considered allophonic in English, does not influence phonemic categorisation in Mandarin Chinese (MC), despite the fact that the borrowing language makes a phonemic distinction between aspirated and unaspirated stops in the native phonology. English voiceless stops and voiced stops are consistenly mapped to MC aspirated stops and MC unaspirated stops respectively, suggesting that the adaptation is based on phonological input.

It has been argued by some phonologists that phonological changes which are made by the borrowing language must be accounted for by the same constraint hierarchy which defines well-formed native words (see Yip 1993; Jacobs and Gussenhoven 2000, among others). In the present study, it is found that not all adaptation patterns can be captured by the same constraint ranking that characterises the native phonology. As has been argued in Section 3.6, English loanwords are rendered in the isolative speech style; thus, every syllable must be bimoraic. CV syllables in some English loanwords are made heavy by a strategy different from a native one. In native words, underlying CV syllables always undergo glottal stop epenthesis to satisfy the bimoraicity requirement. In the loan corpus, English loanwords with CV syllables are repaired via different strategies including glottal stop epenthesis, consonant gemination, and vowel lengthening. Kenstowicz and Suchato (2006) argue that gemination is restricted to loanwords; however, it is noted in the literature (Masuko and Kiritani 1991) that it also occurs in native Thai words. It is assumed that geminate consonants in Thai are underlyingly moraic, following Hayes (1989) and Davis (1994, 1999, 2003), and they surface as such. Vowel lengthening is treated as a loanword-specific strategy given that it occurs only in loanwords, resulting in a mismatch in length. To capture different repair strategies in native lexical items and loanwords, some researchers propose that the native grammar includes loanword-specific faithfulness constraints which are distinct from native input-output constraints (e.g. Kenstowicz and Suchato 2006; Yip 2006; Smith 2009). They argue that loanwords and native words satisfy the same markedness constraints but the adapter exercises power over the native grammar to choose a strategy that produces an output which closely resembles the source word. Given that the majority of the loanwords in the loan corpus fulfill all constraints that characterise the native phonology, the fact that some loanwords avoid violation of the prosodic constraint $\sigma_{\mu\mu}$ by undergoing the non-native strategy of vowel lengthening can be accounted for in terms of Itô and Mester's (1995a,b; 1999) model of a core-periphery organisation of the lexicon without constraints specific to mimicking foreign inputs (see Section 2.7.3 for the key assumptions of this approach) . It is argued in the present study that loanwords that undergo insertion of a glottal stop and gemination are fully nativised and have become part of the lexical core because these two strategies are attested in native words. They are subject to the same constraint ranking which defines well-formed Thai words: $\sigma_{\mu\mu}$, CODA-AC, IDENT-IO (place), IDENT-IO (sing), IDENT-IO (μ) >> DEP-IO (C), IDENT-IO (gem) >> *GEMCON. Those that undergo vowel lengthening to satisfy the bimoraicity requirement are in the periphery. This results from the reranking of faithfulness constraints in peripheral loanwords: $\sigma_{\mu\mu}$, CODA-AC, IDENT-IO (place), IDENT-IO (sing), DEP-IO (C) >> IDENT-IO *(μ)*, IDENT-IO (gem) >> *GEMCON. The

rankings for native words and peripheral loanwords reveal that the constraints holding in the periphery also hold in the core, as predicted by the model. They differ in the relative ranking of the faithfulness constraints DEP-IO (C) and IDENT-IO (μ). It can be seen that IDENT-IO (μ), which is always satisfied by native words, is not fulfilled in peripheral loanwords, resulting in a mismatch with the short vowel in the English source. The adaptation of lax vowels as long vowels results from the fact that faithfulness to vowel length is overridden by a prosodic constraint. This suggests that the preservation of vowel length is less important than that of vowel quality in loanwords. This finding is congruent with Yip's (2006) and Kenstowicz's (2012) observations that faithfulness to vowel quality dominates faithfulness to vowel length in Cantonese. Short lax English vowels [ɛ] and [ɒ] are mapped to Cantonese long vowels [ɛː] and [ɔː] respectively rather than short vowels [e] and [o], thus preserving the mid-open/round vowel quality of the English input.

6.3.3 Factors involved in variations in adaptation

This section answers the research question concerning factors involved in variations in adaptation. The behaviour of vowels in English loanwords in Thai observed in Chapters 3 to 5 has shown that some of them can be mapped to more than one vowel in the borrowing language. Different surface forms of the same segment in the loan corpus appear to be motivated by the following factors.

6.3.3.1 The phonetic characteristics of the input

In loanword phonology, there are two major views that phonologists adopt to explain the behaviour of loanwords, as presented in Section 2.4. One maintains that the input is the phonological representation of the source word and that the non-native segment is replaced by its phonologically closest segment in the borrowing language (Paradis and LaCharité 1997; Jacobs and Gussenhoven 2000; LaCharité and Paradis 2005; Paradis and Tremblay 2009). This view, thus, predicts uniform substitution across different contexts. The other view, by contrast, posits that the input is the phonetic surface form of the source language (Silverman 1992; Yip 1993, 2006; Kenstowicz 2005, 2007; Peperkamp *et al*. 2008). This view predicts that a certain phoneme of the source language can have different adapted forms in the borrowing language based on its phonetic characteristics in different segmental environments in the source language. The variable adaptations of some English vowels found in the loan corpus appear to be cases of phonetic approximation. English /æ/ which is also available in Thai is mapped to

either Thai /æ/ or /æː/ (see Section 3.5 for tha adaptation of English /æ/). This appears to contradict the phonological view which maintains that if a phoneme in the source language exists in the borrowing language, it will be mapped even though the source phoneme is phonetically more similar to another phoneme in the native inventory. The realisation of English /aɪ/, /ɔɪ/, and /aʊ/ as either a VG or VːG sequence is also likely to be conditioned by the phonetic characteristics of the input (see Section 4.2.2 for details). The influence of the phonetic characteristics of the input in the source language on Thai loanword adaptation reported in the present study is congruent with Kenstowicz and Suchato's (2006) observations concerning the behaviour of English voiceless stops displayed in their loan corpus. It is worth noting that vowel duration and aspiration, which are phonetic in English, are contrastive in Thai; they are, thus, perceptually salient for Thai native speakers. This suggests that if the subphonemic details of the source language are phonological in the borrowing language, they are likely to be preserved in the adapted form, which results in variable adaptation. Hence, the present study confirms the findings of previous studies that the subphonemic details of the source language are involved in different realisations of the same phoneme (e.g. Kang 2003; Adler 2006; Davis and Cho 2006; Hsieh *et al.* 2009).

6.3.3.2 Orthography

Not only are the phonetic details of the input language responsible for different adapted forms of a certain phoneme, but non-phonological factors also play a role in variable adaptation in Thai loanword phonology. It has been observed in Chapter 5 and discussed in Section 6.2 that the variations in matches for English schwa and English /ɪ/ in unstressed position is attributed to the orthography of the source language and analogy rather than phonetic approximation, given that vowels in unstressed position are relatively weak and less prominent. This is different from observations in previous studies (e.g. Cohen 2009; Daland *et al.* 2015) which report only orthographic effects in variations in adaptation of unstressed vowels. Cohen (2009) points out that the adaptation of English schwa in Hebrew clearly demonstrates orthographic effects given that its realisation varies according to spelling, such as in the tokens of English schwa in the final syllables of the words which 'Evan' (name), 'Kevin' (name), 'sponsor', and 'user' surface as [a], [i], [o], and [e] respectively. Daland *et al.* (2015) observe that the adaptation of English unstressed vowels in Korean is less consistent than that of stressed vowels. They attribute the adaptation of English schwa to several Korean vowels to orthography. They conclude that orthographic effects in loanword adaptation will be strongest when the adaptation is underdetermined by perceptual factors. Unlike in previous studies, the findings in the present

study have revealed that the adaptation of the vowels under discussion is conditioned by stressed vowels in words with the same spelling. That is, the adapter determines how they are realised in the borrowing language by analogy with orthographically similar syllables in the source language. In other words, unstressed vowels are mistaken for English stressed vowels in syllables with the same spelling. As a result, their adapted forms vary according to the stressed vowels represented by the same graphemes.

Studies which mention orthographic effects in loanword adaptation note that the source language's spelling appears to be an extra-linguistic influence in loanword adaptation if borrowers know the spelling of the loanwords in the source language or adaptation is based on written input (Peperkamp and Dupoux 2003; Smith 2006; Vendelin and Peperkamp 2006; Cohen 2009; Guba 2016). Vendelin and Peperkamp (2006) present experimental evidence showing that the inclusion of the orthographic representation of the source word indeed does have an influence on loanword adaptation. Speakers exposed to orthography adapt the word differently from those not exposed to orthography. Guba (2016) notes that borrowers who are L2 learners can access the orthography of the source language and the adaptation process can be influenced by spelling pronunciation. In a situation where adapters cannot access the spelling of the source language, orthographic effects are less likely to occur. Paradis and LaCharité (1997) argue that orthography plays a limited role in French loanwords in Fula. The authors note that the majority of the Fula speakers of French are illiterate. Thus, the Fula pronunciation of French loanwords can hardly be influenced by the French spelling. With respect to the Thai adapters, I assume that they are bilinguals who have learned English at schools and universities; therefore, they can access the orthographic form of the loanword in the source language. This does not mean that they always refer to orthography when it comes to adaptation. It is argued that they are likely to consider the English spelling when the adaptation is underdetermined by perceptual factors or a given loanword is borrowed via written language. Given that unstressed vowels like English schwa and /ɪ/ are represented with more than one grapheme (e.g. <a>, <u>, <e>, <o>, and etc.), they can have different adapted forms according to the English spelling.

6.3.3.3 Phonemic variability in L2 source

Some of the differences in adaptation found in the loan corpus are attributed to phonemic variability in the L2 source. It is noted that the vowel systems of RP and GenAm are not identical (Wells 1982a; Carr 2013). For instance, English words such as 'pot', 'stop', 'rob' have /ɒ/ in RP but /ɑː/ in GenAm. Although native Thai speakers may be exposed to both RP and

GenAm as discussed in Section 1.2, the present study assumes that RP is the chief source of English loanwords in Thai given that English loanwords that have /ɒ/ in RP but /ɑː/ in GenAm are typically pronounced with [ɔ] in Thai; none of them show up with Thai [aː]. Another piece of evidence is that certain tokens of RP /ɑː/ surface as [æː] (e.g. 'dance' [dǽːn] and 'cast' [kʰǽːt]) rather than [aː], which is its typical realisation in Thai (e.g. 'staff' [sa.táːp] and 'graph' [kráːp]). These different surface forms result from the fact that the input to adaptation are from different varieties of the source language. Some English words that have /ɑː/ in RP contain /æ/ in GenAm, such as 'staff', 'graph', 'dance', and 'cast'. Thus, the loanwords 'dance' and 'cast' must have been borrowed from GenAm, while 'staff' and 'graph' are from RP. This phenomenon is also reported by Lin (2008a: 370). Her study adopts American English vowels as a basis for discussion on the behaviour of English vowels in loanwords in Standard Mandarin (SM). It is found that English vowels are not consistently adapted to a single SM vowel. Certain realisations of the same vowel are influenced by the source vowel from British English. For example, English low back vowel /ɑ/ is variably mapped to SM [ɑ, a_C, ɑu]. The author points out that adaptation to [ɑu] could have resulted from the British input vowel /ɒ/ rather than the American input /ɑ/, given a mismatch in rounding. English front and low unrounded vowels are rarely mapped to a rounded one in SM. Cohen (2009: 87) also mentions phonemic variability in the L2 source in his loan corpus; however, it does not play a role in the adaptation of English vowels in Hebrew. For example, 'dance' which has /ɑː/ in British English but /æ/ in American English surfaces with [a] in Hebrew. It appears that either of them can serve as the input given that both are mapped to the same Hebrew vowel [a].

Apart from origins in American English, a historic variety of British English is responsible for variations in adaptation. This is evidenced by the adaptation of some tokens of /ɒ/. They are realised as Thai long vowels [ɔː]. Such adaptation is restricted to a token in a context of a following fricative, as in 'boss' [bɔ́ːt], 'moss' [mɔ́ːt], or 'soft' [sɔ́ːp]. The mapping to Thai /ɔː/ rather than /ɔ/ could be explained by the fact that CLOTH words are pronounced with [ɔː] by older RP speakers (Wells 1982a: 136). It might be the case that they have been borrowed into Thai a very long time ago. Moreover, variants of the source vowel can cause differences in adaptation. The different adaptations of English /ɪə/ and /ʊə/ in Thai *(*see Section 4.2.3*)* can be explained by the fact that such English diphthongs can be realised as either diphthongs or tense vowels in the source language.

6.4 Conclusion

Loanword adaption has received considerable attention from phonologists given that it reveals aspects of phonological knowledge of native speakers which might not come into play when they deal with native data. In adapting a loanword, a speaker attempts to produce an output form that is faithful to the source word as much as possible and which also conforms to the phonological system of the borrowing language. The adaptation patterns that emerge in vowel adaptation have shown that the phonological system of the borrowing language plays a considerable role in the adaptation process. This can be seen from the way adapters deal with illicit vowels and syllable structures. The results have shown that non-native vowels are not allowed to surface in the loan forms. English monophthongs are replaced with their phonetic matches, preserving the quality and length of the input vowels. As for the adaptation of English diphthongs, the adapter attempts to preserve the features of both vocalic elements of non-native diphthongs as much as possible by employing three different simplification strategies to deal with them: monophthongisation, glide formation, and substitution. Apart from foreign segments, the realisation of CV syllables as heavy syllables is also attributed to the native requirement for all syllables to be bimoraic. Different repair strategies for CV syllables in native words and loanwords provide evidence for the stratification of the Thai lexicon, supporting Itô and Mester's (1995a,b; 1999) model of a core-periphery organisation of the lexicon. Loanwords for which a native repair strategy is used are fully nativised and have become part of the core vocabulary whereas those modified by a loanword-specific strategy are in the periphery. This is demonstrated by different constraint rankings for native words and loanwords, which results in different repair strategies.

The present study also found that perception plays a role in the adaptation process given that the adapter takes the phonetic characteristics of the source language into consideration. One piece of evidence for this is that the phonetic length of the English vowels conditions how they are realised in Thai. An English lax vowel which is phonetically short is mapped to a Thai short vowel, and an English tense vowel which has a longer duration surface as a Thai long vowel. Another piece of evidence is that English /æ/, /aɪ/, /aʊ/, and /ɔɪ/ have different adapted forms in different segmental contexts depending on their surface form in the source language, which also reflects the adapter's sensitivity to the phonetic duration of the source vowels. The fact that vowel duration, which is non-salient in English, is perceptually salient in Thai supports the principle of phonological perception proposed by Iverson and Lee (2006). This principle maintains that phonetic details of the source language are interpreted according to the

contrastive categories of the borrowing language. Given that vowel length is phonemic in Thai, the Thai adapter maps English lax and tense vowels to short and long vowels respectively based on the nonsalient category of vowel duration in English.

The other important finding is that certain English vowels can be mapped to more than one Thai vowel. One of the factors that are involved in variations in adaptation is the phonetic characteristics of the input vowel. This is evidenced by different realisations of English /æ/, /aɪ/, /aʊ/, and /ɔɪ/ depending on their surface phonetic characteristics in the source language, as mentioned above. The variable adaptation of English schwa and some tokens of English /ɪ/ in unstressed syllables tend to be influenced by the non-phonological factors, i.e. orthography and analogy. They appear to play a role when adaptation is underdetermined by perceptual factors. It is argued that the adapter considers orthography to determine adaptation due to the fact that English unstressed syllables are relatively weak and less prominent. It appears that the input to the adaptation process is determined by analogy with orthographically similar syllables. The unstressed vowels in question are mistaken for English stressed vowels in syllables with the same spelling. Orthographic effects are also evident in different repair strategies for CV syllables. Consonant gemination, which is one of these strategies, appears to be triggered by English orthography. The other factor responsible for differences in vowel adaptation is phonemic variability in L2. It is assumed that RP is the chief source of English loanwords in Thai. Given that the vowel systems of RP and GenAm are not identical (Wells 1982a; Carr 2013), some realisations of English vowels appear to be based on GenAm vowels rather than RP vowels.

The present study has shown that both perception and phonology appear to play crucial roles in determining how English vowels are realised in Thai. Moreover, non-phonological factors come into play when adaptation is underdetermined by other factors.

6.5 Contributions of the study

The present study contributes to theories of Thai phonology and loanword phonology. Firstly, it has filled a gap in Thai loanword phonology, which has hitherto mainly focused on the behaviour of consonants, the adaptation of ill-formed syllable margins, and tone assignment. Although the behaviour of vowels in English loanwords has been explored in some previous studies (Nacaskul 1979; Panlay 1997), the findings reported in those studies focus on which Thai vowels are substituted for English vowels. However, the way Thai adapters determine the

best match and motivations for mapping the source vowel to more than one Thai vowel are not examined. The present study has given insights into the factors which play a role in determining how English vowels are realised in the borrowing language.

Secondly, it provides insights into the Thai grammar. Findings from vowel adaptation provide evidence for distinct rankings for native words and peripheral loanwords which differ in the relative ranking of the faithfulness constraints IDENT-IO (μ) and DEP-IO (C), which results in different repair strategies for CV syllables in native lexical items and loanwords. Despite the reranking of the faithfulness constraints in the periphery, the fundamental constraints that determine the basic syllable canons of the Thai grammar are always fulfilled by foreign words, as proposed by Itô and Mester (1995a,b; 1999). Given that not all loanwords with a CV syllable undergo vowel lengthening, which is a loanword-specific constraint, this gives rise to the internal stratification of the Thai lexicon. Loanwords which undergo a native strategy have become part of the core vocabulary given that they are subject to the same constraint ranking, while those that undergo a loanword-specific strategy are in the periphery where they are allowed to violate constraints active in the core.

Thirdly, the results in the present study provide evidence for the role of perception in loanword adaptation. The adaptation of English tense and lax vowels as Thai long and short vowels respectively is determined by the phonetic length of the vowels in the source language, supporting the perceptual view maintaining that the input to the adaptation process includes subphonemic details of the source language. The mapping of English /æ/ to either Thai short /æ/ or long /æː/ depending on its phonetic duration in the source language provides counter-evidence against the production-only view as advanced by Paradis and LaCharité (1997) and LaCharité and Paradis (2005) who argue for uniform substitution across different contexts. The fact that the Thai adapter takes vowel duration in the source language, which is phonetic, into consideration supports Iverson and Lee's (2006) and Boersma and Hamann's (2009) claim that perception is phonological. Vowel duration, which is non-salient in English, is interpreted according to the salient perceptual category of the borrowing language, which is phonemic vowel length. Furthermore, the analysis of the loan data reveals that orthography appears to be an extra-linguistic influence if the adapter can access the spelling of the source language. It plays an active role when the adaptation is underdetermined by perceptual factors, as in the case of the adaptation of English unstressed vowels as pointed out in previous studies (Cohen 2009; Daland *et al.* 2015).

Lastly, vowel adaptation is a less understood area of loanword phonology. The present study contributes to feature theory concerning which vowel features are more faithfully retained in loanword adaptation. Findings in previous studies reveal that the front-back dimension is more faithfully replicated in the loan form than height and roundness (Kenstowicz 2012; Lin 2008ab). By contrast, the analysis of the loan data in the present study reveals that height and roundness are more likely to be preserved than the front-back dimension.

6.6 Limitations of the study and recommendations for future study

The present study has examined vowel adaptation, which has been less explored in Thai loanword phonology. However, there are some limitations of this study. As far as the methodology is concerned, the loan tokens observed in the present study were mainly drawn from standard Thai dictionaries. It might be the case that the Thai pronunciation of some loanwords retrieved from written language is different from the way in which native Thai speakers actually pronounce them. It is recommended that future research should explore the realisations of English vowels exhibited in loanwords collected from spoken language. The present study argues for the role of phonological perception in certain adaptation patterns but did not carry out a perceptual experiment to examine how the Thai speakers interpret the segments which they perceive. Conducting a perception experiment in a future loanword study to examine how native speakers of the borrowing language perceive non-native segments would provide stronger evidence for the role of perception in loanword adaptation. With respect to the segments examined in this study, the focus is on the behaviour of English monophthongs and diphthongs. There is still more room to expand this scope in future research. The other type of English vowels which is not considered here is a triphthong. Moreover, not only do vowels occupy a syllable nucleus in English, but certain consonants can also be the nucleus of a syllable. Given that both triphthongs and syllabic consonants are absent in Thai, the way in which Thai speakers deal with them should also be investigated to find out how an interaction between markedness and faithfulness constraints determines their surface forms in Thai. Vowels in hiatus, which are legitimate in English, are also worth examining given that they are not allowed in Thai. It would be interesting to explore what repair strategies for this type of ill-formed syllable structure are employed by Thai adapters. It is hoped that more researchers will focus on vowel adaptation, which has been less studied, in order to provide a more comprehensive understanding of loanword phonology.

References

Abramson, A. S. 1962. *The Vowels and Tones of Standard Thai: Acoustical Measurements and Experiments*. Bloomington: Indiana University Research Centre in Anthropology, Folklore and Linguistics, Pub. 20.

Abramson, A. S. 1974. 'Experimental phonetics in phonology: vowel duration in Thai'. *Pasaa* 4(1): 71-90.

Abramson, A. S. 2001. 'The stability of distinctive vowel length in Thai'. In K. Tingsabadh and A. S. Abramson (eds.) *Essays in Tai linguistics*. Bangkok: Chulalongkorn University Press. 13-26.

Abramson, A. S. and N. Ren. 1990. 'Distinctive vowel length: duration vs spectrum in Thai'. *Journal of Phonetics* 18(2): 79-92.

Adler, A. N. 2006. 'Faithfulness and perception in loanword adaptation: a case study from Hawaiian'. *Lingua* 116: 1024-1045.

Adomako, K. 2008. *Vowel Epenthesis and Consonant Deletion in Loanwords: A Study of Akan*. MA thesis, Universitetet i Tromsø.

Adra, M. A. 1999. *Identity Effects and Opacity in Syrian Arabic: An Optimality Theory Analysis*. PhD thesis, University of Illinois at Urbana-Champaign.

Archangeli, D. 1997. 'Optimality Theory: an introduction to linguistics in the 1990s'. In D. Archangeli and D. T. Langendoen (eds.) *Optimality Theory: An Overview*. Massachusetts: Blackwell Publishers. 1-58.

Baker, W. 2012. 'English as a lingua franca in Thailand: characterizations and implications'. In R. Baird, M. Kitazawa, H. Y. Lee, and Y. Wang (eds.). *Englishes in Practice: Working Papers of the Center for Global Englishes*. University of Southampton. 18-27.

Ball, M. J. and J. Rahilly. 2013. *Phonetics: The Science of Speech*. London: Routledge.

Beckman, J. 1998. *Positional Faithfulness*. PhD thesis, University of Massachusetts.

Bee, P. 1975. ‘Restricted phonology in certain Thai linker-syllables’. In J. G. Harris and J. R. Chamberlain (eds.) *Studies in Tai Linguistics in Honour of William J. Gedney*. Bangkok: Central Institute of English Language. 17-32.

Bennett, J. F. 1995. *Metrical Foot Structure in Thai and Kayah Li: Optimality-Theoretic Studies in the Prosody of Two Southeast Asian Languages*. PhD thesis, University of Illinois at Urbana-Champaign.

Bickner, R. J. 1986. ‘Thai tones and English loanwords: a proposed explanation’. In R.J. Bickner, T. J. Hudak, and P. Peyasantiwong (eds.) *Papers from a Conference on Thai Studies in Honour of William J. Gedney*. Ann Arbor: Center for South and Southeast Asian Studies, University of Michigan.19-39.

Boberg, C. and S. M. Strassel. 2000. ‘Short-a in Cincinnati: a change in progress’. *Journal of English Linguistics* 28(2): 108-126.

Boersma, P. and S. Hamann. 2009. ‘Loanword adaptation as first-language phonological perception’. In A. Calabrese and W. L. Wetzels (eds.) *Loan Phonology*. Amsterdam: John Benjamins Publishing. 11-58.

Boonyapaluk, P. 2004. *French Loanwords in Current Thai*. Bangkok: Chulalongkorn University Press. [In Thai].

Broselow, E. 2009. ‘Stress adaptation in loanword phonology: perception and learnability’. In P. Boersma and S. Hamann (eds.) *Phonology in Perception*. Berlin: Mouton de Gruyter. 191–234.

Btoosh, M. A. 2006. ‘Constraint interactions in Jordanian Arabic phonotactics: an Optimality-theoretic approach’. *Journal of Language and Linguistics* 5 (2): 192-221.

Burquest, D. A. and D. L. Payne. 1993. *Phonological Analysis: A Functional Approach*. Dallas, TX: Summer Institute of Linguistics.

Calabrese, A. 2009. ‘Perception, production, and acoustic inputs in loanword phonology’. In A. Calabrese and W. L. Wetzels (eds.) *Loan Phonology*. Amsterdam: John Benjamins Publishing. 59-114.

Calabrese, A. and W. L. Wetzels (eds.). 2009. *Loan Phonology*. Amsterdam: John Benjamins Publishing.

Carr, P. 2013. *English Phonetics and Phonology: an Introduction*. *2nd ed.* UK: Wiley-Blackwell.

Casali, R. 1996. *Resolving Hiatus*. PhD thesis, UCLA. ROA-215.

Casali, R. 1997. 'Vowel elision in hiatus contexts: which vowel goes?'. *Language* 73:493-533.

Casali, R. 2011. 'Hiatus resolution'. In M. V. Oostendorp, C. J. Ewen, E. V. Hume, and K. Rice (eds) *The Blackwell Companion to Phonology*. Massachusetts: Wiley-Blackwell. 1434-1460.

Chang, C. B. 2009. 'English loanword adaptation in Burmese'. *Journal of the Southeast Asian Linguistics* Society 1: 77-94.

Chomsky, N. and M. Halle. 1968. *The Sound Pattern of English*. New York: Harper & Row.

Clements, G. N. 1990. 'The role of the sonority cycle in core syllabification'. *Papers in laboratory phonology* 1: 283-333.

Clements, G. N. and S. J. Keyser. 1983. *CV Phonology: A Generative Theory of the Syllable*. Cambridge, MA: MIT Press.

Cohen, E. G. 2009. *The Role of Similarity in Phonology: Evidence from Loanword Adaptation in Hebrew*. PhD thesis, Tel Aviv University.

Cohen, E. G. 2013. 'The emergence of the unmarked: vowel harmony in Hebrew loanword adaptation'. *Lingua* 131: 66-79.

Cruttenden, A. 2001. *Gimson's Pronunciation of English*. 6th ed. London: Edward Arnold.

Daland, R., M. Oh, and S. Kim. 2015. 'When in doubt, read the instructions: orthographic effects in loanword adaptation'. *Lingua* 159: 70-92.

Darasawang, P. 2007. 'English language teaching and education in Thailand: a decade of change'. In D. Prescott (ed.) *English in Southeast Asia: Varieties, Literacies and Literatures*. Newcastle: Cambridge Scholars Publishing. 187-204.

Davis, S. 2011. ‘Geminates’. In M. V. Oostendorp, C. J. Ewen, E. V. Hume, and K. Rice (eds.) *The Blackwell Companion to Phonology*. Massachusetts: Wiley-Blackwell. 873-897.

Davidson, L., and R. Noyer. 1997. ‘Loan phonology in Huave: nativization and the ranking of faithfulness constraints’. *WCCFL* 15: 65-79.

Davis, S. 1994. ‘Geminate consonants in moraic phonology’. *Proceedings of the West Coast Conference on Formal Linguistics* 13: 32-45.

Davis, S. 1999. ‘On the moraic representation of underlying geminates: evidence from prosodic morphology’. In R. Kager, H. van der Hulst and W. Zonneveld (eds.) *The Prosody-Morphology Interface*. Cambridge: Cambridge University Press. 39 – 61.

Davis, S. 2003. ‘The controversy over geminates and syllable weight’. In: C. Féry and R. van de Vijver (eds.) *The Syllable in Optimality Theory*. Cambridge: Cambridge University Press. 77–98.

Davis, S., and M. H. Cho. 2006. ‘Phonetics versus phonology: English word final/s/in Korean loanword phonology’. *Lingua 116*: 1008-1023.

Davis, S. and M. Hammond. 1995. ‘On the status of onglides in American English’. *Phonology* 12: 159-182.

Davis, S., N. Tsujimura, and J. Tu. 2012. ‘Toward a taxonomy of loanword prosody’. *Catalan Journal of Linguistics* 11: 13-39.

De Jong, K. and M. H. Cho. 2012. ‘Loanword phonology and perceptual mapping: comparing two corpora of Korean contact with English’. *Language* 88(2): 341-368.

Dohlus, K. 2005. ‘Phonetics or phonology: asymmetries in loanword adaptations - French and German mid front rounded vowels in Japanese’. *ZAS Papers in Linguistics* 42: 117-135.

Dupoux, E., K. Kakehi, Y. Hirose, C. Pallier, and J. Mehler. 1999. ‘Epenthetic vowels in Japanese: a perceptual illusion?’. *Journal of Experimental Psychology: Human Perception and Performance* 25: 1568-1578.

Endarto, I. T. 2015. 'Comparison between English loanwords in Thai and Indonesian: a comparative study in phonology and morphology. *ASEAN/Asian Academic Society International Conference Proceeding Series*. 49-52.

Foley, J. A. 2005. 'English in… Thailand'. *RELC Journal* 36(2): 223-234.

Fudge, E. 1977. 'Long and short [æ] in one Southern British speaker's English'. *Journal of the International Phonetic Association* 7(2): 55-65.

Gandour, J. 1979. 'Tonal rules for English loanwords in Thai'. In T. L. Thongkum, P. Kullavanijaya, V. Panupong and M. R. K. Tingsabadh (eds.) *Studies in Tai and Mon-Khmer Phonetics and Phonology in Honour of Eugénie J.A. Henderson*. Bangkok: Chulalongkorn University Press. 131-144.

Gordon, M. J. 2008a. 'New York, Philadelphia, and other northern cities: phonology'. In E.W. Schneider (ed.) *Varieties of English 2: the Americas and the Caribbean*. Berlin: Mouton de Gruyter.67-86.

Gordon, M. J. 2008b. 'The West and Midwest: phonology'. In E.W. Schneider (ed.) *Varieties of English 2: the Americas and the Caribbean*. Berlin: Mouton de Gruyter.129-143.

Guba, A. 2016. *Phonological Adaptation of English Loanwords in Ammani Arabic*. PhD thesis, University of Salford.

Hamann, S., and D. W. L. Li. 2016. 'Adaptation of English onset clusters across time in Hong Kong Cantonese: The role of the perception grammar'. *Linguistics in Amsterdam* 9(3): 56-76.

Hamdi, S. 2017. 'Lexical borrowing in Arabic and the role of orthography'. *International Journal of Language and Linguistics* 4 (2): 17-28.

Hammond, M. 1999. *The Phonology of English: A Prosodic Optimality-Theoretic Approach: A Prosodic Optimality-Theoretic Approach*. UK: Oxford University Press.

Hancin-Bhatt, B. 2000. 'Optimality in second language phonology: codas in Thai ESL'. *Second Language Research* 16(3): 201-232.

Hayes, B. 1985. *A Metrical Theory of Stress Rules*. New York: Garland.

Hayes, B. 1989. 'Compensatory lengthening in moraic phonology'. *Linguistic Inquiry* 20(2): 253-306.

Henderson, E. J. A. 1949. 'Prosodies in Siamese: a study in synthesis'. *Asia Major* (new series) 1.2: 189–215.

Hillenbrand, J. M., M. J. Clark, and R. A. Houde. 2000. 'Some effects of duration on vowel recognition'. *The Journal of the Acoustical Society of America* 108: 3013-3022.

Hogan, J. T. and A. J. Rozsypal. 1980. 'Evaluation of vowel duration as a cue for the voicing distinction in the following word-final consonant'. *The Journal of the Acoustical Society of America* 67(5): 1764-1771.

Hsieh, F., M. Kenstowicz, and X. Mou. 2009. 'Mandarin adaptations of coda nasals in English loanwords'. In A. Calabrese and W. L. Wetzels (eds.) *Loan Phonology*. Amsterdam: John Benjamins Publishing. 131-154.

Hussain, Q., R. Mahmood, and M. A. Mahmood. 2011. 'Vowel substitution: a comparative study of English loans in Punjabi and Urdu'. *International Journal of Linguistics* 3: 1-31.

Itô, J. and A. Mester. 1995a. 'Japanese Phonology'. In J. A. Goldsmith (ed.) *The Handbook of Phonological Theory*. Cambridge, Mass.: Blackwell. 817–838.

Itô, J. and A. Mester. 1995b. 'The core-periphery structure of the lexicon and constraints on reranking'. *University of Massachusetts Occasional Papers* 18: 181-209.

Itô, J. and A. Mester. 1999. 'The phonological lexicon'. In N. Tsujimura (ed.) *The Handbook of Japanese Linguistics*. Oxford: Blackwell. 62-100.

Iverson, G. K. and A. Lee. 2006. 'Perception of contrast in Korean loanword adaptation'. *Korean Linguistics* 13: 49-87.

Jacobs, H. and C. Gussenhoven. 2000. 'Loan phonology: perception, salience, the lexicon and OT'. In J. Dekkers, F. V. D. Leeuw, and J. V. D. Weijer (eds.) *Optimality Theory: Phonology, Syntax, and Acquisition*. Oxford: Oxford University. 193-210.

Jones, D. 1975. *An Outline of English Phonetics*. 9th ed. Cambridge: Cambridge University Press.

Jones, D. 2011. *Cambridge English Pronouncing Dictionary*.18th ed. Cambridge: Cambridge University Press.

Kadenge, M. and C. Mudzingwa. 2011. 'Diphthong simplification through spreading: An Optimality Theory account. *Language Matters* 42: 142-161.

Kager, R. 1999. *Optimality Theory*. Cambridge: Cambridge University Press.

Kambuziya, A. and N. Hosseinzadeh. 2014. 'English loanwords in Persian: vowel adaptation'. *Research on Humanities and Social Sciences* 4: 1-15.

Kaneko, E. 2006. 'Vowel selection in Japanese loanwords from English'. *Proceeding LSO Working Papers in Linguistics* 6: 49-62.

Kang, H. 1996. 'English loanwords in Korean'. *Studies in Phonetics, Phonology, and Morphology* 2: 21-47.

Kang, Y. 2003. 'Perceptual similarity in loanword adaptation: English postvocalic word-final stops in Korean'. *Phonology* 20(2): 219-273.

Kang, Y. 2009. 'English /z/ in 1930s Korean'. *Simon Fraser University Working Papers in Linguistics 2*. [No page].

Kang, Y. 2010. 'Tutorial overview: suprasegmental adaptation in loanwords'. *Lingua* 120: 2295–2310

Kang, Y. 2011. 'Loanword phonology'. In M. V. Oostendorp, C. J. Ewen, E. V. Hume, and K. Rice (eds) *The Blackwell Companion to Phonology*. Massachusetts: Wiley-Blackwell. 2258-2282.

Katayama, M. 1998. *Optimality Theory and Japanese Loanword Phonology*. PhD thesis, University of California, Santa Cruz.

Kenstowicz, M. 2005. 'The phonetics and phonology of Korean loanword adaptation'. In S. Rhee (ed.) *Proceedings of the 1st European Conference on Korean Linguistics* Seoul: Hankook Publishing Co. 17–32.

Kenstowicz, M. 2007. 'Salience and similarity in loanword adaptation: a case study from Fijian'. *Language Sciences* 29(2-3): 316-340.

Kenstowicz, M. 2012. 'Cantonese loanwords: conflicting faithfulness in VC rime constraints'. *Catalan Journal of Linguistics* 11: 65-96.

Kenstowicz, M. and H. S. Sohn. 2001. 'Accentual adaptation in North Kyungsang Korean'. In M. Kenstowicz (ed.) *Ken Hale: A Life in Language*. Cambridge, Mass: MIT Press. 239-270.

Kenstowicz, M., and A. Suchato. 2006. 'Issues in loanword adaptation: a case study from Thai'. *Lingua* 116: 921-949.

Kettig, T. 2015. *The BAD-LAD Split: A Phonetic Investigation*. MA thesis, University of Cambridge.

Kettig, T. 2016. 'The BAD-LAD split: secondary/æ/-lengthening in Southern Standard British English'. *Proceedings of the Linguistic Society of America* 32:1-14.

Khongnakhorn, S. 2011. *Characteristics and Changing of English Loanwords in Thai Language*. MA thesis, Kasetsart University, Thailand.

Kreidler, C.W. 2004. *The Pronunciation of English: A Course Book*. 2th ed. Oxford: Blackwell.

Labov, W. 1971. 'Methodology'. In W. O. Dingwall (ed.) *A Survey of Linguistic Science*. College Park, MD: University of Maryland. 412-497.

Labov, W. 1981. 'Resolving the Neogrammarian controversy'. *Language* 57: 267-308.

Labov, W. 2007. 'Transmission and diffusion'. *Language* 83: 344-387.

Labov, W., S. Ash, and C. Boberg. 2006. *The Atlas of North American English: Phonetics, Phonology, and Sound Change*. Berlin: Mouton de Gruyter.

LaCharité, D. and C. Paradis. 2005. 'Category preservation and proximity versus phonetic approximation in loanword adaptation'. *Linguistic Inquiry* 36: 223-258.

Ladefoged, P. and S. F. Disner. 2012. *Vowels and Consonants*. 3rd ed. West Sussex: Wiley-Blackwell.

Levin, J. 1985. *A Metrical Theory of Syllabicity*. PhD thesis, MIT.

Lin, Y. 2008a. 'Variable vowel adaptation in Standard Mandarin loanwords'. *Journal of East Asian Linguistics* 17: 363-380.

Lin, Y. 2008b. 'Patterned vowel variation in Mandarin loanword adaptation: evidence from a dictionary corpus'. In M. K. M. Chan, and H. Kang (eds), *Proceedings of the 20th North American Conference on Chinese Linguistics (NACCL-20)*, Columbus, Ohio.175-187.

Luce, P. A. and J. Charles-Luce. 1985. 'Contextual effects on vowel duration, closure duration, and the consonant/vowel ratio in speech production'. *The Journal of the Acoustical Society of America* 78(6): 1949-1957.

Luksaneeyanawin, S. 1983. *Intonation in Thai*. PhD thesis, University of Edinburgh.

Masuko, Y. and S. Kiritani. 1991. 'The duration of geminate consonants in Indonesian and in Thai'. *Annual Bulletin Research Institute of Logopedics and Phoniatrics* 25: 81-89.

McCarthy, J. and A. Prince. 1995. 'Faithfulness and reduplicative identity'. In J. Beckman, L. W. Dickey, and S. Urbanczyk (eds.) *University of Massachusetts Occasional Papers in Linguistics 18*. Amherst, MA: GLSA Publications. 249-384.

Miglio, V. 2005. *Markedness and Faithfulness in Vowel Systems*. New York: Routledge.

Mohanan, T., and K. P. Mohanan, (2003). 'Towards a theory of constraints in OT: emergence of the not-so-unmarked in Malayalee English'. Available as ROA-601 from the Rutgers Optimality Archive.

Morén, B., and E. Zsiga. 2001. 'Lexical tone and markedness in standard Thai'. In *Annual Meeting of the Berkeley Linguistics Society* 27(1): 181-191.

Mwihaki, A. 2001. 'Consonant-vowel harmony: evidence from the phonotactics of loanword adaptation'. *Poznan Studies in Contemporary Linguistics* 37: 139-145.

Nacaskul, K. 1979. 'A note on English loanwords in Thai'. In T. L. Thongkum, P. Kullavanijaya, V. Panupong and M. R. K. Tingsabadh (eds.) *Studies in Tai and Mon-Khmer Phonetics and Phonology in Honour of Eugénie J.A. Henderson*. Bangkok: Chulalongkorn University Press. 151-162.

Nacaskul, K. 2013. *Rabop Saing Phaasaa Thai*. (Thai Phonological System). 2nd ed. Bangkok: Chulalongkorn University Press. [In Thai].

Nagy N. and J. Roberts. 2008. 'New England: phonology'. In E.W. Schneider (ed) *Varieties of English 2: the Americas and the Caribbean*. Berlin: Mouton de Gruyter.52-66.

Otaki, Y. 2013. 'Consonant gemination in loanwords as preservation of syllable weight'. A talk given in *NINJAL International Conference on Phonetics and Phonology 2013*, Japan.

Owino, D. 2003. *Phonological Nativization of Dholuo Loanwords*. PhD thesis, University of Pretoria.

Panlay, S. 1997. *The Effect of English Loanwords on the Pronunciation of Thai*. MA thesis, Michigan State University.

Paradis, C. and D. LaCharité. 1997. 'Preservation and minimality in loanword adaptation'. Journal of Linguistics 33: 379-430.

Paradis, C. and D. LaCharité. 2008. 'Apparent phonetic approximation: English loanwords in old Quebec French'. *Journal of Linguistics* 44(1): 87-128.

Paradis, C. and D. LaCharité. 2011. 'Loanword adaptation: from lessons learned to findings'. In J. Goldsmith, J. Riggle and A. Yu (eds.) *The Handbook of Phonological Theory* (2nd ed.) Oxford: Wiley-Blackwell. 751-778.

Paradis, C. and A. Tremblay. 2009. 'Nondistinctive features in loanword adaptation: the unimportance of English aspiration in Mandarin Chinese phoneme categorization'. In A. Calabrese and W. L. Wetzels (eds.) *Loan Phonology*. Amsterdam: John Benjamins Publishing. 211-224.

Peperkamp, S. 2005. 'A psycholinguistic theory of loanword adaptations'. *BLS* 30: 341–352.

Peperkamp, S., and E. Dupoux. 2003. 'Reinterpreting loanword adaptations: the role of perception'. In: *Proceedings of the 15th International Congress of Phonetic Sciences*. 367–370.

Peperkamp, S., I. Vendelin and K. Nakamura. 2008. 'On the perceptual origin of loanword adaptations: experimental evidence from Japanese'. *Phonology* 25(1): 129-164.

Peterson, G. E. and I. Lehiste. 1960. 'Duration of syllable nuclei in English'. *The Journal of the Acoustical Society of America* 32(6): 693-703.

Picard, M. 2003. 'On the emergence and resolution of hiatus'. *Folia Linguistica Historica* 24: 44–57.

Prince, A. and P. Smolensky. 1993/2004. *Optimality Theory: Constraint Interaction in Generative Grammar*. Massachusetts: Blackwell publishing.

Reetz, H., and A. Jongman. 2009. *Phonetics: Transcription, Production, Acoustics, and Perception*. UK: Wiley-Blackwell.

Repetti, L. 1993. 'The integration of foreign loans in the phonology of Italian'. *Italica* 70: 182-196.

Repetti, L. 2006. 'The emergence of marked structures in the integration of loans in Italian'. In R.S. Gess and D. Arteaga (eds.) *Historical Romance Linguistics: Retrospective and Perspectives*. Amsterdam/Philadelphia: John Benjamins. 209-235.

Repetti, L. 2009. 'Gemination in English loans in American varieties of Italian'. In A. Calabrese and W. L. Wetzels (eds.) *Loan Phonology*. Amsterdam /Philadelphia: John Benjamins. 225-240.

Riggs, D. 2014. *Sound Sequence Adaptation in Loanword Phonology*. PhD thesis, University of Southern California.

Roach, P. 2004. 'British English: received pronunciation'. *Journal of the International Phonetic Association* 34(2): 239-245.

Roach, P. 2009. *English Phonetics and Phonology: A Practical Course*. 4th ed. Cambridge: Cambridge University Press.

Roengpitya, R. 2001. *A Study of Vowels, Diphthongs, and Tones in Thai* [Online]. Unpublished PhD thesis, University of California at Berkeley. Last accessed 23 July 2015, from http://escholarship.org/uc/item/1qq9g93z.

Roengpitya, R. 2002a. 'Different durations of diphthongs in Thai: a new finding'. In *Annual Meeting of the Berkeley Linguistics Society* 28(2): 43-54.

Roengpitya, R. 2002b. 'A historical and perceptual study of vowel length in Thai'. In M. Maklin (ed.) *Papers from the Tenth Annual Meeting of the Southeast Asian Linguistics Society*. Tempe: Arizona State University Program Southeast Asian Studies. 353–366.

Rose, Y. and K. Demuth. 2006. 'Vowel epenthesis in loanword adaptation: representational and phonetic considerations'. *Lingua* 116(7): 1112-1139.

Royal Institute. 2006. *Foreign Words that have their Thai Equivalents*. Bangkok: Royal Institute of Thailand.

Royal Institute Dictionary. 1950. 1st ed. Bangkok: Karn Satsana.

Royal Institute Dictionary. 1982. 2nd ed. Bangkok: Aksorn Charoentat.

Royal Institute Dictionary. 2011. 4th ed. Bangkok: Royal Institute of Thailand.

Royal Institute Dictionary of New Words. 2007. Vol.1. Bangkok: Royal Institute of Thailand.

Royal Institute Dictionary of New Words. 2009. Vol.2. Bangkok: Royal Institute of Thailand.

Royal Institute Dictionary of New Words. 2011. Vol.3. Bangkok: Royal Institute of Thailand.

Ruangjaroon, S. 2006. 'Consonant-tone interaction in Thai: an OT analysis'. *Taiwan Journal of Linguistics* 4.2: 1-66.

Rungruang, A. 2008. *English Loanwords in Thai and Optimality Theory: English Loanwords, Optimality Theory, Phonology, the Thai Language.* Germany: VDM Verlag Dr. Müller.

Ryu, N. 2017. 'Phonetic and phonological adaptation of loanwords: Mandarin falling diphthongs in Heritage Korean in China'. Paper presented at the Workshop on Phonetics and phonology in loanword adaptation. Cologne, Germany.

Selkirk, E. 1984. 'On the major class features and syllable theory'. In M. Aronoff and R. T. Oehrle (eds.) *Language Sound Structure*. Cambridge, MA: MIT Press. 107–136.

Sharma, T. n.d. *History of lip gloss*. [Online]. Available from: https://makeup.lovetoknow.com/History_of_Lip_Gloss [Accessed 1/12/19].

Shinohara, S. 2006. 'Perceptual effects in final cluster reduction patterns'. *Lingua* 116(7): 1046-1078.

Silverman, D. 1992. 'Multiple scansions in loanword phonology: evidence from Cantonese'. *Phonology* 9: 289-328.

Smith, J. L. 2006. 'Loan phonology is not all perception: evidence from Japanese loan doublets'. In V. J. Timothy and J. A. Kimberly (eds.) *Japanese/Korean Linguistics 14*. Palo Alto: CLSL. 63-74.

Smith, J. 2009. 'Source similarity in loanword adaptation: Correspondence Theory and the posited source- language representation'. In S. Parker (ed.) *Phonological Argumentation: Essays on Evidence and Motivation*. London: Equinox. 155-177.

Steriade, D. 1982. *Greek Prosodies and the Nature of Syllabification*. PhD thesis, MIT.

Sumdangdej, S. 2007. *Input and the acquisition of suprasegmental phonology in English by Thai school children* [Online]. Unpublished PhD thesis. Durham University. Last accessed 30 June 2018, from http://etheses.dur.ac.uk/2479/

Surintramont, A. 1973. 'Some aspects of underlying syllable structure in Thai: evidence from khamphuan--a Thai word game. *Studies in the Linguistic Sciences* 3: 121-42.

Suthiwan, T. and U. Tadmor. 2009. 'Loanwords in Thai'. In M. Haspelmath and U. Tadmor (eds.) *Loanwords in the World's Languages: A Comparative Handbook*. Berlin: De Gruyter Mouton. 599-616.

Tsukada, K. 2009. 'An acoustic comparison of vowel length contrasts in Arabic, Japanese and Thai: durational and spectral data'. *International Journal on Asian Language Processing* 19 (4): 127-138.

Tumtavitikul, A. 1997. 'The metrical structure of Thai in a non-linear perspective'. In A. S. Abramson (ed.) *Southeast Asian Linguistics in Honour of Vichin Panupong*. Bangkok: Chulalongkorn University Press. 309-324.

Uffmann, C. 2007. *Vowel Epenthesis in Loanword Adaptation*. Berlin: De Gruyter.

Ulrich, C. 1997. 'Loanword adaptation in Lama: testing the TCRS model'. *Canadian Journal of Linguistics* 42: 415-463.

Vendelin, I. and S. Peperkamp. 2006. 'The influence of orthography on loanword adaptations'. *Lingua* 116: 996-1007.

Watson Todd, R. and S. Keyuravong. 2004. 'Process and product of English language learning in the National Education Act, Ministry of Education standards and recommended textbooks at the secondary level'. *ThaiTESOL Bulletin* 17(1): 15-45.

Wei, Y. and F. Zhou. 2002. 'Insights into English pronunciation problems of Thai students'. *Paper presented at the Annual Meeting of the Quadruple Helix*. Last accessed 30 June 2018, from https://files.eric.ed.gov/fulltext/ED476746.pdf

Wells, J. C. 1982a. *Accents of English 1: An Introduction*. Cambridge: Cambridge University Press.

Wells, J. C. 1982b. *Accents of English 2: The British Isles*. Cambridge: Cambridge University Press.

Wells, J. C. 1982c. *Accents of English 3: Beyond the British Isles*. Cambridge: Cambridge University Press.

Wells, J. C. 2000. *Longman Pronunciation Dictionary*. Harlow: Longman.

Wongsothorn, A., K. Hiranburana and S. Chinnawongs. 2002. 'English language teaching in Thailand today'. *Asia Pacific Journal of Education* 22(2): 107-116.

Yip, M. 1993. 'Cantonese loanword phonology and Optimality Theory'. *Journal of East Asian Linguistics* 2: 261-291.

Yip, M. 2002. 'Perceptual influences in Cantonese loanword phonology'. *Journal of the Phonetic Society of Japan* 6: 4-21.

Yip, M. 2006. 'The symbiosis between perception and grammar in loanword phonology'. *Lingua* 116: 950-957.

Zec, D. 1995. 'Sonority constraints on syllable structure'. *Phonology* 12: 85–129.

Zec, D. 2007. 'The syllable'. In P. Lacy (ed.) *The Cambridge Handbook of Phonology*. Cambridge: Cambridge University Press. 161-194.

Zivenge, W. 2009. *Phonological and Morphological Nativisation of English Loans in Tonga*. PhD thesis, University of South Africa.

Appendix A

Loan Corpus

Loanwords	RP English pronunciation	Thai pronunciation[32]
acre	[eɪ.kə]	[ʔeː.kʰɤ̂ː]
acrylic	[ə.kʰɹɪ.lɪk]	[ʔaʔ.kʰriʔ.lìk]
actinium	[æk.tɪ.ni.əm]	[ʔǽk.tʰiʔ.nîam]
action	[æk.ʃn̩]	[ʔǽk.cʰân]
admission	[əd.mɪ.ʃn̩]	[ʔǽt.mít.cʰân]
aerobics	[ɛə..ɪəʊ.bɪks]	[ʔæː.roː.bìk]
agency	[eɪ.dʒən.si]	[ʔeː.jen.sî:], [-cen-]
agent	[eɪ.dʒənt]	[ʔeː.jên], [-cen-]
album	[æɬ.bəm]	[ʔan.la.bâm]
alcohol	[æɬ.kə.hɒɬ]	[ʔæn.kɔː.hɔː]
alpha	[æɬ.fə]	[ʔæn.fâː]
ammeter	[æ.miː.tə]	[ʔæm.míʔ.tɤ̂ː]
ammonia	[ə.məʊ.ni.ə]	[ʔæm.moː.nia]
ampere	[æm.pɛə]	[ʔæm.pæː]
antigen	[æn.tɪ.gən]	[ʔæn.tiʔ.cên]
apartment	[ə.pʰɑːt.mənt]	[ʔaʔ.pʰáːt.mén]
apple	[æ.pl̩]	[ʔǽp.pɤ̂n]
argon	[ɑː.gɒn]	[ʔaː.kɔ̂n]
arm	[ɑːm]	[ʔaːm]
art paper	[ɑːt]	[ʔáːt]
artist	[ɑːt.ɪst]	[ʔáːt.tít]
Asia	[eɪ.ʒə]	[ʔeː.cʰia]
asphalt	[æs.fɔːlt]	[ʔǽː.fán]
aspirin	[æs.pɹɪn]	[ʔǽː.pʰaj.rin]
astatine	[æs.tə.tʰiːn]	[ʔæː.tʰaː.tʰiːn]
ATM	[eɪ.tʰiː.ɛm]	[ʔeː.tʰiː.ʔem]
atom	[æ.təm]	[ʔaʔ.təm]
bacillus	[bə.sɪ.ləs]	[baː.sin.lát]

[32] Final /l/, /s/, and /f/ are typically pronounced as [n], [t], and [p] in Thai but they are often pronounced as [w], [s], and [f] by speakers who have a good knowledge of English. However, some loanwords with final /l/ such as 'sale' and 'email'are usually realised with final [w] rather than [n].

background	[bæk.gɹaʊnd]	[bǽk.kraːw]
backup	[bæk.ʌp]	[bǽk.ʔáp]
bacon	[beɪ.kən]	[beː.kʰə̂n]
bacteria	[bæk.tʰɪə.ɹi.ə]	[bǽk.tʰiː.ria]
bad boy	[bæd.bɔɪ]	[bǽːt.bɔːj]
badminton	[bæd.mɪn.tən]	[bǽt.min.tə̂n]
bakery	[beɪ.kə.ɹi]	[beː.kɤː.rîː]
balance	[bæ.ləns]	[baː.láːn]
ballet	[bæ.leɪ]	[ban.lêː]
balloon	[bə.luːn]	[bɔn.luːn]
ballroom	[bɔːɬ.ɹuːm]	[bɔn.ruːm]
ban	[bæn]	[bæːn]
banjo	[bæn.dʒəʊ]	[bæn.coː]
bank	[bæŋk]	[bǽŋ]
banner	[bæ.nə]	[bæn.nɤ̂ː]
bar	[bɑː]	[baː]
bar code	[bɑː.kʰəʊd]	[baː.kʰóːt]
barber	[bɑː.bə]	[baː.bɤ̂ː]
barium	[bɛə.ri.əm]	[bæː.ríam]
barley	[bɑː.li]	[baː.lêː]
barrel	[bæ.rəɬ]	[baː.rew]
bartender	[bɑː.tʰɛn.də]	[baː.tʰen.dɤ̂ː]
base	[beɪs]	[bèːt]
basic	[beɪ.sɪk]	[beː.sìk]
basketball	[bɑː.skɪt.bɔːɬ]	[báːt.sa.két.bɔn]
bass	[beɪs]	[bèːt]
battery	[bæ.tə.ɹi]	[bǽt.tɤː.rîː]
beauty	[bjuː.ti]	[biw.tîː]
beer	[bɪə]	[bia]
beige	[beɪʒ]	[bèːt]
belt	[beɬt]	[béw]
benzene	[bɛn.ziːn]	[ben.sin]
berkelium	[bɜː.kʰiː.li.əm]	[bɤː.kʰiː.lîam]
beryllium	[bə.ɹɪ.li.əm]	[beː.rin.lîam]

Bible	[baɪ.bɬ]	[baj.bɤ̂n]
big	[bɪg]	[bík]
bill	[bɪɬ]	[bin]
billboard	[bɪɬ.bɔːd]	[bin.bɔ̀ːt]
billiards	[bɪ.lɪədz]	[bin.lîat]
bisexual	[baɪ.sɛk.ʃu.əɬ]	[baj.sék.cʰûan]
bismuth	[bɪz.məθ]	[bít.mát]
blacklist	[blæk.lɪst]	[blék.lít]
blackmail	[blæk.meɪɬ]	[blék.meː]
block	[blɒk]	[blɔ́k]
blog	[blɒg]	[blɔ́k]
blogger	[blɒ.gə]	[blɔ́k.kɤ̂ː]
blond	[blɒnd]	[blɔn]
Bluetooth	[bluː.tʰuːθ]	[bluː.tʰúːt]
bluff	[blʌf]	[bláp]
blur	[blɜː]	[blɤː]
board	[bɔːd]	[bɔ̀ːt]
boat	[bəʊt]	[bóːt]
bob	[bɒb]	[bɔ́p]
bodyguard	[bɒ.di.gɑːd]	[bɔː.dîː.kàːt]
bogie	[bəʊ.gi]	[boː.kîː]
bonus	[bəʊ.nəs]	[boː.nát]
booking	[bʊk.ɪŋ]	[búk.kîŋ]
boom	[buːm]	[buːm]
boot	[buːt]	[búːt]
booth	[buːθ]	[búːt]
boron	[bɔː..ɹɒn]	[boː.rɔ̂n]
boss	[bɒs]	[bɔ́ːt]
Botox	[bəʊ.tʰɒks]	[boː.tʰɔ̀k]
bow	[bəu]	[boː]
bowling	[bəʊ.lɪŋ]	[boː.lîŋ]
boxers	[bɒk.səz]	[bɔ́k.sɤ̂ː]
boy band	[bɔɪ.bænd]	[bɔːj.bæːn]
boycott	[bɔɪ.kʰɒt]	[bɔːj.kɔ̀ːt]

brake	[bɹeɪk]	[brè:k]
brand	[bɹænd]	[bræ:n]
brandy	[bɹæn.di]	[ba.ràn.di:]
break	[bɹeɪk]	[brè:k]
brochure	[bɹəʊ.ʃə]	[bro:.c^{h}u:a]
broker	[bɹəʊ.kə]	[bró:k.kɤ̂:]
bromine	[bɹəʊ.mi:n]	[bro:.mi:n]
bronze	[bɹɒnz]	[brɔ́n]
browser	[bɹaʊ.zə]	[bráw.sɤ̂:]
built	[bɪɬt]	[bíw]
bungalow	[bʌŋ.gə.ləʊ]	[baŋ.kàʔ.lo:]
bungee jump	[bʌn.dʒi dʒʌm]	[ban.cî:.cám]
burette	[bjʊ.ɹɛt]	[biw.rè:t]
bus	[bʌs]	[bát]
bye	[baɪ]	[ba:j]
cabaret	[k^{h}æ.bə.ɹeɪ]	[k^{h}a:.ba:.rê:]
cable	[k^{h}eɪ.bl̩]	[k^{h}e:.bɤ̂n]
caddie/caddy	[k^{h}æ.di]	[k^{h}áet.dî:]
cadmium	[k^{h}æd.mi.əm]	[k^{h}áet.mîam]
cake	[k^{h}eɪk]	[k^{h}é:k]
calcium	[k^{h}æɬ.si.əm]	[k^{h}æn.sîam]
calculus	[k^{h}æɬ.kjə.ləs]	[k^{h}æn.k^{h}u:.lát]
calorie	[k^{h}æ.lə.ɹi]	[k^{h}æ:.lɔ:.rî:]
camp	[k^{h}æmp]	[k^{h}ám]
campaign	[k^{h}æm.p^{h}eɪn]	[k^{h}æm.pe:n]
cancel	[k^{h}æn.sl̩]	[k^{h}æn.sɤ̂n]
cap	[k^{h}æp]	[káep]
capsule	[k^{h}æp.sju:ɬ]	[k^{h}áep.su:n]
captain	[k^{h}æp.tɪn]	[káp.tan]
caption	[k^{h}æp.ʃn̩]	[k^{h}áep.c^{h}ân]
capture	[k^{h}æp.tʃə]	[k^{h}áep.cɤ̂:]
car bomb	[k^{h}ɑ:.bɒm]	[k^{h}a:.bɔm]
caramel	[k^{h}æ.ɹə.meɬ]	[k^{h}a:.ra:.mew]
carat	[k^{h}æ.ɹət]	[kaʔ.rát]

caravan	[kʰæ.ɹə.væn]	[kʰa:.ra:.wa:n]
carbolic	[kʰɑ:.bɒ.lɪk]	[kʰa:.bɔ:.lȉk]
carbon	[kʰɑ:.bən]	[kʰa:.bɔ̂n]
carbonate	[kʰɑ:.bə.neɪt]	[kʰa:.bɔ:.nè:t]
card	[kʰɑ:d]	[ká:t]
care	[kʰɛə]	[kʰæ:]
carrot	[kʰæ.ɹət]	[kʰæ:.rɔ̀t]
cartoon	[kʰɑ:.tʰu:n]	[ka:.tu:n]
case	[kʰeɪs]	[kʰé:t]
cash	[kʰæʃ]	[kʰǽ:t]
cashier	[kʰæ.ʃɪə]	[kʰǽt.cʰia]
cast	[kʰɑ:st]	[kʰǽ:t]
catalogue	[kʰæ.tə.ɒg]	[kʰǽt.ta:.lɔ́k]
Catholic	[kʰæ.θə.lɪk]	[kʰa:.tʰɔ:.lȉk]
catwalk	[kʰæt.wɔ:k]	[kʰǽt.wɔ́:k]
Caucasoid	[kʰɔ:.kə.sɔɪd]	[kʰɔ:.kʰe:.sɔ:j]
CD	[si:.di:]	[si:.di:]
celeb	[sə.lɛb]	[se:.lép]
cell	[sɛɬ]	[sew]
celluloid	[sɛ.ljə.lɔɪd]	[sew.lu:.lɔ:j]
cellulose	[sɛ.ljə.ləʊs]	[sew.lu:.lɔ́:t]
Celsius	[sɛɬ.si.əs]	[sew.sîat]
cement	[sɪ.mɛnt]	[si:.men]
censor	[sɛn.sə]	[sen.sɤ̂:]
centre	[sɛn.tə]	[sen.tɤ̂:]
CEO	[si:.i:.əʊ]	[si:.ʔi:.ʔo]
ceramics	[sə.ɹæ. mɪks]	[se:.ra:.mìk]
cereal	[sɪə.ɹi.əɬ]	[si:.rîaw]
cerium	[sɪə.ɹi.əm]	[si:.rîam]
cesium	[si:.zi.əm]	[si:.sîam]
chalk	[ʧɔ:k]	[cʰɔ́k]
champ	[ʧæmp]	[cʰǽm]
champagne	[ʃæm.pʰeɪn]	[cʰæm.pe:n]
charge	[ʧɑ:dʒ]	[cʰá:t]

chart	[tʃɑːt]	[cʰáːt]
chassis	[ʃæ.si]	[cʰǽt.siː]
chat	[tʃæt]	[cʰǽt]
check	[tʃek]	[cʰék]
cheer	[tʃɪə]	[cʰia]
cheerleader	[tʃɪə.liː.də]	[cʰia.liː.dɤː]
cheese	[tʃiːz]	[cʰíːt]
chef	[tʃef]	[cʰéːp]
cheque	[tʃek]	[cʰék]
cherry	[tʃe.ɹi]	[cʰɤː.rîː]
chic	[tʃɪk]	[cʰík]
chill	[tʃɪɬ]	[cʰiw]
chimpanzee	[tʃɪm.pæn.ziː]	[cʰim.pæn.siː]
chip	[tʃɪp]	[cʰíp]
chlorine	[kʰɔː.ɹiːn]	[kʰlɔː.riːn]
chloroform	[kʰlɒ.ɹə.fɔːm]	[kʰlɔː.roː.fɔːm]
chlorophyll	[kʰlɒ.ɹə.fiɬ]	[kʰlɔː.roː.fiw]
chocolate	[tʃɒ.kʰlət]	[cʰɔ́k.koː.lǽt]
choice	[tʃɔɪs]	[cʰɔ́j]
chord	[kʰɔːd]	[kʰɔ̀ːt]
chorus	[kʰɔː.ɹəs]	[kʰɔː.rát]
Christian	[kʰɹɪs.ʃən]	[kʰrít.tian]
Christmas	[kʰɹɪs.məs]	[kʰrít.mát]
chromium	[kʰɹəʊ.mi.əm]	[kʰroː.mîam]
chromosome	[kʰɹəʊ.mə.səʊm]	[kʰroː.moː.soːm]
cigar	[sɪ.gɑː]	[sɪ́ʔ.kâː]
cinnamic	[sə.næ.mɪk]	[sin.naː.mìk]
claim	[kʰleɪm]	[kʰleːm]
class	[kʰlɑːs]	[kʰláːt]
classic	[kʰlæ.sɪk]	[kʰláːt.sìk]
clear	[kʰlɪə]	[kʰlia]
click	[kʰlɪk]	[kʰlík]
clinic	[kʰlɪ.nɪk]	[kʰliː.nìk]
clip	[kʰlɪp]	[kʰlíp]

club	[kʰlʌb]	[kʰlàp]
clutch	[kʰlʌtʃ]	[kʰlát]
coach	[kʰəʊtʃ]	[kʰóːt]
coat	[kʰəʊt]	[kʰóːt]
cobalt	[kʰəʊ.bɒɬt]	[kʰoː.bɔ́n]
cocaine	[kʰəʊ.kʰeɪn]	[kʰoː.kʰeːn]
coccus	[kʰɒ.kəs]	[kʰɔ́k.kát]
cocktail	[kʰɒk.tʰeɪɬ]	[kʰɔ́k.tʰeːw]
cocoa	[kʰəʊ.kʰəʊ]	[koː.kôː]
cod	[kʰɒd]	[kʰɔ́d]
code	[kʰəʊd]	[kʰóːt]
coffee shop	[kʰɒ.fi ʃɒp]	[kʰɔp.fîː.cʰɔp]
coil	[kʰɔɪɬ]	[kʰɔːj]
Coke	[kʰəʊk]	[kʰóːk]
collagen	[kʰɒ.lə.dʒən]	[kʰɔn.laː.cên]
collection	[kə.lɛk.ʃn̩]	[kʰɔn.lék.cʰân]
column	[kʰɒ.ləm]	[kʰɔː.lâm]
columnist	[kʰɒ.ləm.nɪst]	[kʰɔː.lâm.nít]
comedy	[kʰɒ.mə.di]	[kʰɔm.meː.dîː]
commando	[kə.mɑːn.dəʊ]	[kʰɔm.maːn.doː]
comment	[kʰɒ.mɛnt]	[kʰɔm.mén]
commission	[kə.mɪ.ʃn̩]	[kʰɔm.mít.cʰân]
communist	[kʰɒ.mju.nɪst]	[kʰɔm.miw.nít]
complain	[kəm.pʰleɪn]	[kʰɔm.pʰleːn]
computer	[kəm.pʰjuː.tə]	[kʰɔm.pʰíw.tɤ̂ː]
concept	[kʰɒn.sɛpt]	[kʰɔn.sèp]
concert	[kʰɒn.sət]	[kʰɔn.sɤ̀ːt]
concrete	[kʰɒŋ.kʰɹiːt]	[kʰɔn.krìːt]
condenser	[kən.dɛn.sə]	[kʰɔn.den.sɤ̂ː]
cone	[kʰəʊn]	[kʰoːn]
conference	[kʰɒn.fə.ɹəns]	[kʰɔn.fɤː.rén]
confirm	[kən.fɜːm]	[kʰɔn.fɤːm]
connection	[kə.nɛk.ʃn̩]	[kʰɔn.nék.cʰân]
contact lens	[kʰɒn.tʰækt lɛnz]	[kʰɔn.tʰæ̀k.len]

container	[kən.tʰeɪ.nə]	[kʰɔn.tʰeː.nɚː]
cookie	[kʰʊ.ki]	[kʰúk.kîː]
copy	[kʰɒ.pi]	[kɔ́p.pîː]
corruption	[kə.ɹʌp.ʃn̩]	[kʰɔː.ráp.cʰân]
costume	[kʰɒs.ʃuːm]	[kʰɔ́ːt.tuːm]
countdown	[kʰaʊnt.daʊn]	[kʰáw.daːw]
counter	[kʰaʊn.tə]	[kʰáw.tɚː]
course	[kʰɔːs]	[kʰɔ́ːt]
cowboy	[kʰaʊ.bɔɪ]	[kʰaːw.bɔːj]
cracker	[kʰɹæ.kə]	[kʰræk.kɚː]
cream	[kʰɹiːm]	[kʰriːm]
create	[kʰɹiː.eɪt]	[kʰriː.ʔèːt]
creative	[kʰɹiː.eɪ.tɪv]	[kʰriː.ʔeː.tʰìːp]
credit	[kʰɹɛ.dɪt]	[kʰreː.dìt]
credit card	[kʰɹɛ.dɪt kʰɑːd]	[kʰreː.dìt.káːt]
crystal	[kʰɹɪs.tl̩]	[kʰrít.tân]
cue	[kʰjuː]	[kʰiw]
cupid	[kʰjuː.pɪd]	[kʰiw.pìt]
cursor	[kʰɜː.sə]	[kʰɤː.sɚː]
custard	[kʰʌs.təd]	[kʰát.tàːt]
cut	[kʰʌt]	[kʰát]
cutout	[kʰʌt.aʊt]	[kʰát.ʔáw]
cutter	[kʰʌ.tə]	[kʰát.tɚː]
cyanide	[saɪə.naɪd]	[saj.jaː.náj]
cyber	[saɪ.bə]	[saj.bɚː]
cyclone	[saɪ. kʰloʊn]	[saj.kʰloːn]
dance	[dɑːns]	[dǽːn]
dancer	[dɑːn.sə]	[dǽːn.sɚː]
date	[deɪt]	[dèːt]
debate	[dɪ.beɪt]	[diː.bèːt]
debit	[dɛ.bɪt]	[deː.bìt]
decibel	[dɛ.sɪ.bɛɬ]	[deː.siʔ.bew]
degree	[dɪ.gɹiː]	[diː.kriː]
delay	[dɪ.leɪ]	[diː.leː]

delete	[dɪ.liːt]	[diː.líːt]
Denmark	[dɛn.mɑːk]	[den.màːk]
depression	[dɪ.pʰɹɛ.ʃn̩]	[diː.préːt.cʰân]
design	[dɪ.zaɪn]	[diː.saːj]
designer	[dɪ.zaɪ.nə]	[diː.saːj.nə̂ː]
detox	[diː.tʰɒk]	[diː.tɔk]
dextrose	[dɛk.stɹəʊs]	[dék.tʰróːt]
diary	[daɪə.ɹi]	[daj.ʔaː.rîː]
diesel	[diː.zl̩]	[diː.sew]
diet	[daɪ.ət]	[daj.ʔèt]
digital	[dɪ.dʒɪ.tl̩]	[diʔ.ciʔ.tə̂n]
dinner	[dɪ.nə]	[din.nə̂ː]
dinosaur	[daɪ.nə.sɔː]	[daj.noː.saw]
directrix	[dɪ.ɹɛk.tɹɪks]	[daj.rék.trìk]
disco	[dɪs.kəʊ]	[dít.sa.kôː]
discotheque	[dɪ.skə.tɛk]	[dít.sa.kôː.tʰèk]
discredit	[dɪs.kʰɹɛ.dɪt]	[dít.kʰreː.dìt]
DJ	[diː.dʒeɪ]	[diː.ceː]
DNA	[diː.ɛn.eɪ]	[diː.ʔen.ʔeː]
dollar	[dɒ.lə]	[dɔn.lâː]
dope	[dəʊp]	[dóːp]
doughnut	[dəʊ.nʌt]	[doː.nát]
download	[daʊn.ləʊd]	[daːw.lòːt]
draft	[dɹɑːft]	[dráːp]
drama	[dɹɑː.mə]	[draː.mâː]
drink	[dɹɪŋk]	[dríŋ]
drop	[dɹɒp]	[drɔ̀p]
Dutch	[dʌtʃ]	[dát]
duty-free	[djuː.ti fiiː]	[diw.tîː.friː]
DVD	[diː.viː.diː]	[diː.viː.diː]
dynamite	[daɪ.nə.maɪt]	[daj.naː.máj]
dynamo	[daɪ.nə.məʊ]	[daj.naː.moː]
dysprosium	[dɪs.pʰɹəʊ.ziː.əm]	[dít.pʰroː.sîam]
early retired	[ɜː.li]	[ʔɤː.lîː]

echo	[e.kʰəʊ]	[ʔék.kʰôː]
ecommerce	[iː.kʰɒ.mɜːs]	[ʔiː.kʰɔm.mɤ́ːt]
effect	[ɪ.fɛkt]	[ʔép.fèk]
ego	[iː.gəʊ]	[ʔiː.kôː]
Egypt	[iː.dʒɪpt]	[ʔiː.jìp]
electron	[ɪ.lɛk.tɹɒn]	[ʔiʔ.lék.trɔn]
email	[iː.meɪɬ]	[ʔiː.meːw]
embryo	[ɛm.bɹɪ.əʊ]	[ʔem.briʔ.ʔôː]
emulsion	[ɪ.mʌɬ.ʃn̩]	[ʔiʔ.maw.cʰân]
entrance	[ɛn.tɹəns]	[ʔen.tʰráːn]
enzyme	[ɛn.zaɪm]	[ʔen.saːj]
EQ	[iː.kʰjuː]	[ʔiː.kʰiw]
erbium	[ɜː.biˌəm]	[ʔɤː.bîam]
ether	[iː.θə]	[ʔiː.tʰɤ̂ː]
Euro	[jʊə.ɹəʊ]	[juː.roː]
Europe	[jʊə.ɹəp]	[júʔ.ròːp]
europium	[jʊ.ɹəʊ.piˌəm]	[juː.roː.pʰîam]
event	[ɪ.vɛnt]	[ʔiː.wén]
export	[ɪk.spɔːt]	[ék.sa.pɔ̀ːt]
eye shadow	[aɪ ʃæ.dəʊ]	[ʔaːj.cʰæː.dôː]
eye-liner	[aɪ laɪ.nə]	[ʔaːj.laj.mɤ̂ː]
Facebook	[feɪs.bʊk]	[fɛ́ː.bùk]
fair	[fɛə]	[fæː]
fake	[feɪk]	[fɛ́ːk]
fan	[fæn]	[fæːn]
fan club	[fæn.kʰlʌb]	[fæːn.kʰlàp]
fancy	[fæn.si]	[fæn.siː]
fantasy	[fæn.tə.si]	[fæn.taː.siː]
farm	[fɑːm]	[faːm]
fascist	[fæ.ʃɪst]	[fǎː.sít]
fashion	[fæ.ʃn̩]	[fæː.cʰân]
fast-food	[fɑːst.fuːd]	[fǎː.fúː.t]
fax	[fæks]	[fæ̀k]
feedback	[fiːd.bæk]	[fiːt.bæ̀k]

feeling	[fiː.lɪŋ]	[fiːn.lîŋ]
fermium	[fɜː.miː.əm]	[fɤː.mîam]
fern	[fɜːn]	[fɤːn]
fever	[fiː.və]	[fiː.wɤ̂ː]
fiber	[faɪ.bə]	[faj.bɤ̂ː]
file	[faɪɬ]	[faːj]
filler	[fɪ.lə]	[fin.lɤ̂ː]
film	[fɪɬm]	[fiːm]
final	[faɪ.nl̩]	[faj.nɔ̂n]
fit	[fɪt]	[fít]
fitness	[fɪt.nəs]	[fít.nèt]
flash	[flæʃ]	[flæ̀t]
flash drive	[flæʃ.dɹaɪv]	[flǽt.dráj]
flat	[flæt]	[flæ̀t]
flax	[flæks]	[flæ̀k]
floor	[flɔː]	[flɔː]
flowchart	[fləʊ.tʃɑːt]	[floː.cʰáːt]
fluke	[fluːk]	[flúk]
fluoride	[flʊə.ɹaɪd]	[fluː.ʔɔː.raːj]
fluorine	[flʊə.ɹiːn]	[fluː.ʔɔː.riːn]
foam	[fəʊm]	[foːm]
focus	[fəʊ.kəs]	[foː.kát]
font	[fɒnt]	[fɔ́n]
foolscap	[fuːɬ.skæp]	[fun.sa.kǽp]
foot	[fʊt]	[fút]
football	[fʊt.bɔːɬ]	[fút.bɔn]
footnote	[fʊt.nəʊt]	[fút.nóːt]
footpath	[fʊt.pʰɑːt]	[fút.bàːt]
footwork	[fʊt.wɜːk]	[fút.wɤ́ːk]
foreman	[fɔː.mən]	[foː.mæːn]
form	[fɔːm]	[fɔːm]
formalin	[fɔː.mə.lɪn]	[fɔː.maː.lin]
fossil	[fɒ.sl̩]	[fɔ́ːt.sîw]
foul	[faʊɬ]	[faːw]

frame	[fɹeɪm]	[fre:m]
franchise	[fɹæn.tʃaɪz]	[fræn.c^{h}a:j]
francium	[fɹæn.si.əm]	[fræn.siam]
free	[fɹi:]	[fri:]
freestyle	[fɹi:.staɪɬ]	[fri:.sa.ta:j]
freezer	[fɹi:.zə]	[fɾí:t.sɤ̂:]
French fries	[fɹentʃ.fɹaɪz]	[frén.fra:j]
friend	[fɹɛnd]	[fre:n]
fructose	[fɹʌk.t^{h}əʊs]	[frák.t^{h}ó:t]
function	[fʌŋ.ʃn̩]	[faŋ.c^{h}ân]
furniture	[fɜ:.nɪ.tʃə]	[fɤ:.niʔ.cɤ̂:]
fuse	[fju:z]	[fiw]
gag	[gæg]	[kǽk]
gala	[gɑ:.lə]	[ka:.la:]
galactose	[gə.læk.təʊs]	[ka:.lǽk.t^{h}ó:t]
galaxy	[gæ.lək.si]	[ka:.lǽk.sî:]
gallium	[gæ.li.əm]	[kæn.l̂iam]
gallon	[gæ.lən]	[kæn.lɔn]
game	[geɪm]	[ke:m]
gang	[gæŋk]	[kǽŋ]
gap	[gæp]	[kǽp]
gas	[gæs]	[gá:t], [gǽ:t]
gasohol	[gæ.sə.hɒɬ]	[kǽ:t.so:.hɔ:]
gauze	[gɔ:z]	[kɔ́:t]
gay	[geɪ]	[ke:]
gear	[gɪə]	[kia]
gel	[dʒeɬ]	[jew], [cew]
germanium	[dʒɜ:.meɪ.ni.əm]	[cɤ:.me:.nîam]
get	[gɛt]	[két]
glucose	[glu:.k^{h}əʊs]	[klu:.k^{h}ó:t]
goal	[gəʊɬ]	[ko:]
golf	[gɒɬf]	[kɔ́p]
Google	[gu:.gɬ]	[ku:.kɤ̂n]
gorilla	[gə.ɹɪ.lə]	[kɔ:.rin.lâ:]

gossip	[gɒ.sɪp]	[kɔ́t.síp]
gout	[gaʊt]	[káw]
grade	[gɹeɪd]	[krè:t]
grain	[gɹeɪn]	[kre:n]
granite	[gɹæ.nɪt]	[kræ:.nìt]
graph	[gɹɑ:f]	[krá:p]
graphite	[gɹæ.faɪt]	[kræ:.fáj]
group	[gɹu:p]	[krúp]
G-string	[dʒi:.stɹɪŋ]	[ci:.sa.triŋ]
guarantee	[gæ.ɹən.ti:]	[ka:.ran.ti:]
guard	[gɑ:d]	[ká:t]
guesthouse	[gɛst.haʊs]	[ké:t.háw]
guide	[gaɪd]	[káj]
guideline	[gaɪd.laɪn]	[káj.la:j]
guitar	[gɪ.tʰɑ:]	[ki:.tâ:]
gym	[dʒɪm]	[jim]
gymnastic	[dʒɪm.næs.tɪk]	[jim.ná:t.tìk]
gypsum	[dʒɪp.səm]	[jíp.sâm]
gypsy/gipsy	[dʒɪp.si]	[jíp.si:]
hacker	[hæ.kə]	[hǽk.kɤ̂:]
hafnium	[hæf.ni.əm]	[hǽp.nîam]
hahnium	[hɑ:.ni.əm]	[ha:.nîam]
ham	[hæm]	[hæm]
hamburger	[hæm.bɜ:.gə]	[hæm.bɤ:.kɤ̂:]
handball	[hænd.bɔ:ɬ]	[hæ:n.bɔn]
hand-made	[hænd.meɪd]	[hæ:n.me:d]
happy	[hæ.pʰi]	[hǽp.pî:]
harem	[hɑ:..ɹi:m]	[ha:.rem]
hashtag	[hæʃ.tʰæg]	[hǽt.tæ̀k]
heater	[hi:.tʰə]	[hi:t.tɤ̂:]
hectare	[hɛk.tʰɛə], [-tʰɑ:]	[hek.ta:]
helium	[hi:.li.əm]	[hi:.lîam]
hero	[hɪə.ɹəʊ]	[hi:.rô:]
heroin	[hɛ..ɹəʊ.ɪn]	[he:.ro:.ʔi:n]

hertz	[hɜːts]	[hɤ́ːt]
hi-fi	[haɪ.faɪ]	[haj.fâːj]
highlight	[haɪ.laɪt]	[haj.láj]
high-tech	[haɪ.tʰɛk]	[haj.tʰèk]
hipster	[hɪp.stə]	[híp.sa.tɤ̂ː]
hit	[hɪt]	[hít]
hockey	[hɒ.ki]	[hɔ́k.kîː]
holiday	[hɒ.lə.deɪ]	[hɔː.liʔ.deː]
Hollywood	[hɒ.li.wʊd]	[hɔː.liː.wuːt]
holmium	[həʊɬ.mi.əm]	[hoːn.mîam]
home made	[həʊm.meɪd]	[hoːm.mèːd]
homestay	[həʊm.steɪ]	[hoːm.sa.teː]
honeymoon	[hʌ.ni.muːn]	[han.niː.muːn]
hook	[hʊk]	[húk]
hormone	[hɔː.məʊn]	[hɔː.moːn]
hot	[hɒt]	[hɔ́t]
hotdog	[hɒt.dɒg]	[hɔ́t.dɔ̀k]
hotel	[həʊ.tʰɛɬ]	[hoː.ten]
hurricane	[hʌ.ɹɪ.kən]	[hɤː.riʔ.kʰeːn]
hurt	[hɜːt]	[hɤ́ːt]
hydra	[haɪ.dɹə]	[haj.drâː]
hydrogen	[haɪ.dɹə.dʒən]	[haj.droː.cên]
hysteria	[hɪ.stɪə.ɹi.ə]	[hít.tʰiː.ria]
ice-cream	[aɪs.kʰɹiːm]	[ʔaj.sa.kʰriːm]
icon	[aɪ.kʰɒn]	[ʔaj.kʰɔ̂n]
idea	[aɪ.dɪə]	[ʔaj.dia]
idiot	[ɪ.di.ət]	[ʔiː.dìat]
idol	[aɪ.dɬ]	[ʔaj.dɔ́n]
image	[ɪ.mɪdʒ]	[ʔim.mèːt]
Imperial	[ɪm.pʰɪə.ɹi.əɬ]	[ʔim.pʰiː.rîaw]
import	[ɪm.pʰɔːt]	[ʔim.pʰɔːt]
indie	[ɪn.di]	[ʔin.dîː]
infrared	[ɪn.fɪə.ɹɛd]	[ʔin.fraː.rèːt]
innocent	[ɪ.nə.sənt]	[ʔin.noː.sén]

insulin	[ɪn.sjə.lɪn]	[ʔin.su:.lin]
intensive	[ɪn.tʰɛn.sɪv]	[ʔin.tʰen.sì:p]
internet	[ɪn.tə.nɛt]	[ʔin.tɤ:.nèt]
iodine	[aɪ.ə.di:n]	[ʔaj.ʔo:.di:n]
ion	[aɪ.ən], [-ɒn]	[ʔaj.ʔôn]
iPad	[aɪ.pʰæd]	[ʔaj.pʰæ̀t]
IQ	[aɪ.kʰju:]	[ʔaj.kʰiw]
iridium	[ɪ.ɪɪ.di.əm]	[ʔiʔ.riʔ.dîam]
isotope	[aɪ.sə.tʰəʊp]	[ʔaj.so:.tʰò:p]
item	[aɪ.təm]	[ʔaj.tʰêm]
jab	[ʤæb]	[jǽp]
jacket	[ʤæ.kɪt]	[cǽk.két]
jackpot	[ʤæk.pʰɒt]	[cǽk.pʰò̞t]
jam (food)	[ʤæm]	[jæ:m]
jam (music)	[ʤæm]	[cæ:m]
jazz	[ʤæz]	[cǽ:t]
jeans	[ʤi:nz]	[ji:n]
jeep	[ʤi:p]	[cí:p]
jelly	[ʤɛ.li]	[jen.lî:]
Jesus	[ʤi:.zəs]	[je:.su:]
jet	[ʤɛt]	[cét]
jet ski	[ʤɛt.ski:]	[cét.sa.ki:]
job	[ʤɒb]	[cɔ́p]
jockey	[ʤɒ.ki]	[cɔ́k.kî:]
join	[ʤɔɪn]	[cɔ:j]
joke	[ʤəʊk]	[có:k]
jumbo	[ʤʌm.bəʊ]	[cam.bô:]
jumpsuit	[ʤʌmp.su:t]	[cám.sù:t]
junk food	[ʤʌŋk.fu:d]	[cáŋ.fŭ:t]
key	[kʰi:]	[kʰi:]
keyboard	[kʰi:.bɔ:d]	[kʰi:.bɔ̀:t]
keycard	[kʰi:. kʰɑ:d]	[kʰi:.ká:t]
keyword	[kʰi:.wɜ:d]	[kʰi:.wɤ̀:t]
kiwi	[kʰi:.wi:]	[ki:.wî:]

knitting	[nɪ.tɪŋ]	[nít.tîŋ]
knock	[nɒk]	[nɔ́k]
knock-down	[nɒk.daʊn]	[nɔ́k.da:w]
knot	[nɒt]	[nɔ́t]
lab	[læb]	[læ̀p]
lacquer	[læ.kə]	[lék.kɤ̂:]
lactose	[læk.tʰəʊs]	[lék.tʰô:t]
lane	[leɪn]	[le:n]
lanthanum	[læn.θə.nəm]	[læn.tʰa:.nâm]
laptop	[læp.tʰɒp]	[læ̀p.tʰɔ́p]
laser	[leɪ.sə]	[le:.sɤ̂:]
late	[leɪt]	[lè:t]
latitude	[læ.tɪ.ʧu:d]	[lá?.tɨ?.cù:t]
lava	[lɑ:.və]	[la:.wa:]
lavender	[læ.vɪn.də]	[la:.wen.dɤ̂:]
lawrencium	[lɒ..ɹɛn.si.əm]	[lɔ:.ren.sîam]
leader	[li:d.ə]	[lì:t.dɤ̂:]
lecture	[lɛk.ʧə]	[lék.cʰɤ̂:]
leggings	[lɛ.gɪŋz]	[lé:k.kîŋ]
lesbian	[lɛz.bi.ən]	[lé:t.bîan]
lifestyle	[laɪf.staɪɬ]	[láj.sa.ta:j]
lift	[lɪft]	[líp]
lignite	[lɪg.naɪt]	[lík.náj]
linen	[lɪ.nɪn]	[lí?.nin]
link	[lɪŋk]	[líŋ]
lip gloss	[lɪp.glɒs]	[líp.klɔ́:t]
lipstick	[lɪp.stɪk]	[líp.sa.tɨ̀k]
lip-synch	[lɪp.sɪŋk]	[líp.síŋ]
list	[lɪst]	[lít]
lithium	[lɪ.θi.əm]	[lí?.tʰîam]
litmus	[lɪt.məs]	[lít.mát]
lobby	[lɒ.bi]	[lɔ́b.bî:]
location	[ləʊ.kʰeɪ.ʃn̩]	[lo:.kʰe:.cʰân]
lock	[lɒk]	[lɔ́k]

locker	[lɒ.kə]	[lɔ́k.kɤ̂ː]
locket	[lɒ.kɪt]	[lɔ́k.két]
logo	[ləʊ.gəʊ]	[loː.kôː]
longitude	[lɒŋ.dʒɪ.tʃuːd]	[lɔːŋ.ciʔ.cùːt]
look(appearance)	[lʊk]	[lúk]
lotion	[ləʊ.ʃn̩]	[loː.cʰán]
lottery	[lɒ.tə.ɹi]	[lɔ́t.tɤː.rîː]
lotus	[ləʊ.təs]	[loː.tát]
love scene	[lʌv.siːn]	[lɤ́ːp.siːn]
lutetium	[luː.tʰiː.ʃi.əm]	[luː.tʰiː.cʰîam]
mafia	[mæ.fi.ə]	[maː.fia]
magazine	[mæ.gə.ziːn]	[mék.kaː.siːn]
magnesium	[mæg.niː.zi.əm]	[mék.niː.sîam]
mail	[meɪɬ]	[meːw]
mailbox	[meɪɬ.bɒks]	[meːw.bɔ́k]
make-ʊp	[meɪk.ʌp]	[méːk.ʔáp]
malaria	[mə.lɛə.ɹi.ə]	[maː.laː.ria]
maltose	[mɔːɬ.tʰəʊz]	[mɔːn.tʰóːt]
manganese	[mæŋ.gə.niːz]	[mæŋ.kaː.níːt]
manganin	[mæŋ.gə.nɪn]	[mæŋ.kaː.nin]
mansion	[mæn.ʃn̩]	[mæːn.cʰân]
marathon	[mæ.ɹə.θən]	[maː.raː.tʰɔn]
marketing	[mɑː.kɪ.tɪŋ]	[maː.két.tîŋ]
mascara	[ma.skɑː.ɹə]	[máːt.kʰaː.râː]
match	[mætʃ]	[mæ̀t]
meeting	[miː.tʰɪŋ]	[míːt.tîŋ]
megahertz	[mɛ.gə.hɜːts]	[mék.kàʔ.hɤ́ːt]
member	[mɛm.bə]	[mem.bɤ̂ː]
menthol	[mɛn.θɒɬ]	[men.tʰôn]
menu	[mɛ.njuː]	[meː.nuː]
meridian	[mə.ɹɪ.di.ən]	[meː.ríʔ.dîan]
message	[mɛ.sɪdʒ]	[mét.sèːt]
messenger	[mɛ.sɪn.dʒə]	[mét.sen.cɤ̂ː]
meter	[miː.tə]	[míʔ.tɤ̂ː]

methane	[miː.θeɪn]	[miː.tʰeːn]
methanol	[mɛ.θə.mɒɬ]	[mét.tʰaː.nɔ̂n]
metric ton	[mɛ.tɪɪk.tʌn]	[mét.trɨ̀k.tan]
microchip	[maɪ.kʰɹəʊ.tʃɪp]	[maj.kʰroː.cʰíp]
microfilm	[maɪ.kʰɹəʊ.fiɬm]	[maj.kʰroː.fiːm]
microphone	[maɪ.kɹə.fəʊn]	[maj.kʰroː.foːn]
microwave	[maɪ.kɹə.weɪv]	[maj.kʰroː.wéːp]
mile	[maiɬ]	[maːj]
milkshake	[mɪɬk.ʃeɪk]	[míw.cʰéːk]
millibar	[mɪ.lɪ.bɑː]	[min.líʔ.baː]
minibus	[mɪ.nɪ.bʌs]	[míʔ.níʔ.bát]
mix	[mɪks]	[mík]
mob	[mɒb]	[mɔ́p]
model	[mɒ.dɬ]	[moː.dew]
modern	[mɒ.dən]	[moː.dɤ̂n]
molecule	[mɒ.lɪ.kʰjuːɬ]	[moː.leː.kun]
moment	[məʊ.mənt]	[moː.mén]
Mongolia	[mɒŋ.gəʊ.li.ə]	[mɔŋ.koː.lia]
Mongoloid(Am)	[mɒŋ.gə.lɔɪd]	[mɔŋ.koː.lɔːj]
mop	[mɒp]	[mɔ́p]
morphine	[mɔː.fiːn]	[mɔː.fiːn]
moss	[mɒs]	[mɔ́ːt]
motor	[məʊ.tə]	[mɔː.tɤ̂ː]
motorway	[məʊ.tə.weɪ]	[mɔː.tɤ̂ː.weː]
mouse	[maʊs]	[máw]
mouth	[maʊθ]	[máw]
mummy	[mʌ.mi]	[mam.mîː]
music	[mjuː.zɪk]	[miw.sɨ̀k]
mustard	[mʌ.stəd]	[mát.tàːt]
nebula	[nɛ.bjə.lə]	[neː.biw.lâː]
necktie	[nɛk.tʰaɪ]	[nék.tʰáj]
neon	[niː.ɒn]	[niː.ʔɔːn]
Neptune	[nɛp.tʃuːn]	[nép.cuːn]
netball	[nɛt.bɔːɬ]	[nét.bɔn]

neutron	[nju:.tʰɹɒn]	[niw.trɔn]
NGO	[ɛn.dʒi:.əʊ]	[ʔen.ci:.ʔo:]
nicotine	[nɪ.kə.tʰi:n]	[níʔ.kʰo:.tin]
nightclub	[naɪt.kʰlʌb]	[náj.kʰlàp]
niobium	[naɪ.əʊ.bi.əm]	[naj.ʔo:.bîam]
nitrogen	[naɪ.tɹə.dʒən]	[naj.tro:.cên]
nobelium	[nəʊ.bi:.li.əm]	[no:.be:.lîam]
nominee	[mɒ.mɪ.ni:]	[nɔ:.míʔ.ni:]
note	[nəʊt]	[nó:t]
notebook	[nəʊt.bʊk]	[nó:t.búk]
notice	[nəʊ.tɪs]	[no:.tít]
nuclear	[nju:.kʰlɪə]	[niw.kʰlia]
nucleus	[nju:.kʰli.əs]	[niw.kʰlîat]
nude	[nju:d]	[nú:t]
number	[nʌm.bə]	[bɤ:]
nursery	[nɜ:.sə.ɹi]	[nɤ́:t.sɤ:.rî:]
nylon	[naɪ.lɒn]	[naj.lɔ̂n]
oak	[əʊk]	[ʔó:k]
oasis	[əʊ.eɪ.sɪs]	[ʔo:.ʔe:.sít]
oat	[əʊt]	[ʔó:t]
observe	[əb.sɜ:v]	[ʔɔ́p.sɤ̀:p]
office	[ɒ.fɪs]	[ɔ́p.fít]
offside	[ɒf.saɪd]	[ɔ́p.sáj]
okay	[əʊ.kʰeɪ]	[ʔo:.ke:]
Olympic	[ə.lɪm.pɪk]	[ʔo:.lim.pìk]
on-air	[ɒn.ɛə]	[ʔɔ:n.ʔæ:]
one-way	[wʌn.weɪ]	[wan.we:]
online	[ɒn.laɪn]	[ʔɔ:n.la:j]
order	[ɔ:.də]	[ʔɔ:.dɤ̂:]
osmium	[ɒz.mi.əm]	[ʔó:t.mîam]
ounce	[aʊns]	[ʔɔ:n]
over	[əʊ.və]	[ʔo:.wɤ̂:]
oxide	[ɒk.saɪd]	[ʔɔ́k.sa:j]
oxygen	[ɒk.sɪ.dʒən]	[ʔɔ́k.siʔ.cên]

ozone	[əʊ.zəʊn]	[ʔo:.so:n]
pack	[pʰæk]	[pʰæk]
package	[pʰæ.kɪdʒ]	[pʰék.kè:t]
palladium	[pə.leɪ.di.əm]	[pʰæn.le:.dîam]
palm	[pʰɑ:m]	[pa:m]
pancake	[pʰæn.kʰeɪk]	[pʰæ:n.kʰé:k]
panda	[pʰæn.də]	[pʰæn.dâ:]
paper	[pʰeɪ.pə]	[pe:.pɤ̂:]
parade	[pə.ɹeɪd]	[pʰa:.rè:t]
paraffin	[pʰæ.ɹə.fin]	[pʰa:.ra:.fin]
parasite	[pʰæ.ɹə.saɪt]	[paʔ.raʔ.sìt]
party	[pʰɑ:.ti]	[pa:.tî:]
passport	[pʰɑ:.spɔ:t]	[pʰá:t.sa.pɔ̀:t]
pattern	[pʰæ.tn̩]	[pʰét.tʰɤ̂n]
peppermint	[pʰɛ.pə. mɪnt]	[pép.pɤ̂:.mín]
Pepsi	[pʰep.si]	[pép.sî:]
percent	[pə.sɛnt]	[pɤ:.sen]
petroleum	[pə.tʰɹəʊ.li.əm]	[pìʔ.tro:.lîam]
phase	[feɪz]	[fè:t]
phone in	[fəʊn.ɪn]	[fo:n.ʔin]
phosphate	[fɒs.feɪt]	[fɔ́:t.fè:t]
phosphorus	[fɒs.fə.rəs]	[fɔ́:t.fɔ:.rát]
physics	[fɪ.sɪks]	[fíʔ.sìk]
piano	[pi.æ.nəʊ]	[pia.no:]
picnic	[pʰɪk.nɪk]	[pík.ník]
pie	[pʰaɪ]	[pʰa:j]
pixel	[pʰɪk.sl̩]	[pʰík.sêw]
pizza	[pʰi:t.sə]	[pít.sâ:]
plankton	[pʰlæŋk.tən]	[pʰlæŋ.tɔ̂n]
plaster	[pʰlɑ:.stə]	[plá:t.sa.tɤ̂:], [pʰlá:t-]
plastic	[pʰlæ.stɪk]	[pʰlá:t.sa.tìk]
platinum	[pʰlæ.tɪ.nəm]	[pʰlét.tʰiʔ.nâm]
playboy	[pʰleɪ.bɔɪ]	[pʰle:.bɔ:j]
plaza	[pʰlɑ:.zə]	[pʰla:.sâ:]

pleat	[pʰliːt]	[pʰlíːt]
plug	[pʰlʌg]	[plák]
plum	[pʰlʌm]	[pʰlam]
pluto	[pʰluː.tʰəʊ]	[pʰluː.toː]
plutonium	[pʰluː.tʰəʊ.niː.əm]	[pʰluː.toː.nîam], [-tʰoː-]
pocketbook	[pʰɒ.kɪt.bʊk]	[pʰɔ́k.két.búk]
poker	[pʰəʊ.kə]	[pôː.kɤ̂ː]
polio	[pʰəʊ.lɪ.əʊ]	[poː.líʔ.ʔoː]
poll	[pʰəʊɬ]	[pʰoː]
polo	[pʰəʊ.ləʊ]	[poː.loː]
polonium	[pə.ləʊ.niː.əm]	[pʰɔː.loː.nîam]
pop	[pʰɒp]	[pɔ́p]
Pope	[pʰəʊp]	[póːp]
poppy	[pʰɒ.piː]	[pɔ́p.pîː]
popular	[pʰɒ.pjə.lə]	[pɔ́p.puː.laː]
positron	[pʰɒ.zɪ.tɹɒn]	[pʰoː.sɨ̌ʔ.trɔn]
post	[pʰəʊst]	[pʰóːt]
postcard	[pʰəʊst.kʰɑːd]	[póːt.káːt]
poster	[pʰəʊ.stə]	[póːt.tɤ̂ː]
potassium	[pə.tʰæ.siː.əm]	[poː.tǽt.sîam], [pʰoː.tʰǽt.sîam]
pound	[pʰaʊnd]	[pɔːn]
power	[pʰaʊə]	[pʰaw.wɤ̌ː]
PowerPoint	[pʰaʊə.pʰɔɪt]	[pʰaw.wɤ̂ː.pʰɔ́j]
premium	[pʰɹiː.miː.əm]	[pʰriː.mîam]
pre-order	[pʰɹiː.ɔː.də]	[pʰriː.ʔɔː.dɤ̂ː]
present(v)	[prɪ.sɛnt]	[pʰriː.sén]
presenter	[pɹɪ.zɛn.tə]	[pʰriː.sen.tɤ̂ː]
pretty	[pʰɹɪ.ti]	[pʰrít.tîː]
pre-wedding	[pʰɹiː.wɛ.dɪŋ]	[pʰriː.wét.dîŋ]
printer	[pʰɹɪn.tə]	[prín.tɤ̂ː]
prism	[pʰɹɪ.zəm]	[priʔ.sûm]
producer	[pɹə.djuː.sə]	[proː.díw.sɤ̂ː]
profile	[pʰɹəʊ.faɪɬ]	[proː.faːj]

program	[pʰɹəʊ.gɹæm]	[proː.kræm]
project	[pʰɹɒ.dʒɛkt]	[proː.cèk]
promethium	[pɹə.miː.θi.əm]	[pʰroː.miː.tʰîam]
promote	[pɹə.məʊt]	[proː.mòːt]
promotion	[pɹə.məʊ.ʃn̩]	[proː.moː.cʰân]
proof	[pʰɹuːf]	[pruːp], [pʰruːp]
prop	[pʰɹɒp]	[pʰrɔ́p]
protein	[pʰɹəʊ.tʰiːn]	[proː.tiːn]
Protestant	[pʰɹɒ.tɪs.tənt]	[proː.téː.tɛ́n]
proton	[pʰɹəʊ.tʰɒn]	[proː.tɔn]
protractor	[pɹə.tʰɹæk.tə]	[proː.tʰrǽk.tɤ̂ː]
psycho	[saɪ.kʰəʊ]	[saj.kʰoː]
pub	[pʰʌb]	[pʰàp]
pudding	[pʰʊ.dɪŋ]	[pʰút.dîŋ]
pump	[pʰʌmp]	[pám]
punch	[pʰʌntʃ]	[pʰán]
pyramid	[pʰɪ.ɹə.mɪd]	[pɨʔ.raː.mít], [pʰiː.raʔ.mít]
queue	[kʰjuː]	[kʰiw]
quinine	[kʰwɪ.niːn]	[kʰwí.nin]
quiz	[kʰwɪz]	[kʰwít]
quota	[kʰwəʊ.tə]	[kʰoː.tâː]
racket	[ɹæ.kɪt]	[rǽk.kêt]
radar	[ɹeɪ.dɑː]	[reː.dâː]
radium	[ɹeɪ.di.əm]	[reː.dîam]
radon	[ɹeɪ.dɒn]	[reː.dɔ̂n]
RAM	[ɹæm]	[ræm]
rap	[ɹæp]	[rǽp]
rate	[ɹeɪt]	[rèːt]
rating	[ɹeɪ.tɪŋ]	[rèːt.tîŋ]
reader	[ɹiː.də]	[ríːt.dɤ̂ː]
reality	[ɹɪ.æ.lɪ.ti]	[riaw.líʔ.tîː]
ream	[ɹiːm]	[riːm]
reception	[ɹɪ.sɛp.ʃn̩]	[riː.sép.cʰân]
recycle	[ɹiː.saɪ.kl̩]	[riː.saj.kʰɤ̂n]

reduction	[ɹɪ.dʌk.ʃn̩]	[ri:.dák.c^{h}ân]
regent	[ɹi:.gənt]	[ri:.gén]
remote	[ɹɪ.məʊt]	[ri:.mò:t]
repair	[ɹɪ.p^{h}ɛə]	[ri:.p^{h}æ:]
replay	[ɹi:.p^{h}leɪ]	[ri:.p^{h}le:]
resort	[ɹɪ.zɔ:t]	[ri:.sɔ̀:t]
return	[ɹɪ.t^{h}ɜ:n]	[ri:.t^{h}ɤ:n]
review	[ɹɪ.vju:]	[ri:.wiw]
rhenium	[ɹi:.ni.əm]	[ri:.nîam]
rhodium	[ɹəʊ.di.əm]	[ro:.dîam]
ribbon	[ɹɪ.bən]	[ríp.bîn]
rifle	[ɹaɪ.fl̩]	[raj.fɤ̂n]
ringtone	[ɹɪŋ.t^{h}əʊn]	[riŋ.t^{h}o:n]
road map	[ɹəʊd.mæp]	[ró:t.mæ̀p]
road show	[ɹəʊd.ʃəʊ]	[ró:t.c^{h}o:]
rock(music)	[ɹɒk]	[rɔ́k]
Roman	[ɹəʊ.mən]	[ro:.man]
romantic	[ɹəʊ.mæn.tɪk]	[ro:.mæ:n.tì̀k]
roulette	[ɹu:.lɛt]	[ru:.lèt]
rubidium	[ɹʊ.bɪ.di.əm]	[ru:.bɨʔ.dîam]
rugby	[ɹʌg.bi]	[rák.bî:]
runway	[ɹʌn.weɪ]	[ran.we:]
ruthenium	[ɹʊ.θi:.ni.əm]	[ru:.t^{h}i:.nîam]
saccharin	[sæ.kə..ɪn]	[sǽk.k^{h}a:.rin]
sad	[sæd]	[sǽ:d]
sadist	[seɪ.dɪst]	[sa:.dì̀t]
safe	[seɪf]	[sé:p]
salad	[sæ.ləd]	[saʔ.làt]
sale	[seɪɬ]	[se:w]
salesman	[seɪɬz.mən]	[se:w.mæ:n]
salmon	[sæ.mən]	[sæw.mɔ̂n]
salon	[sæ.lɒn]	[sa:.lɔn]
salute	[sə.lu:t]	[saʔ.lù̀t]
sample	[sɑ:m.pl̩]	[sæm.pɤ̂n]

sandwich	[sænd.wɪtʃ]	[sæːn.wít]
sauce	[sɔːs]	[sɔ́ːt]
sauna	[sɔː.nə]	[saːw.nâː]
save	[seɪv]	[séːp]
sax	[sæks]	[sék]
saxophone	[sæk.sə.fəʊn]	[sék.soː.foːn]
scan	[skæn]	[sa.kæːn]
scandium	[skæn.di.əm]	[sa.kæːn.dîam]
scene	[siːn]	[siːn]
scoop	[skuːp]	[sa.kúːp]
screen	[skɹiːn]	[sa.kriːn]
screw	[skɹuː]	[sa.kruː]
script	[skɹɪpt]	[sa.kʰríp]
scrub	[skɹʌb]	[sa.kʰráp]
seafood	[siː.fuːd]	[siː.fűːt]
search	[sɜːtʃ]	[sɤ̀ːt]
see-through	[siː.θɹuː]	[siː.tʰruː]
selenium	[sɪ.liː.ni.əm]	[siː.liː.nîam]
selfie	[seɬ.fi]	[séw.fiː]
serge	[sɜːdʒ]	[sɤ̀ːt]
series	[sɪə.ɹiːz]	[siː.rîː]
serious	[sɪə.ɹi.əs]	[siː.rîat]
serum (medical)	[sɪə.ɹəm]	[seː.rûm]
serum (beauty product)	[sɪə.ɹəm]	[siː.râm]
serve	[sɜːv]	[sɤ̀ːp]
service	[sɜː.vɪs]	[sɤ̀ː.wɨ̀t]
set	[sɛt]	[sét]
sex	[sɛks]	[sék]
sexy	[sɛk.si]	[sék.sîː]
shade	[ʃeɪd]	[cʰèːt]
shake hands	[ʃeɪk.hændz]	[cʰéːk.hæːn]
shampoo	[ʃæm.pʰuː]	[cʰæm.pʰuː]
shape	[ʃeɪp]	[cʰéːp]

share	[ʃɛə]	[cʰæː]
sheet	[ʃiːt]	[cʰíːt]
shirt	[ʃɜːt]	[cʰɤ́ːt]
shock	[ʃɒk]	[cʰɔ́k]
shocking pink	[ʃɒk.ɪŋ pʰɪŋk]	[cʰɔ́k.kîŋ.pʰíŋ]
shoot	[ʃuːt]	[cʰúːt]
shopping	[ʃɒ.pʰɪŋ]	[cʰɔ́p.pîŋ]
short-circuit	[ʃɔːt-sɜː.kɪt]	[cʰɔ́t]
shot	[ʃɒt]	[cʰɔ̀t]
show	[ʃəʊ]	[cʰoː]
showroom	[ʃəʊ.ɹuːm]	[cʰoː.ruːm]
shutter	[ʃʌ.tʰə]	[cʰát.tɤ̂ː]
signal	[sɪg.nl̩]	[sík.næw]
silicon	[sɪ.lɪ.kən]	[siʔ.liʔ.kʰɔ̂n]
silicone	[sɪ.lɪ.kʰəʊn]	[siʔ.liʔ.kʰoːn]
silo	[saɪ.ləʊ]	[saj.loː]
sine	[saɪn]	[saːj]
single	[sɪŋ.gl̩]	[siŋ.kɤ̂n]
siren	[saɪ.ɹən]	[saj.reːn]
site	[saɪt]	[sáj]
six-pack	[sɪks.pʰæk]	[sík.pʰæ̀k]
size	[saɪz]	[sáj]
skate	[skeɪt]	[sa.két]
skateboard	[skeɪt.bɔːd]	[sa.kèt.bɔ̀ːt]
sketch	[skɛt]	[sa.két]
ski	[skiː]	[sa.kiː]
skunk	[skʌŋk]	[sa.káŋ]
slacks	[slæks]	[sa.lǽk]
slang	[slæŋ]	[sa.læːŋ]
slide	[slaɪd]	[sa.láj]
sling	[slɪŋ]	[sa.liŋ]
slip	[slɪp]	[sa.líp]
slogan	[sləʊ.gən]	[sa.loː.kæːn]
slum	[slʌm]	[sa.lam]

smart	[smɑːt]	[sa.máːt]
smart card	[smɑːt kʰɑːd]	[sa.máːt.káːt]
SME	[ɛs.ɛm.iː]	[ʔét.ʔem.ʔiː]
snooker	[snuː.kə]	[sa.núk.kɤ̂ː]
social	[səʊ.ʃl̩]	[soː.cʰîan]
soda	[səʊ.də]	[soː.daː]
sodium	[səʊ.diəm]	[soː.dîam]
sofa	[səʊ.fə]	[soː.faː]
soft	[sɒft]	[sɔ́ːp]
solar	[səʊ.lə]	[soː.lâː]
solo	[səʊ.ləʊ]	[soː.lôː]
soup	[suːp]	[súp]
spa	[spɑː]	[sa.paː]
spaghetti	[spə.gɛ.ti]	[sa.paː.két.tîː]
spare	[spɛə]	[sa.pæː]
spark	[spɑːk]	[sa.páːk]
spec	[spɛk]	[sa.pék]
spectrum	[spɛk.tɹəm]	[sa.pék.trâm]
speed	[spiːd]	[sa.pìːt]
sperm	[spɜːm]	[sa.pɤːm]
sphinx	[sfɪŋks]	[sa.fíŋ]
spirillum	[spaɪ.ɹɪ.ləm]	[sa.paj.rin.lâm]
spirit	[spɪ.ɹɪt]	[sa.pìʔ.rìt]
spoil	[spɔɪɬ]	[sa.pɔːj]
sponsor	[spɒn.sə]	[sa.pɔn.sɤ̂ː]
spore	[spɔː]	[sa.pɔː]
sport	[spɔːt]	[sa.pɔ̀ːt]
spot	[spɒt]	[sa.pɔ̀t]
spotlight	[spɒt.laɪt]	[sa.pɔ̀t.láj]
spray	[spɹeɪ]	[sa.preː]
spring	[spɹɪŋ]	[sa.priŋ]
springboard	[spɹɪŋ.bɔːd]	[sa.priŋ.bɔ̀ːt]
staff	[stɑːf]	[sa.táːp]
stainless	[steɪn.ləs]	[sa.tæːn.lèːt]

stamp (n)	[stæmp]	[sa.tæm]
stamp (v)	[stæmp]	[sa.tǽm]
steak	[steɪk]	[sa.ték]
stereo	[stɛ.ɹi.əʊ]	[sa.tɤ:.rí?.ʔo:]
steroid	[stɪə.ɹɔɪd]	[sa.tia.rɔ:j]
steward	[stju:.əd]	[sa.cúat]
sticker	[stɪ.kə]	[sa.tík.kɤ̂:]
stock	[stɒk]	[sa.tɔ́k]
strawberry	[stɹɔ:.bə.ɹi]	[sa.trɔ:.bɤ:.rî:]
strike	[stɹaɪk]	[sa.tráj]
strontium	[stɹɒn.tʰi.əm], [-ʃi.əm]	[sa.trɔn.cʰîam]
strychnine	[stɹɪk.ni:n]	[sa.trík.nin]
studio	[stu:.di.oʊ]	[sa.tu:.dí?.ʔo:]
stuntman	[stʌnt.mæn]	[sa.tán.mæ:n]
style	[staɪɬ]	[sa.ta:j]
sucrose	[su:.kʰɹəʊz]	[su:.kʰró:t]
suit	[su:t]	[sù:t]
sulpha	[sʌɬ.fə]	[san.fa:]
summer	[sʌ.mə]	[sam.mɤ̂:]
supply	[sə.pʰlaɪ]	[sáp.pʰa:j]
support	[sə.pʰɔ:t]	[sáp.pɔ̀:t]
sure	[ʃʊə]	[cʰua]
survey	[sɜ:.veɪ]	[sɤ:.we:]
sweater	[swɛ.tə]	[sa.wét.tɤ̂:]
sweet	[swi:t]	[sa.wì:t]
swing	[swɪŋ]	[sa.wiŋ]
switch	[swɪtʃ]	[sa.wít]
syphilis	[sɪ.fi.lɪs]	[sí?.fi?.lít]
tab	[tʰæb]	[tʰæ̀p]
tablet	[tʰæ.blət]	[tʰǽp.lèt]
tag	[tʰæg]	[tʰæ̀k]
take over	[tʰeɪk əʊ.və]	[tʰé:k.ʔo:.wɤ̂:]
tan	[tʰæn]	[tʰæ:n]
tangent	[tʰæn.dʒənt]	[tʰæ:n.cên]

tank	[tʰæŋk]	[tʰáŋ]
tantalum	[tʰæn.tə.ləm]	[tʰæn.tʰaː.lâm]
tape	[tʰeɪp]	[tʰéː.p]
tart	[tʰɑːt]	[tʰáː.t]
tattoo	[tə.tʰuː]	[tʰæt.tʰuː]
taxi	[tʰæk.si]	[tʰæk.sîː]
team	[tʰiːm]	[tʰiːm]
technetium	[tʰɛk.niː.ʃi.əm]	[tʰék.niː.cʰîam]
technique	[tʰɛk.niːk]	[tʰék.nìk]
teen	[tʰiːn]	[tʰiːn]
Teflon	[tʰɛ.flɒn]	[tʰéː.p.lɔ̂n]
tellurium	[tʰɛ.ljuə.ɹi.əm]	[tʰen.luː.rîam]
tennis	[tʰɛ.nɪs]	[tʰen.nít]
tent	[tʰɛnt]	[tént]
terbium	[tʰɜː.bi.əm]	[tʰɤː.bîam]
term	[tʰɜːm]	[tɤːm]
test	[tʰɛst]	[tʰéːt] / [tʰéːs]
thallium	[θæ.li.əm]	[tʰæn.lîam]
thorium	[θɔː.ɹi.əm]	[tʰɔː.rîam]
thyroid	[θaɪ.ɹɔɪd]	[tʰaj.rɔːj]
tincture	[tʰɪŋk.tʃə]	[tʰiŋ.cɤːr]
tip	[tʰɪp]	[tʰíp]
tissue	[tʰɪ.ʃuː]	[tʰít.cʰûː]
title	[tʰaɪ.tl̩]	[taj.tɕ̂n]
TNT	[tʰiː.ɛn.tʰiː]	[tʰiː.ʔen.tʰiː]
toffee	[tʰɒ.fi]	[tʰɔ́p.fîː]
tone	[tʰəʊn]	[tʰoːn]
tonsil	[tʰɒn.sl̩]	[tɔn.sin]
tornado	[tʰɔː.neɪ.dəʊ]	[tʰɔː.naː.doː]
torpedo	[tʰɔː.pʰiː.dəʊ]	[tɔː.pîʔ.doː]
tour	[tʰʊə]	[tʰua]
tractor	[tʰɹæk.tə]	[tʰráek.tɕ̂ː]
trading	[tʰɹeɪ.dɪŋ]	[tʰrèː.t.dîŋ]
train	[tʰɹeɪn]	[tʰreːn]

trainer	[tʰɹeɪ.nə]	[tʰre:n.nɤ̂:]
transistor	[tʰɹæn.zɪ.stə]	[tʰra:n.sít.tɤ̂:]
treatment	[tʰɹi:t.mənt]	[tʰrí:t.mén]
trend	[tʰɹɛnd]	[tʰren]
trip	[tʰɹɪp]	[tʰríp]
trombone	[tʰɹɒm.bəʊn]	[tʰrɔm.bo:n]
trumpet	[tʰɹʌm.pɪt]	[tʰram.pèt]
tulip	[tʰju:.lɪp]	[tʰiw.lȉp]
tuna	[tʰu:.nə]	[tʰu:.nâ:]
tune	[tʰju:n]	[cu:n]
turquoise	[tʰɜ:.kʰwɔɪz]	[tʰɤ:.kʰɔ́j]
tutor	[tʰju:.tə]	[tiw.tɤ̂:]
TV	[tʰi:.vi:]	[tʰi:.wi:]
typhoid	[tʰaɪ.fɔɪd]	[tʰaj.fɔ:j]
typhoon	[tʰaɪ.fu:n]	[táj.fûn]
uniform	[ju:.nɪ.fɔ:m]	[ju:.níʔ.fɔ:m]
unit	[ju:.nɪt]	[ju:.nìt]
unseen	[ʌn.si:n]	[ʔan.si:n]
update	[ʌp.deɪt]	[ʔáp.dè:t]
upgrade	[ʌp.gɹeɪd]	[ʔáp.krè:t]
upload	[ʌp.ləʊd]	[ʔáp.lò:t]
uranium	[jʊə.ɹeɪ.ni.əm]	[ju:.re:.nîam]
Uranus	[jʊə.ɹə.nəs]	[ju:.re:.nát]
urea	[jʊə.ɹi.ə]	[ju:.ria]
uric	[jʊə.ɹɪk]	[ju:.rìk]
U-turn	[ju:. tʰɜ:n]	[ju:.tʰɤ:n]
vaccine	[væk.si:n]	[wák.si:n]
valency	[veɪ.lən.si]	[wa:.len.si:]
valve	[væɬv]	[wa:w]
vanadium	[və.neɪ.di.əm]	[wa:.ne:.dîam]
vanilla	[və.nɪ.lə]	[wáʔ.níʔ.la:]
VDO	[vi:.di:.əʊ]	[wi:.di:.ʔo:]
version	[vɜ:.ʃn̩]	[wɤ:.cʰân]
video	[vɪ.di.əʊ]	[wíʔ.di:.ʔo:]

view	[vjuː]	[wiw]
villa	[vɪ.lə]	[win.lâː]
vintage	[vɪn.tɪdʒ]	[win.tèːt]
vinyl	[vaɪ.nl̩]	[waj.nîw]
violin	[vaɪə.lɪn]	[waj.ʔoː.lin]
virus	[vaɪ.ɹəs]	[waj.rát]
visa	[viː.zə]	[wiː.sâː]
vitamin	[vɪ.tə.mɪn]	[wít.taː.min]
vodka	[vɒd.kə]	[wɔ́t.kâː]
volleyball	[vɒ.li.bɔːɬ]	[wɔn.lêː.bɔn]
vote	[vəʊt]	[wòːt]
wallpaper	[wɔːɬ.pʰeɪ.pə]	[wɔːn.peː.pɤ̂ː]
waltz	[wɒɬs]	[wɔ́n]
war room	[wɔː ɹuːm]	[wɔː.ruːm]
wax	[wæks]	[wǽk]
website	[wɛb.saɪt]	[wép.sáj]
week	[wiːk]	[wíːk]
wheelchair	[wiːɬ.tʃɛə]	[wiːw.cʰæː]
whisky	[wɪ.ski]	[wít.sa.kiː]
wifi	[waɪ.faɪ]	[waːj.faːj]
wig	[wɪg]	[wík]
win	[wɪn]	[win]
Windows	[wɪn.dəʊz]	[win.dôːw]
wine	[waɪn]	[waːj]
workshop	[wɜːk.ʃɒp]	[wɤ́ːk.cʰɔ̀p]
write	[ɹaɪt]	[ráj]
xenon	[zɛ.nɒn]	[siː.nɔ̂n]
x-ray	[ɛks.ɹeɪ]	[ʔék.sa.reː]
yacht	[jɒt]	[yɔ́ːt]
yeast	[jiːst]	[jíːt]
yogurt	[jɒ.gət]	[joː.kɤ̀t]
YouTube	[juː.tʰjuːb]	[juː.tʰúːp]
ytterbium	[ɪ.tʰɹɜː.biˌəm]	[ʔít.tʰɤː.bîam]
yttrium	[ɪ.tʰɹiˌəm]	[ʔít.tʰrîam]

zigzag	[zɪg.zæg]	[sík.sǽk]
zip	[zɪp]	[síp]
zirconium	[zɜː.kʰəʊ.ni.əm]	[sɤː.kʰoː.nia]
zoning	[zəʊn.ɪŋ]	[soːn.nîŋ]
zoom	[zuːm]	[suːm]

Appendix B

F1 and F2 of English and Thai monophthongs in Figure 3.1

Br	F1	F2
ɪ	407	2127
ɛ	602	2042
ʌ	754	1323
ɑː	733	1129
ɒ	597	930
ʊ	414	1127
ɜː	581	1485
ə	541	1419

(Cruttenden 2001)

Thai	F1	F2
iː	300	2200
i	360	2100
e	540	1980
eː	480	1980
a	720	1200
aː	780	1260
ɤ	540	1200
ɤː	540	1260
u	360	720
uː	300	660
ɔ	660	960
ɔː	660	960

(Abramson 1962)