

**WESTERN SYDNEY**  
UNIVERSITY



**A Phonological Study on English Loanwords in Mandarin Chinese**

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degree of Doctor of Philosophy**

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## **Dedication**

This thesis is dedicated to my family for their endless love, support and encouragement.

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### **Statement of Authentication**

The work presented in this thesis is, to the best of my knowledge and belief, original except as acknowledged in the text. I hereby declare that I have not submitted this material, either in full or in part, for a degree at this or any other institution.

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### Abbreviations

A	Adjective
AOL	Age of Learning
C	Consonant
CC	Consonant Cluster
Con	Constraint
CPH	Critical Period Hypothesis
DEP	Dependent
Eval	Evaluation
F	Formant
F2	Second Formant
G	Glide
Gen	Generator
H	High
IDENT	Identity
IO	Input Output
L	Low
L1	First Language
L2	Second Language
M	Medium
MAX	Maximize
MINWD	Minimal Word
N	Noun
N1	First Noun
N2	Second Noun
Nuc	Nucleus
OT	Optimality Theory

PAM	Perceptual Assimilation Model
PM	Phonetic Matching
PSM	Phono-Semantic Matching
RL	Recipient Language
SL	Source Language
SLM	Speech Learning Model
SPM	Semanticised Phonetic Matching
T	Tone
T1	First Tone
T2	Second Tone
T3	Third Tone
T4	Fourth Tone
TL	Target Language
V	Vowel
VOT	Voice Onset Time
X	Coda in Mandarin Syllable

## Abstract

The general opinion about the way English borrowings enter Mandarin is that English words are preferably integrated into Mandarin via calquing, which includes a special case called Phonetic-Semantic Matching (PSM) (Zuckermann 2004), meaning words being phonetically assimilated and semantically transferred at the same time. The reason for that is that Mandarin is written in Chinese characters, which each has a single-syllable pronunciation and a self-contained meaning, and the meaning achieved by the selection of characters may match the original English words. There are some cases which are agreed by many scholars to be PSM, such as *humor* > 幽默 *youmo* ‘secluded, deep and remote + silent, tacit, quiet’, and *shock* > 休克 *xiuke* ‘inactive, stop+ overcome, conquer’ (Ramsey 1989, Zuckermann 2003, Fleming & Zuckermann, 2013). However, as this study demonstrates, the semantics of the borrowing and the original word do not really match, the relation considered to be “artificial” by Novotná (1967).

This study analyses a corpus of 600 established English loanwords in Mandarin to test the hypothesis that semantic matching is not a significant factor in the loanword adaptation process because there is no semantic relation between the borrowed words and the characters used to record them. To measure the phonological similarity between the English input and the Mandarin output, one of the models in adult second language perception, the Perceptual Assimilation Model (Best 1995a), is used as the framework to judge the phonemic matching between the English word and the adapted Mandarin outcome. The meanings of the characters used in recording the loanwords are referred in *The Dictionary of Modern Chinese* to see whether there are cases of semantic matching. The phonotactic adaptation of illicit sound sequences is also analysed in

Optimality Theory (McCarthy 2002) to give an account of phonetic-phonological analysis of the adaptation process. Thus, the percentage of Phono-Semantic Matching is obtained in the corpus. As the corpus investigation shows, the loanwords that can match up both the phonological and the semantic quality of the original words are very few. The most commonly acknowledged phono-semantic matching cases are only phonetic loanwords.

In conclusion, this paper argues that the semantic resource of Chinese writing system is not used as a major factor in the integration of loanwords. Borrowing between languages with different writing systems is not much different than borrowing between languages with same writing system or without a writing system. Though Chinese writing system interferes with the borrowing, it is the linguistic factors that determine the borrowing process and results. Chinese characters are, by a large proportion, conventional graphic signs with a phonetic value being the more significant factor in loanword integration process.



## Chapter One

### Introduction

#### 1.1 A General Picture of English Borrowings in Mandarin

All languages have borrowed words, or loanwords, in their vocabulary. “No language is entirely free from borrowed words, because no nation has ever been completely isolated” (Jespersen, 1922, p. 208). Mandarin has borrowed many words from several languages, particularly English, a language with which it has had a long history of contact. From the beginning of the modernisation of China with the “May Fourth Movement” in 1919, the quantity of borrowed words has been expanding at a rapid rate and has not slowed down. Wang Li commented that “by looking from the aspect of vocabulary, the evolving pace of Chinese language in the last 50 years far exceeded that of the past millennia” (1958, p. 516). Chinese languages form the Sinitic branch of the Sino-Tibetan languages family. One of Chinese languages, Mandarin, is spoken natively by the ethnic Han Chinese majority and many minority ethnic groups in Greater China, as the official standard language of China.

English is an international language, and is the most influential language in science, technology, sports, and entertainment. The contact between English and Chinese inevitably produces a mutual borrowing of words. For example, English has borrowed many words related to Chinese cuisine such as *toufu* from Mandarin. English has also had a great influence on Mandarin which has imported many foreign words from heteronomous origins, among which English is the primary donor. According to Shi Youwei, among the 7,704 loanwords in Mandarin lexicon, 3,426 are from English, 882 from Japanese, 780 from Sanskrit, 401 from Russian, and 400 from Mongolian, with the remaining words from other languages (2000, pp. 162-163). When classifying the loanwords borrowed from English, Shi’s statistics show that approximately two-thirds of them are related to

politics, economy, religion, entertainment, and daily activities. The great number of English loanwords demonstrates the pervasiveness of the English language and English culture within China.

In recent years, English loanwords in Mandarin have been receiving increased levels of attention. There are plenty of studies in the field, including Gao and Liu, 1958; Shi, 2000, 2004, 2020, etc. Moreover, with the impact of the internet and globalisation in general, English loanwords have been causing huge changes in the vocabulary and morphology of the Chinese language (Hu, 2001, pp. 222-225). However, most studies on English loanwords have not succeeded beyond a purely descriptive listing. The purpose of this study is not simply to produce another list of loanwords but to reveal the process of integration by which English loanwords are adapted into Mandarin.

Generally speaking, a recipient language borrows loanwords from a donor language because of need or prestige (Campbell, 2013; Hockett, 1958; Bright, 1952). Need implies a lexical gap in the recipient language and thus the foreign word is borrowed along with the new concept (Campbell, 2013). Prestige, on the other hand, suggests that the “foreign term for some reason is highly esteemed” (Campbell, 2013, p. 64). Oftentimes a recipient language will already have a native word but instead prefers the prestige of the “luxury” loan. The motives for borrowing into Mandarin involve both the need and the prestige in different periods of time.

The initial wave when English words started to enter Chinese vocabulary from the late 19th to the early 20th century was due to the need to receive western culture and technology. During that time, Chinese people were suffering from both cruel domestic governing and a heavy foreign invasion. Many Chinese believed that the only way to free from their abject misery was to learn from western civilization. Representatives of these pioneering people were Liang Qichao, Kang Youwei, and Yan Fu, who were devoted to the study of foreign languages and cultures. Their work saw a great number of foreign words introduced into the Chinese vocabulary. When integrating the foreign

words, a morpheme meaning ‘overseas, foreign’ *yang* 洋 is often added to the words to indicate its origin, for example, *yanghuo* 洋火 lit. ‘foreign + fire’, meaning *match*.

The real climax of English borrowing began after China’s implementation of the “Reform and Opening-up Policy” in the late 1970s. Chinese people were still eager to learn new ideas and concepts. Words borrowed at that time symbolised China’s opening up towards the world and its attempts at striving for synchronicity with the world. China wanted to communicate with western countries or at least keep up with them. Chinese people wanted to learn of their science and technology, culture, education, and so on, and most importantly, the correspondent words and expressions. New science and technology, culture, and education came to China through loanwords. Besides that, the prestige of English has added to the motivation of borrowing, and the exotic flavor of loanwords enjoys great popularity in different dialects of Chinese language and among Chinese people.

Another important aspect of loanwords in Mandarin is that the loanwords are often borrowed through some dialects spoken southeast of China, for example Cantonese in Hong Kong or Guoyu 国语 “national language” in Taiwan, which is also called Taiwan Mandarin. As these areas were the first to have contact with the western world, the feeling of freshness in loanwords frequently attracts a great deal of fascination even though the same concept can be found in a Mandarin expression. A Cantonese transliteration of the English word for *taxi* 的士 is a great example. The Taiwanese use the native term *jichengche* 计程车 lit. ‘measure + distance + car’ and in mainland China it is called *chuzuche* 出租车 lit. ‘rent + car’. The native Mandarin words are frequently used since the concept of renting a car is not a new one at all. But in Hong Kong, the loan for *taxi* is *dishi* 的士 which is borrowed phonetically. Due to the intercultural exchange and the common writing system between Hong Kong and mainland China, *dishi* 的士 entered Mandarin and became a more popular word. The first syllable of the phonetic loan *di* even became a new

morpheme and a series of new words have developed with it, such as *dadi* 打的 lit. ‘take + a taxi’ and *miandi* 面的 lit. ‘bread + taxi’, meaning ‘a bread-shaped taxi’.

Nowadays, loanwords from English can be seen everywhere in China. Their wide use has enhanced the establishment of their own status in Chinese vocabulary. Some of the English loanwords share certain similarities with native Chinese words, and it’s hard for people to differentiate them from native ones. Some Chinese idiomatic expressions actually have foreign origins, which are not well known without careful investigation, such as *yishierniao* 一石二鸟 lit. ‘one + stone + two + birds’, borrowed from the English expression to *kill two birds with one stone*. Furthermore, loanwords can be found in almost all aspects of Chinese culture (Tian, 2005). For example, *soap opera* is borrowed as *feizaoju* 肥皂剧 lit. ‘soap + opera’, *game point* is borrowed as *judian* 局点 lit. ‘game + point’, and *white collar* is borrowed as *bailing* 白领 lit. ‘white + collar’. All these examples embody certain concepts of western culture and life.

How a foreign word enters Mandarin can also be affected by China’s attitude towards the western world. As is the case with so many other facets of Chinese society, political factors have influenced how foreign words are borrowed and to what extent they can be used. Take the *taxi* case as an example. The use of the phonetic loanword *dishi* 的士 was prohibited in the 1980s because of government intervention. The Shanghai municipal administration restricted depictions on the taxis and posted the following in 1985:

Cars which continue to use the sign with characters *dishi* 的士 will not be allowed to enter the streets and do business. Starting from September 1st, we unitedly start to standardise the taxi sign lamps, which will state both *chuzu* 出租车 lit. ‘rent + car’ and *taxi* on the front. (Yang, 2002, p. 214)

Though Mandarin is classified as a low-borrowing language in Tadmor (2009), it is calculated that there are 5,218 English entries in total according to the *Dictionary of loanwords in Modern*

*China* (Shi 2019), and among them approximately 340 have come into common use (Liu, 2010). With more and more international exchange, it is inevitable that more words will be borrowed from English into Chinese.

## 1.2 Studies on English borrowings in Mandarin

As mentioned above, the history of language contact in Mandarin is very long, from as early as the Han Dynasty, and the phenomenon of lexical borrowing is not new to contemporary China. Yet the systematic studies on loanwords can only be traced back to the previous century. Gao Mingkai and Liu Zhengtan (1958) were the first to conduct scholarly research on lexical borrowing in Chinese and they affirmed that the earliest examples of phonetic loans can be attested to the late Han dynasty (25-220 AD). In their study, the loanwords were classified into western loanwords and Japanese loanwords based on their etymology. The first scholars to collect English loanwords in Mandarin were probably foreigners living in Shanghai in the first decades of the 20th century, according to Zhou Chengguang and Jiang Yajun (2004, p. 48).

Over the last few decades, as the number of loanwords increased greatly in the Mandarin lexicon, the studies of loanwords centered on the collection and the classification of loanwords from the sociolinguistic perspective. The following compilation of dictionaries of loanwords demonstrates that the study of loanwords has become an important field in Chinese linguistics and lexicography. The first scholarly book on loanwords is *Xiandai Hanyu Wailaici Yanjiu* (*A study on loan words in contemporary Chinese*) by Gao Mingkai and Liu Zhengtan, published in 1958. 1984 saw the publication of Gao Mingkai et al., *Hanyu Wailaici Cidian* (*A dictionary of loan words in Chinese*). Studies on loanwords include the publication of *Hanyu Wailaiyu Cidian* (*A dictionary of loan words in Chinese*) by Cen Qixiang in 1990, *Hanyu Wailaici* (*Loanwords in Chinese*) by Shi Youwei in 2000, and *Jinxiandai Hanyu Xinci Ciyuan Cidian* (*An etymological glossary of selected modern Chinese words*) by Hong Kong Association of Chinese Language and Literature (CLSHK) in 2001. There was also a

translation and publication of Italian scholar Federico Masini's *The foundation of modern Chinese lexicon and its evolution toward a national language: The period from 1840 to 1898* published in 1997. More recent dictionaries include *Jinxiandai ci yuan* 近现代辞源 (*An etymological dictionary of modern Chinese lexicon*) by Huang (2010) and the *Xinhua wailaici cidian* by Shi (2019), which are two of the largest dictionaries in modern Chinese. Yet, Masini observes that "it is remarkable that no Chinese scholars working in the field of loans have produced a satisfactory description that includes all the various types of new formations either inspired by or modelled on foreign words" (1993, p. 129). Angela Cook (2018) attempted to give the borrowings in Mandarin a comprehensive classification based on the sounds, semantics, and written forms of the loanwords. Shi (2020) proposed to classify loanwords based on four factors: way of borrowing, usage and frequency, user community, and semantics.

Recent years have seen an increasing enthusiasm in the study of borrowings in Chinese. Shi (2020) collected 448 papers (129 degree-oriented theses and 319 journal papers) on loanword studies in Mandarin from 2001 to 2018, of which 150 (38 theses and 112 non-theses) focused on loanwords of English origin, taking up 33.5%. Yet, the progress seems far from remarkable since there is a lack of different perspectives among those papers (Shi 2020) and most of the papers are centered on the topic of letter words, focusing on the issue of their identity as loanwords.

### **1.3 An Outline of How English Loanwords are Borrowed in Mandarin**

Borrowing is defined as a process through which a kind of import of a structure or form happens from one language system into another. The items affected by it are called "borrowings", "loans", or "transfers" (Matras, 2009, p. 158). Borrowing is a metaphor that denotes the use of a structure (i.e., phone, phoneme, morpheme, semantic value, or form-function alignment) within a particular linguistic system although it is normally associated with another linguistic system (Adamou & Matras, 2020, p. 237). Borrowings must be remodeled "to fit the phonological and morphological

structure of the recipient language, at least at the beginning of language contact” (Campbell, 2013, p. 65). Borrowing is thus a process of “innovative reproduction” (Haugen, 1950, p. 212). Other terms such as “copying” and “replication” are also used to refer to two kinds of replication of a linguistic structure (Matras & Sakel, 2007), which include replication of linguistic “matter” (concrete, identifiable sound-shapes of words and morphs) and replication of the mode of organising units of speech, that is, of linguistic “patterns”. The languages involved in this process are commonly referred to as “model” and “replica” (see Heine & Kuteva, 2005) or “source language” and “recipient language” (Van Coetsem, 2000).

The earliest recorded case of borrowing from a donor language in China coincided with the incoming of Buddhism and the Sanskrit words, which accompanied the religion of Buddhism in the sixth century (Hu & Xu, 2003). During that period, translators of Buddhist texts were using transliteration as their primary means to create new words (Luo, 1989). But there was a problem for these new Buddhist texts because, for most Chinese people, it was difficult to determine what the borrowed religious terms meant without appropriate semantic clues. Over time as more Buddhist texts were borrowed and translated, a new approach gradually started to become popular (Ma, 1998). Realising the importance of combining semantics with phonetics, monks began to borrow words into Chinese through a phono-semantic approach. Such various ways of borrowing English loanwords helped make the Chinese language more diversified and more expressive. Gao Mingkai and Liu Zhengtan (1958) distinguished between a) phonetic loans, b) semantic loans, c) loan translations, d) hybrid semantic/phonetic loans, and e) combinations of semantic and phonetic loans.

Therefore, the principal ways of assimilating loan words of foreign origin in the Chinese language are phonetic and semantic. In the history of the Chinese language, the same English loan word could be borrowed at the same time through phonetic and semantic ways. For example, the word *laser* was first borrowed as *lase* 莱塞 lit. ‘a kind of plant + block’, then translated in mainland

China as *jiguang* 激光 lit. ‘excite + light’ and as *leishe* 镭射 lit. ‘a kind of metal + shoot’ in Hong Kong and Taiwan. Many English words have therefore come into Chinese in two or more forms. Of the 5,275 loanwords contained in the *Etymological glossary* (CLSHK, 2001), only 1,700 are principal entries, while the rest are secondary entries referring to the same thing or idea as the principal entries. This means, on average, that one original word can have three corresponding loanwords in Chinese. The diversity of borrowing is due to several reasons, including the difference between the speaking community and the variation of borrowing strategies over time.

During the integration of English words, there exists the process of replacing semantic ways to phonetic ways, and vice versa. For example, the word *vitamin* was borrowed in the 1920s as a phonetic loan as *weitaming* 维他命 lit. ‘sustain + his + life’. It was changed to *weishengsu* 维生素 lit. ‘sustaining + life + substance’ in mainland China in the 1950s, when the “Ideological Remolding Campaign” was launched, during which some leading translators advocated free translation and naturalisation to avoid a “foreign tone”. An example of a phonetic way replacing a semantic way is the borrowing of *logic* which entered Chinese in the Ming Dynasty when Li Zhizao (李之藻) translated it as *mingli tan* 名理探 lit. ‘name + reason + explore’. Until the end of Qing dynasty, it had been continuously retranslated into traditional Chinese local vocabularies by the names of *bianxue* 辩学 lit. ‘argue + science’, *mingxue* 名学 lit. ‘name + science’, *lizexue* 理则学 lit. ‘reason + order + science’ and many others. The terms *mingxue* 名学 lit. ‘name + science’ and *luoji* 逻辑 (phonetic loan) were also both used by Yan Fu (Chen, 2011, p. 4). Another commonly used term was the Japanese translation, namely *lunlixue* 论理学 lit. ‘argue + reason + science’ (Wang, 1958, p. 525). Nowadays, these traditional Chinese-translated words are not used and have been replaced by the phonetic loan form *luoji* 逻辑.

One famous example of borrowing with a combined phonetic and semantic way is the borrowing of the brand name *Coca Cola*. When it was first introduced into China, it was phonetically



borrowed as *kekekenla* 蝌蚪啃蜡 lit. ‘tadpole + tadpole + bite + wax’. It was not well-received by the market because the associated meaning did not interest people. Later, the company held a contest for its name and the winning Chinese name for *Coca Cola* was *Kekou Kele* 可口可乐 lit. ‘delicious and enjoyable’, which adds marketing value to the American beverage brand, and has helped make it a best-selling beverage in China. This example shows that when borrowing an English word, the semantics of the character will influence the acceptance of the word. Also, it is assumed that the so-called phono-semantic borrowing is an ideal way or best technique of borrowing and is always pursued in the adaptation of English words. Until now, in Chinese linguistics, the “competition” between phonetic borrowing and semantic borrowing has not reached a consensus, remaining an open controversy.

Usually, the phonetically-borrowed loanword and the semantically-borrowed loanword can be used interchangeably. Yet, sometimes, the phonetic and semantic loan may have different applications. For example, *opium* is phonetically borrowed as *yapian* 鸦片 lit. ‘a black drug’ to be used in daily conversation and *apian* 阿片 to mean ‘a pharmaceutical constituent’ used in the medical field. Also, the phonetic and semantic loan of the same word may belong to different parts of speech. Take *hysteria* for example: its phonetic loan *xiesidili* 歇斯底里 is used as an adjective according to *Xiandai Hanyu cidian (di 6 ban)* (现代汉语词典第六版)[Dictionary of Modern Chinese 6th Edition], while its free semantic translation *yibing* 癔病 is a noun.

## 1.4 The Purpose and Significance of this Study

### 1.4.1. On the Mechanism of Borrowing English Loanwords

One of the purposes of this study is to reveal the mechanism of borrowing because there are so many techniques employed in borrowing foreign words and the multiple outcomes are not well-

systematised. The traditional classification of borrowings in Chinese linguistics is a system of redundancy and inefficiency.

To explore the mechanism of borrowing from English to Mandarin, how Mandarin is written should first be understood. Mandarin, as a major language in the Chinese language family, employs the character script. Words in Mandarin are made up of one or more syllables, each of which is represented by a character in the written form. Chinese is written with Chinese characters, which is roughly monosyllabic; that is, a character generally represents one syllable of spoken Chinese and may be a word on its own or a part of a polysyllabic word. Since Chinese has a logographic script, words in the Latin script must be transformed into words written in characters when they are borrowed into Mandarin. What makes the borrowing process complicated is the strategies that are taken in the conversion from foreign words and sounds into Chinese characters and sounds. It is for this reason that studies of borrowings in Chinese have been using different typologies of classification. It is helpful if the different types of borrowings can be classified based on the mechanism used during the integration process, that is, what is transferred from the original English word to Mandarin.

As mentioned above, English words are borrowed into Mandarin in a phonetic way (where the sound of the word is integrated into the recipient language) or a semantic way (where word semantics are reproduced). If it is borrowed in a phonetic way, Chinese characters are used to simulate the original pronunciation, regardless of the original meaning of the characters. The sound sequence of the English words is adapted to abide by the Mandarin phonologic system and the phonotactic constraints. During the process, the phonetic and semantic origin is transferred into Mandarin.

If an English word is borrowed by calquing, the meaning (instead of the sound) is transferred. There are two subtypes in this category. First, the meaning of the word is transferred by a morpheme-for-morpheme match between the two languages, which results in loan translation.

Second, in Chinese typology, there is a phrase for *semantic loan*, which is *yiyici* 意译词 lit. ‘meaning + translation + word’. It refers to a new Chinese word which is coined using indigenous morphemes in a way that attempts to capture the most significant feature of the foreign concept. Thus, it is also called “free translation”. For Masini (1997), it is “autochthonous neologism” because it refers to a word that is coined under the influence of a foreign word but does not follow the structure of the original. Terms created as loan translation/calque or semantic loans carry the semantic of the original word, not the phonetic. Though the morphosyntactic structure of the foreign word may or may not be taken as a model, these words are generally not considered loanwords as they are made up of native Mandarin morphemes with no regard for phonetic similarity. Some linguists such as Gao Mingkai (1958) and Wangli (1988) suggested only phonetic loans should be considered as real borrowings; others such as Lv Shuxiang (1984) would rather conclude that borrowings include both phonetic loans and semantically-borrowed loans.

Besides the above two broad types of borrowings, there is a type of borrowing which combines a phonetic and semantic way, termed “Phono-semantic matching” by Zuckermann (2003, 2004). It can be understood as the simultaneous phonetic loan and semantic loan. In such borrowings, while matching the sound of the original word, the combination of the characters also creates a semantic meaning matching to the original word. Chinese linguists prefer to refer to them as *yinjianyi* 音兼意 lit. ‘phonetic + at the same time + semantic’. This type of borrowing is a dual-layered borrowing and is believed to be a much more effective way of bringing understandable foreign terms to the literate Chinese population. In this type of borrowing, the phonetic and the semantic origins are transferred but in a hidden way. In this way, this type of borrowing is termed “camouflaged borrowing” by Zuckermann (2000, 2003).

It has been assumed that of the different types of borrowings, preference is given to semantically-borrowed loans over phonetically-borrowed loans. As Chen Ping comments:

Chinese readers tend to pay more attention to the meaning conveyed by the graphic forms of characters than to their phonetic values; it is not uncommon for Chinese readers to recognise the semantic content of characters without being able to pronounce them [...]

When alternatives exist, Chinese readers who tend to read meaning into the graphic forms of a text would prefer words in which each character makes sense as opposed to those coined purely through transliteration. (1999, p. 105)

Based on this claim, the phono-semantic loans should also be popular as they are also semantically-borrowed forms. Zuckermann (2000) even argues that phono-semantic matching is an important mechanism of camouflaged borrowing and that this type of borrowing, i.e. Phono-Semantic Matching, is widespread and common in languages using a “phono-logographic script”.

Given the claim that the semantically-borrowed form is much-favoured and the camouflaged form is also widespread, it is hypothesised that in a corpus-based loanword study, the percentage of such cases should be high. Yet, there has not been detailed empirical research on how English loanwords are adapted into Mandarin. In order to fill this gap, this study aims to conduct a quantitative research based on a database of 600 English loanwords. The loanwords will be classified on the mechanism of their adaptation, with in-depth analysis of the phonological comparison and the semantic matching between the original word and the borrowed form. After the various borrowing methods and their percentages in the corpus are revealed, the cases with phonological unfaithful adaptations will be further analysed to see whether the deviation has anything to do with semantics, or if there is any other reason for the unfaithful adaptation. As the loanword seeks the phonetic approximation of the original word, the sacrifice of the phonetic approximation should be within certain limits. The data will show what aspects of phonetic sacrifice can be tolerated and what cannot. By looking at whether the ill-formed segments and sequences are repaired minimally and whether the non-minimal repair has semantic consideration, this investigation will give readers a true picture of how Mandarin integrates English loanwords instead of just an elusive perception.

### 1.4.2 On the Phonological Integration of English Loanwords

English loanwords pose a challenge to Mandarin grammar as Mandarin borrowers not only attempt to maintain the source language pronunciation and simultaneously satisfy recipient language's phonological constraints, but they also have to deal with the influence imposed by the Chinese morphosyllabic system, which is represented by its written form: Chinese characters. The tug-of-war between these demands posed by phonology and phonetics of the two languages will highlight many phonological aspects of the borrowing language, as will be seen throughout the thesis.

A quick look at the phonological shape of these loanwords calls for a thorough study in an attempt to look for a systematic order as Chinese loanwords seem to be in a state of chaos. Many feel that English loanwords are adapted randomly into Mandarin; a few examples will clarify this point of view. The English word *radar* is borrowed as *leida* 雷达 with mapping of English liquid /ɹ/ to Mandarin /l/. Another example is the word *disco* which is borrowed as *disike* 迪斯科 instead of *disikou*, which is a more faithful assimilation to the original sound. A third example is the plural word *fans*, which is borrowed as a singular noun, *fensi* 粉丝. Such modifications are rich in the corpus of loanwords in Mandarin Chinese, some of which appear to be unnecessary. The reason for them varies from phonological to morphological, and they provide an invaluable tool to examine the grammar of Mandarin. This is because they provide external evidence to investigate phonological and morphological aspects in Mandarin that could enhance our understanding of its phonology and morphology.

A phonological analysis of the integration of loanwords into a recipient language is valuable for two main reasons: it contributes to a better understanding of L1 phonology; and may shed light on phonological theory in general. First, investigating loanwords leads to an increased understanding

of L1 phonology and unveils its hidden rules that would remain latent due to the lack of input that would stimulate such rules (Crawford, 2009; Paradis & LaCharite, 1997; among others). Loan phonology is a window to native phonology that provides phonologists with new insights into the borrowing language (LaCharite & Paradis, 2005; Calabrese & Wetzels, 2009). Some controversial phonetic features of certain sounds in L1 phonology can be revealed by loanword adaptation. For example, phonetic loanwords will clarify the phonetic feature of /r/ in Mandarin phonology. The classification of Mandarin /r/ is as an approximant or a fricative has not been a consensus. The introduction of English loanwords with /r/, which are borrowed as /l/ in Mandarin in most cases, would help clarify the phonetic feature of this sound. Second, the adaptation of loanwords will shed more light on phonological theory as a whole and its interaction with phonetics and the relationship between perception and production. It will be shown through the adaptation of consonant clusters, nasal codas, and illicit codas that perceptual adaptation can justify unusual behaviours of certain processes.

Loanwords can also help us understand the phonological organisation of the mental lexicon (Crawford, 2009). It is argued that loanword analysis enables us to observe how language is processed, which will help us understand the organisation of language within the human brain, such as the role and organisation of phonological features.

In summary, the second purpose of the study is to conduct a detailed analysis of the phonological adaptation of English loanwords in Mandarin. Together with the first purpose, the thesis aims to give a picture of how, in a system of phonetics and semantics working together in a morphosyllabic syllabary, Mandarin adapts English loanwords.

### **1.5 The Structure of the Thesis**

The thesis is about borrowings from English to Mandarin and consists of six chapters. The first chapter is the introduction of the thesis which provides a general picture of English borrowings

in Mandarin and discusses the purpose and the significance of the study. The second chapter is about the language contact between English and Mandarin and the classification of English borrowings in Mandarin. It provides a literature review of the loanwords in Mandarin and the background for the study. Due to the confusing present classification system of loanwords in Mandarin, the thesis proposes a classification based on Van Coestem's (2000) framework on language contact. Among the different types of loanwords in Mandarin, the discussion focuses on phono-semantic matching and semantic loans.

Chapter Three mainly deals with the peculiarity of borrowing in Mandarin, which is how borrowing is impacted by Mandarin syllables and the morphosyllabic writing system. The simple Mandarin syllable structure evidently causes variations in loanword adaptation and the morphosyllabary of characters makes the loanword semantically different from the original word. How the semantics of the representing characters is exploited in loanword adaptation is always debated. Therefore, the thesis aims to investigate whether semantic transparency is preferred in the adaptation process, which can be referred to as the competition between the "overt borrowing" and the "covert borrowing". In this thesis, the loanwords will be analysed phonologically and semantically between the two types of borrowings.

Chapters Four and Five provide a full-scale analysis of Mandarin loanwords. Before the phonological matching between English and Mandarin is tested, theories of loanword adaptation are reviewed, and English and Mandarin phonologies are compared to lay the foundation of the adaptation of English loanwords. Based on the "Perception Assimilation Model" (Best, 1995a), the study makes a prediction of phonemic mapping between English segments and Mandarin segments. Then the adaptation of English consonants and vowels in Mandarin loanwords is analysed, providing a reliable result for the patterns of phonemic replacement between English and Mandarin in a data corpus collected from dictionaries, previous studies, and current neologisms in China. Chapter Five uses Optimality Theory (OT) to analyse the adaptation process. The phonology of Mandarin and the

phonetic factors will be considered in the adaptation process following the phonology-phonetic approach, which believes that the inputs in the adaptation are how borrowers perceive the acoustic signals of the source language and how they are modified or adapted by the phonology of the borrowing language. The Mandarin syllable inventory strongly controls the results of loanword adaptation. Furthermore, some extra-linguistic factors such as the level of bilingualism and the influence of morpheme frequency will be discussed. Lastly, the conclusion and the limitation of the thesis are discussed in Chapter Six.



## Chapter Two

### Literature Review on Borrowing and English Loanwords in Mandarin and Methodology

#### 2.1 Borrowing

##### *2.1.1 Borrowing as a Phenomenon of Language Contact*

Few societies are completely isolated from other societies. Based on this, linguists agree on the statement that nowhere in the world can a language be found that was never, at some point in its history, influenced by another language. Along with societies, languages are constantly in contact with other languages. According to Lim and Ansaldo, language contact “occurs frequently in bilingual and multilingual societies, in trading environments, through technological transfer as well as colonisation and globalisation” (2016, p. 5). Language contact can be simply defined as “the use of more than one language, at the same time, at the same place” (Thomason & Kaufman, 2001, p. 1). Possible outcomes of language contact include the creation of a pidgin or creole, the emergence of code-switching, or the occurrence of borrowed features; this depends on the nature of the contact situation, its intensity, and on the dominance and prestige of one (or both) languages. According to the framework built up by Thomason and Kaufman (1988), the intensity of contact can be classified into five levels and so is the borrowing scale. They are:

1. Casual contact which only undergoes lexical borrowing on the content word level;
2. Slightly more intense contact which involves some function words (e.g., conjunctions, adverbials);
3. More intense contact which involves more function words (e.g., prepositions and postpositions), derivational affixes, inflectional affixes, pronouns, numerals, and minor structural features;
4. Strong cultural pressure: moderate structural borrowing; and

5. Very strong cultural pressure: heavy structural borrowing.

With the different intensity of contact situations in general, the most likely kind of language contact that one language may exert on another is borrowed words due to sociolinguistic reasons (Sapir, 1921, p. 206).

Winford (2003) points out that a short perusal of linguistic literature shows that the word “borrowing” has been used to describe almost every kind of contact-induced change under the sun. Thomason and Kaufman (1988) use the term to refer only to the importation of foreign elements into one’s native language. Thomason and Kaufmann (1988) define interference in a way that covers the entire spectrum of language change. With the additionally confusing use of mixed terms like borrowing interference, Winford (2003, 2005) is right to point out that a clear delineation of terminology is important in understanding the processes of language contact. Moreover, conflicting terminologies also indicate that there are fundamental disagreements about the nature of contact-induced change.

In order to clarify these vague terminologies and to understand the process of language contact, we must ask ourselves what it really means to say that transfer has occurred in a bilingual context. When we take the time to return to an examination of the process of language contact itself, it becomes easy to see that monolithic terms like interference and borrowing are inadequate. I adopt the position held by Winford (2005) and Van Coetsem (1988) that both the directionality of transfer and the linguistic backgrounds of the speakers are crucial in understanding the outcomes of language contact.

Lexical borrowing refers to a natural process of language change whereby one language adds new words to its own lexicon by copying those words from another language. The pattern in the donor language that is borrowed is the model and the attempted reproduction in the recipient language is the replica. As Jespersen (1922, p. 208) and Haugen (1950, p. 211) note, the borrowing metaphor sounds absurd since the donor does not deprive itself of anything more than if it had not

been borrowed, while the recipient is under no obligation to return it at any future time; it is not different from stealing since it happens without the donor's consent or even awareness. A historical quirk as it is, the term *borrowing* is now an accepted term. Haugen defines borrowing as the "attempted reproduction" because making a perfect reproduction from a language is almost impossible. The process of borrowing is "one of the most frequent ways of acquiring new words, and speakers of all languages do it" (Trask, 1996, p. 18).

Languages involved in the borrowing situation may have different statuses. One language may belong to the superstratum level, which means it is the more prestigious or upper-level language, and the other language belongs to the substratum level. Sometimes, there may exist an adstratal relationship between the two languages; that is, the languages in contact are equally prestigious. In substratal and superstratal relationships, the influences between the languages are primarily unidirectional.

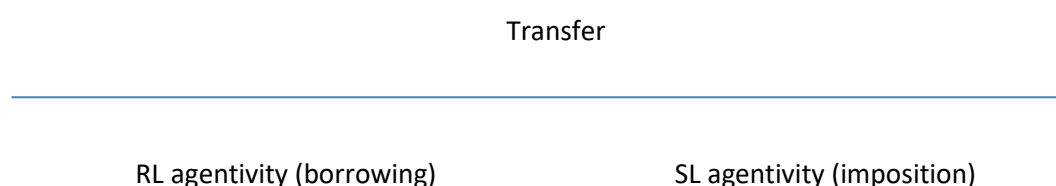
When borrowed words are accepted and integrated into the borrowing language, they are known as borrowings or loanwords. Some definitions of lexical borrowings/loanwords can be obtained from different sources. "A loanword is a lexical item which has been 'borrowed' from another language, a word which originally was not part of the vocabulary of the recipient language, but was adopted from some other language and made part of the borrowing language's vocabulary" (Campbell, 2013, p. 58). Görlach gives the following definition:

A foreign lexical item is borrowed at word level or above, usually when no term exists for the new objects, concepts, or state of affairs. Both form and content are affected in the process of borrowing and in later integration, namely by adaptation to the formal categories of the receiving language, and by the selection of a meaning. The process normally starts with an occasional use in a native context, and integration proceeds with the spread of the word in the speech community. (1977, p. 145)

### **2.1.2 Van Coetsem's (1998, 2000) Framework**

Haugen stated that "all borrowing by one language from another is predicated on some minimum of bilingual mastery of the two languages" (1950, p. 211). Borrowing does not require the involvement of individuals with perfect bilingual or multilingual knowledge. People with a restricted understanding of the foreign language are capable of introducing and using foreign words in their speech. It is an observable fact that when two languages come into contact in the mind of the bilingual, transfer of material from one system to the other can occur, which most often takes the form of lexical transfer.

In Van Coetsem's (1998, 2000) language contact model, which formulates two transmission processes in language contact, borrowing is defined as a phenomenon of language contact and results from the introduction of a foreign word by a recipient language (RL) speaker. This framework represents a shift in perspective from the contact situation between languages to the linguistic dominance relationship within a certain speaker. In the previous frameworks (e.g., Haugen, 1950; Weinreich, 1953; Poplack et al., 1988; Thomason & Kaufman, 1998) about borrowing, the outcome of language contact is determined by the relationship between the languages. Van Coetsem basically distinguishes between two types of transfer in languages contact: recipient language (RL) agentivity or borrowing; and source language (SL) agentivity or imposition. In other words, borrowing is typically produced by recipient-language speakers and imposition by source-language speakers. The main achievement of Van Coetsem's framework is that it is the individual speakers who make the language contact, and the linguistic dominance relationships of the speaker are the parameters of the outcome of language contact. The definition of borrowing in Coetsem's framework is "the transfer of language elements from a subdominant SL to a dominant RL" (Coetsem, 2000, p. 49).

**Figure 1***Borrowing and Imposition as Types of Transfer in Language Contact*

*Note.* Coetsem, 2000, p. 35

The linguistic dominance relation within a certain speaker determines which language is active, or the agentivity. The difference of borrowing and imposition is tied to the linguistic dominance of RL or SL. Borrowing happens when language elements are transferred from the subdominant SL to the dominant RL of the borrower. Imposition is the transfer of language material from the dominant SL to the subdominant RL. The dominance of the SL in SL agentivity (imposition) can lead to an increased transfer of language structures to the RL, whereas RL agentivity (borrowing) resists structural transfer from the SL to a large extent (Coetsem, 2000, p. 73).

Van Coetsem's model separates the situations of SL agentivity and RL agentivity from the operations that occur in these situations. The linguistic material is always transferred from SL to RL. For example, in the English and Mandarin example, traditionally English is the cultural superstratum language and Mandarin is the cultural substratum language. In the traditional framework, Mandarin borrows loanwords from English. In Van Coetsem's framework, if the linguistic material is from English to Mandarin and the introduction of the linguistic material is done by a Mandarin dominant speaker, it is RL agentivity. So, it is called borrowing whereby adaptation is the more dominant

operation than imitation. On the contrary, if the linguistic material is also from English to Mandarin, but the introduction of the linguistic material is done by an English dominant speaker, it is SL agentivity, in which imitation is more dominant than adaptation. Therefore, it is called imposition which, in a traditional framework, is called interference.

Van Coetsem's framework makes the distinction between borrowing and imposition from the psycho-linguistic perspective of the speaker by treating the contact situation from the agentivity point of view, that is, which language is more active for the speaker. In this framework, it is easier to understand that for a RL dominant speaker, the grammatical system of the borrowing language is not easily changed. Therefore, only the free-floating elements such as individual words or phrases, pragmatic markers, sentence adverbials, etc. are frequently borrowed because they are not part of the grammatical system of the borrowing language, and adding them does not change the grammatical system (Hickey, 2010, p. 11). In other words, lexical borrowings occur much more often than structural borrowings. Whereas for the SL dominant speaker, the grammatical system of the source language is not easily changed, thus the linguistic material to be transferred is more likely to be structural, which is exactly what the term "imposition" captures. Van Coetsem defines borrowing as follows:

If the recipient language speaker is the agent, as in the case of an English speaker using French words while speaking English, the transfer of material (and this naturally includes structure) from the source language to the recipient language is *borrowing (recipient language agentivity)*. (Van Coetsem, 1998, p. 3, italics in original)

He continues, "in RL agentivity (borrowing) *the agent speaker performs a pull transfer that affects his own, linguistically dominant language*" (2000, p. 53, italics in original).

Van Coetsem's framework entails an understanding of borrowing as the transmission of linguistic units of form and meaning from subdominant SL (in the present study: English) to dominant RL language (in the present study: Mandarin) (Coetsem, 2000, p. 38). With regards to the

influence of English on Mandarin in the Mandarin speaking dominant areas of China, language contact generally lacks immediate speaker contact. Nevertheless, English has exerted great influence on Mandarin through mediated channels (e.g., newspapers, TV, the internet). The present study focuses on the adaptation of English elements in modern Mandarin Chinese, which coheres to the notion of RL agentivity (borrowing) in Coetsem's framework.

In this framework, Van Coetsem uses stability as another crucial factor in the transmission process in language contact. Stability is based on the fact that:

... certain language components or subcomponents are by nature more stable, while other such components are less stable. For example, lexical items, specifically content words, are far more likely borrowed than phonological or grammatical elements, which are more stable and less transferable. (Coetsem, 2000, p. 58)

There are two kinds of stability: "inherent stability" and "subsidiary stability" which determine the probability of transmission from SL to RL (2000, p. 58). Inherent stability relates to the fact that content items are most commonly transferred whereas structural elements resist borrowing to a greater extent. Subsidiary stability includes typological affinity between SL and RL, and also the attitude of speakers of the RL towards the SL.

As Hoffer reports, the notion of stability was referred to as early as 1881 by Whitney who proposed a scale of adaptability that ranged from nouns, as most adaptable, to affixes, inflections, as most resistant to change (1966, p. 544). Similar claims by Haugen (1950, p. 224) emphasise that the lexicon is most readily affected by borrowing whereas phonology and morphology largely resist borrowing. Field et al. (2002, p. 117) provides a recent account of stability which he summarises in the following hierarchy of borrowability:

content item > function word > agglutinating affix > fusional affix

According to Field et al., the hierarchy of borrowability not only implies the probability according to which linguistic items are borrowed into the RL, but also relates to the sequence of borrowing (2002, p. 38).

It is almost universal that all lexical items can be borrowed, but not all word classes are borrowed with the same frequency. The most frequently borrowed lexical items are nouns. Some scholars (e.g. Haugen, 1950, Muysken, 1987) propose a hierarchy of categories from frequently to rarely borrowed:

nouns>adjectives>verbs>prepositions>coordinating

conjunctions>quantifiers>determiners>free pronouns>clitic pronouns>subordinating

conjunctions

A plausible explanation for this phenomenon is that nouns are high-content words compared to verbs and adjectives which bear a high syntactic and semantic load (Field, 2002, p. 116). In many cases, borrowed nouns refer to culturally specific objects or concepts. People are confronted with the need to name these new items when they encounter new things from a new culture, as Weinreich states there is “the need to designate new things” (1979, p. 56). This is less the case for verbs, pronouns, classifiers, etc., which are, in many cases, not culturally specific and do not require new name-giving operations (Muysken, 2000, p. 232).

In the subsidiary stability aspect, which includes affinity between SL and RL and the attitude of the speaker (Coetsem, 2000, p. 58), English and Mandarin are not close. English belongs to the Indo-European family while Mandarin belongs to the Sino-Tibetan family, which are quite different in terms of phonological and morphological features. Mandarin, an analytic language, is considered a language with little morphology, like all other varieties of modern Chinese. It depends on syntax — word order and other aspects of sentence structure — rather than morphology to indicate grammatical meaning. In other words, Mandarin doesn't have inflectional morphemes marking tense, voice, gender, or number. So, when English words are borrowed into Mandarin, they are



immediately integrated into the grammatical paradigms of Mandarin, and they can be used as different word classes in the simple morphological form.

As for the attitude towards borrowing, Anchimbe (2006, pp. 194-195) suggests that the more favourable the attitude towards the source language, the more imitative operations will be used when a word is borrowed. When there is a negative attitude towards the source language, a word will be borrowed more adaptively. Heffernan (2011) specifically examines two borrowing strategies, transliteration and translation, applied in the borrowing process of English into Japanese and Chinese. He suggests that there is a correlation between the social distance of the SL country and the RL country, and the strategy used to adapt the borrowings. If the social distance is far, the predominant strategy would be the more adaptive one: translation. If the social distance is close, the predominant strategy would be the more imitative one: transliteration.

The two primary operations Van Coetsem differentiates are imitation and adaptation, depending on how actively the dominant language plays in the transmission process:

Imitation is an initiating operation, reflecting the need to copy, acquire or incorporate SL material into the RL. On the other hand, adaptation is a natural reaction to imitation, a defensive and conserving mechanism against the effects of imitation. Adaptation is adjusting or conforming SL material to the RL; it is RL conforming. (2000, p. 69)

Borrowing takes place on a scale of “imitation and adaptation” (2000, p. 49). Imitation incorporates the “inclusion” of terms in their original form of the SL as well as the “integration” of borrowing in the RL. In fact, the theoretical difference between inclusion and integration is minimal in the context of English borrowings in Mandarin. In contrast to imitation, adaptation relates to adaptive reactions of the RL that can affect a borrowed term on various levels, such as orthography, phonology, and semantics. Therefore, adaptation is seen as the “result of borrowing” for items that are entirely integrated (Coetsem, 2000, p. 72).

In general, Coetsem's theory of the transmission process in language contact provides a description of the underlying processes of borrowing that go beyond the scope of common attempts at classification. With the interrelation of imitation and adaptation and their dependence on stability, van Coetsem establishes a theoretical framework that depicts principles of the transfer of language elements in a borrowing relationship between SL and RL. This framework will be used as the basis for the classification of overt and covert borrowings from English to Mandarin. Before the overt and covert borrowings are defined, the mainstream classification of borrowings will be reviewed.

### ***2.1.3 Mainstream Classification of Borrowing***

The mainstream loanword taxonomy was proposed by German linguist Werner Betz in 1936, when he analysed the Latin influence on the German vocabulary and structured the field of lexical borrowing, which is divided into direct loan influences and indirect loan influences. In Betz's classification, a basic distinction can be drawn between direct and indirect loan influences (loan word vs. loan coinage). Einar Haugen developed Betz's classification and distinguished between three types of borrowing: (a) loanwords, which show morphemic importation without substitution, with degrees of phonological integration (all, none, or partial); (b) loanblends, which show morphemic substitution as well as importation; and (c) loanshifts, which show morphemic substitution without importation (1950, pp. 214-15). It includes "loan translation" (calque) and "semantic loan". For Haugen, a loanword shows morphemic importation without substitution but possible phonemic adaptation (cf. foreign word/assimilated loanword in Betz). The term "loanblend" was coined by Haugen meaning "morphemic substitution as well as importation" to describe hybrid constructions that "involve a discoverable foreign model" (1950, p. 215). "Loanshifts" are characterised by a total substitution with native elements in loan meaning and loan formation. Winford (2003) follows Haugen (1950) and makes a more comprehensive classification of lexical

contact phenomena. These traditional approaches of establishing borrowing taxonomy (Betz, 1936; Haugen, 1953; Winford, 2003) categorise borrowing based on the mechanisms used during the process of borrowing, which are called importation, substitution, or a combination of both. A comparison of the classification by Betz, Haugen, and Winford are listed in Table 1.

**Table 1**

*Classification of Borrowing*

Author	Categories in Traditional Borrowing Taxonomies				
	Morphemic importation	Part importation, part substitution	Morphemic substitution		
Betz (1936)	Loanwords		Loan formation	Loan meaning	
Haugen (1950)	Loanwords	Loanblends	Loan shifts	Loan creation	
Winford (2003)	Pure loanwords	Loanblends	Loan translation	Semantic loan	Creative loan

*Note.* Adapted from Betz, 1936; Haugen, 1950; Winford, 2003.

Durkin wrote the following on this phenomenon:

Lexical borrowing occurs when the lexis of the donor language exercises an influence on the lexis of the borrowing language, with the result that the borrowing language acquires a new word form or word meaning, or both, from the donor language. (2014, p. 8)

From the borrowing strategies, it can be concluded that when the foreign word has entered the native lexicon, the borrowing can take the shape of an importation or a substitution in the receiving language. An importation can evolve into a substitution:

The diffusional process would begin with importation and could then be followed by substitution. For example, new items in the area of food and cuisine could be first added to

the recipient culture, along with the designations for them (importation), and subsequently some or many of these items may replace indigenous items (substitution), thus altering the fabric of the recipient culture in important ways. (T'sou, 2001, pp. 37-38)

The core of the classification of borrowings based on the degree of native morphemic replacement is the result of the borrowing process. It tries to grasp the borrowing phenomena from the outside depending on their degree of similarity to the English model. A loanword and a native term with the same meaning can co-occur (Haspelmath, 2009, p. 49) and this "coexistence" can last for some time. But as one meaning is usually encoded by only one form, suggested by the principle of linguistic economy, such coexistence may disappear in time.

Haugen (1950) has made special remarks on the semantic loan, saying that the term is not appropriate because all types of borrowings are semantic. This type means that a new meaning is added to the native morpheme and causes the functional shifts of native morphemes. An example is given: AmPort. *humoroso* uses the meaning of AmE 'humorous', though it meant only 'capricious' in Portugal (Hoffer, 2002, p. 219). As there is no formal structural element imported, the new meaning is the only evidence of the borrowing. There are similar examples in Chinese. For example, *shangdi* 上帝 lit. 'up + emperor' meant 'ruler on high' in a Confucian context, and subsequently adopted the meaning of a Christian God. Kurtz refers to this phenomenon as "conceptual takeovers" (2001, p. 40). The old meaning and the new meaning are also compared. If they have nothing in common, the borrowing with the new meaning is called a loan homonym. If they show some amount of semantic overlap, the borrowing may be called a "loan synonym". It has also been pointed out that as "there is lack of satisfactory method of classifying degrees of semantic similarity; it is not always possible to make the distinctions" (Haugen, 1950, p. 220). A semantic loan usually happens when a source item and a recipient item have formal similarity and semantic overlap, which causes interference in the recipient item and leads to the semantic extension of the recipient item. In such a scenario, the formal resemblance triggers a semantic change in the recipient language item. But as the form and

meaning of the SL item is split, evidence of conceptual transfer from SL to RL is reduced to speculation or demands etymological analysis.

## **2.2 English Borrowing in Mandarin**

### ***2.2.1 Language Contact Between English and Mandarin***

The Chinese languages, as a family of language, have been in contact with other languages since ancient times and have been greatly influenced by them. The first contact between English and Mandarin Chinese dates back to the late Qing Dynasty. During this period, China began to come into contact with Europeans and Americans when Western missionaries and merchants started to arrive in China, along with their cultures. The borrowed words of this period were mainly scientific and technological terms. Since the communication with the western world was restricted at this time, the number of borrowed words was also limited.

The substantial influence of foreign languages on Chinese began from the late 19th century. After their defeat in the first Opium War (1839-1842), China underwent radical changes. China recognised the backwardness and weakness of their country as well as the necessity and urgency of introducing advanced science and technology from the western world. At the turn of the 20th century, the need for modernisation was perceived by a small number of Chinese elites as a means of saving China from exploitation and division by western imperial colonisers (Cheng, 1985). Books in many aspects of studies, such as physics, chemistry, politics, geography, and commerce, were translated into Chinese. For those translators who wanted to incorporate Western grammar into Chinese, they regarded western languages to be more precise and logical than Chinese. They insisted that, “in order to be faithful to the original, we must remodel the Chinese language in exact accordance with the rhetorical taste and grammatical order of a Western language” (Compton 1971, p. 183). Hence, some of the stylistic and structural features of the originals were imitated through

the translation of Western works into the vernacular (Masini, 1993). Consequently, numerous foreign terms flowed into Chinese, most of which were borrowed as phonetic loans.

From the time of the first Opium War in 1840, Chinese came into intensive contact with the English language. For historical, political, and social reasons, the extent of contact between English and Chinese has varied greatly in different areas in China. The early open areas such as the southern and eastern coastal areas have had more intensive contact with English than the more inner parts of China. Language contact also varies between English and some dialects of Chinese, for example Cantonese, Min, and Wu are the dialects that have also had close contact with English. Therefore, both Mandarin Chinese and some of the other dialects have borrowed a great many lexical elements from English.

With the foundation of the People's Republic of China in 1949 and later the implementation of reforms in the 1990s, China witnessed a greater absorption of loanwords into Mandarin. Wang (1993) records over 5,300 new words or terms that emerged from 1949 to 1988 on the mainland, of which 85 are foreign words or terms. According to Wang, during the first 30 years of that period (1949–78), only 27 foreign words or terms, a mere 0.75%, were among the 3,600 new words and terms. In contrast, 58 foreign terms were among the 1,700 new words and terms that emerged during the nine years from 1979 to 1988, a percentage of 3.41% (Wang, 1993).

**Table 2**

*Neologisms in Mandarin*

Years	Total New Terms	Foreign Loan Terms	Percentage
1949–78	3,600	27	0.75%
1979–88	1,700	58	3.41%

*Note.* Adapted from Wang, 1993

Thus, the borrowing of words from 1979 to 1988 was 4.5 times higher than the amount of borrowing from 1949 to 1978. A considered survey of the terms in Li (1992) and Yu (1992, 1993) verifies the acceleration of borrowings, particularly from English. See Tables 3 and 4.

**Table 3**

*New Terms Per Year*

Years	New Terms	New Terms Per Year
1949–77	2,308	82.4
1978–88	2,781	278.1
1991–92	783	391.5

*Note.* Adapted from Li, 1992; Yu, 1992, 1993

**Table 4**

*Loan Terms and English Terms*

Years	New Terms	Loan Terms	Percentage of Loan Terms	English Terms	Percentage of Loan Terms
1991	335	21	6.27%	17	80.95%
1992	448	28	6.25%	23	82.14%

*Note.* Adapted from Li, 1992; Yu, 1992, 1993

In addition, over 80% of the recent loan terms are derived from English (mainly from American English), the international language of science and technology. English-speaking countries also exercise great economic and cultural influence, which makes their language attractive to nations desirous of cultural exchange and international development.

Before the Open-door Policy, English-Mandarin contact occurred chiefly through literary translations. In this regard, as there was no level of face-to-face contact between the speakers, it is

clear that the amount of exposure to written English in China was significantly greater than the exposure to spoken English.

Entering the 21st century, contact between English and Mandarin has increased dramatically. In the current age of the internet and ever-intensifying globalisation, Mandarin comes into more intense contact with English. English speaking foreigners, including government officials, industrialists, and merchants come into China in large numbers. English itself has become the most prestigious language on earth (Trask, 1996, p. 20). It is taught as a foreign language world-wide, sometimes as the main second language. China has the largest number of English learners as a foreign language in the world (Crystal, 1985) and English is taught in schools and universities for higher learning. There are now over 100 million English learners in China and bilingual English language students play a major role in introducing English terminology into Mandarin. The majority of Chinese people possess a knowledge of simple English words and sketchy English grammar (Crystal, 2008). The level of English-Chinese bilingualism has greatly increased since the Open-door Policy. Wei and Su (2015) estimate the number of people having learnt at least some English formally in schools to be an astonishing total of 400 million, which is around one third of the national population.

### ***2.2.2 The Current Situation of English and Borrowing in China***

The absorption of English lexical items into Mandarin Chinese has been met with positive attitudes and has continued to gain momentum over the last two decades and is indicative of the desire among Chinese speakers to “join the trend of international modernization” (Sun & Jiang, 2000, p. 98). Indeed, stereotypically positive associations of English with modernity, progress, innovation, and upward mobility have been documented among Chinese speakers (Wiebusch & Tadmor, 2009; Xu, 2009). However, at the government level, an awareness of the potential of the internationalisation of English as a hegemonic process has led some linguists and government



officials to resist the adoption of English loanwords. Li (2004) discusses the government's efforts to prevent the linguistic "contamination" of Mandarin Chinese from foreign languages such as English. Such efforts to maintain the linguistic purity of Chinese do not, however, appear sufficient to counterbalance the ongoing appropriation of English lexical items into Chinese by contemporary Mandarin speakers (Li, 2004).

The percentage of loanwords in Chinese is relatively low compared to other languages. Among the lexical borrowing rates in the Loanword Typology Project (LWT) (Tadmor, 2009), Mandarin is listed as a low borrower with a borrowing rate of 1.2%. However, the history of Chinese language is one of contact with languages in the western region, east Asian, and European countries, resulting in the assimilation and dissimilation of the Chinese language. In short, foreign languages have significantly affected the formation of the modern Chinese vocabulary (Li, 2004).

The great number of Chinese loanwords leads to questions concerning the effect of these words on the Chinese language. First, loanwords enrich the Chinese vocabulary mainly through the production of new words and morphemes. According to Masini:

Modern Chinese lexicon is not simply the fruit of the linguistic experiments that took place in the context of the literary movement of the early 20th century but in fact developed thanks both to its traditional base and to the contribution of lexical invention of the 19th century. (1993, Preface)

Second, Chinese loanwords affect the variety of Chinese syllables and phrases. This is also one of the direct influences of new vocabulary and morphemes.

### **2.2.3 The Classification of English Borrowing in Mandarin**

The studies on borrowing in Mandarin do not have a long history. In 1958 Gao Mingkai and Liu Zhengdan (1958) proposed a typology of borrowing in 现代汉语外来词研究 *Xiandai hanyu wailaici yanjiu* (Study on loanwords in modern Chinese). In their analysis these authors gave priority

to the formal relations between the source word and the new Chinese word. They were the first to give a systematic contribution to the field of *wailaici* 外来词 lit. ‘foreign + come + word’, which could not be found in any textbook until 26 years after China started its Opening-up policy. Later, many scholars tried to give borrowings in Mandarin a more accurate classification. Among the many attempts to devise classification systems for borrowings are: Gao and Liu, 1958; Luo, 1989; Masini, 1993; Shi, 2000; Wang, 1993; Yip, 2000; etc. Masini claims that Chinese scholars have never been able to provide a satisfactory typology of borrowings in Chinese. He himself classified them into six groups: phonemic loans, loan translations, semantic loans, hybrids, autochthonous neologisms, and graphic loans (1993, p. 154). Graphic borrowing means the meaning and written form of a SL item is transferred to a RL, which is rarely referred to by western scholars (such as Masini) but mainly by eastern scholars. In this kind of borrowing the written form, the Chinese character, is the medium.

The six most important types of Mandarin loans are illustrated below, with phono-semantic matching added to the list and graphic loan removed, as graphic loan basically refers to loans and return loans from the Japanese (Masini, 1993).

#### 1. Phonetic loan

The first type is yinyici 音译词 lit. ‘sound + translation + word’, similar to “phonetic loan” in Haugen’s taxonomy. Such kind of borrowing has the closest possible sound in the borrowing language to the original word. This kind of borrowing has existed since Buddhism entered China in the first century CE (Dessein & Heirman, 2011, pp. 23-26) which was the first time a significant number of foreign loanwords entered the Chinese language. With translations of the Buddhist text, the sutras, in the Han dynasty (206 BC to 220 AD), around 2,300 sutras were translated, containing circa 56 million characters (Cao & Yu, 2015, p. 204). Facing the difficulties of introducing Buddhist conceptual schemes and terms that were unknown to Chinese, translators made use of obscure characters, or those whose meanings had become obsolete, to represent the phonetic value of the

syllables in the Buddhist terms; these characters formed a “rudimentary system” (Zürcher, 2007).

These kinds of borrowings were opaque to the extent that they were unintelligible for the Chinese audience as they contained a high level of exoticism and could be very difficult to understand for the readers, who had very limited knowledge of foreign languages. Table 5 lists some examples of loans which entered the Chinese lexicon through Buddhist translations.

**Table 5**

*Phonetically Translated Sanskrit Words in Chinese*

Chinese Characters	Modern Chinese Pronunciation	Middle Chinese Pronunciation (Pulleyblank, 1991)	Sanskrit	English Meaning
佛	fó	but	Buddha	Buddha
菩提萨埵 (later shortened as 菩萨)	púsà	posat	bodhisattva	bodhisattva
僧	sēng	səŋ	saṃgha	monk
涅槃	nièpán	netban	nirvana	nirvana
刹那	chà nà	tʂʰaɪtna'/tʂʰeɪtna'	kṣaṇa	instant, moment

*Note.* Adopted from Vervaet, 2017, p. 24

The borrowings from Sanskrit had a great influence on the Chinese lexicon as some of the borrowings are specifically Buddhist terms used only inside the sphere of Buddhism, while many other others have come into the Chinese language. It could be said that the Buddhist translation strategy has laid the tradition for foreign concepts and cultural terms to be introduced into Chinese.

When it came to the 19th century, the inflow of western products, ideas, science, and technology greatly affected the Chinese lexicon. Wiebusch and Tadmor write: “Only since the 19th century, mainly after the ‘Opium War’ (1839-1842), does contact between Chinese and European

colonial languages leave traces in the Chinese basic lexicon, in spite of earlier encounters since the 16th century” (2009, p. 580). In introducing western terms concerning religion, philosophy, and science, the Jesuits encountered the same kind of problems as Buddhist translators. The same borrowing strategy, phonetic borrowing, was used, but differed in that obsolete characters were not always sought. Instead, some new characters were coined with the ‘mouth’ 口 component, which marked them as phonetic characters. It means that the mouth-radical is added to an existing character, indicating that the new character has quasi the same pronunciation as the original. (Hu & Xu, 2003, p. 313; Masini, 1993, p. 132). Some examples are *píjiu* 啤酒 *beer*, *kāfēi* 咖啡 *coffee*, *gāli* 咖喱 *curry*, *dūn* 吨 *ton*, etc.

A phonetic loan has basically two subtypes: phonetic loan and phonetic loan plus annotation. The annotation is a Chinese morpheme added to a phonetic loan to supply additional information, usually about the semantic category of the foreign item. Since the annotation is not borrowed but added, it is a subtype to the phonetic loan. The added annotation can be either kept or dropped. For example, *ballet* is borrowed as *bālei wǔ* 芭蕾舞 lit. ‘ballet + dance’, *jeep* is borrowed as *jí pǔ chē* 吉普车 lit. ‘jeep + vehicle’. But when people say *bālei* 芭蕾 without the annotation *wǔ* ‘dance’, or *jí pǔ* 吉普 without the annotation *chē* ‘vehicle’, it is still acceptable.

As Mandarin has a monomorphosyllabic system (DeFrancis, 1989), each syllable represents a morpheme, which is mostly true in modern Chinese. When a foreign syllable is adapted into a Mandarin syllable, the new foreign meaning is added to the original meaning. So, when the loanword is monosyllabic, it is always a phonetic loan and semantic loan/shift at the same time when it gets adapted. For example, the syllable *xiu* is the closest phonetic match to the English word *show*. Thus, *show* is phonetically adapted into Mandarin *xiu*. Semantically, the word *xiu* 秀 originally means ‘beautiful’ and it became polysemous after it was used to represent the English word *show*, with the added meaning ‘show, exhibit, performance, programme’.

## 2. Calquing

Calquing is a “borrowing of meaning, but not (directly) of word form” (Durkin, 2014, p. 8), which belongs to semantic loan as a broad type of borrowing only of meaning. That is “a lexical unit created by an item-by-item translation of the (complex) source unit” (Haspelmath, 2009, p. 39), while “the structure of the source word is retained” (Durkin, 2014, p. 9), which means that they are borrowed on the basis of the morphological or syntactic structure of the foreign model. It is also called a “morpheme-for-morpheme” translation, since each morpheme is translated independently to form a new compound. There are a large number of calques in Mandarin, most of which are borrowed from compound words in English, such as: *bailing* 白领 lit. ‘white + collar’ > *white collar*; *chaoren* 超人 lit. ‘super + man’ > *superman*; *niuzai* 牛仔 lit. ‘cow + boy’ > *cowboy*, etc. It can also be borrowed from an English simplex word with more than one morpheme, for example, the English word ‘lover’ consists of two morphemes: the verb ‘to love’, and the agentive morpheme *er*. These morphemes are translated separately in Chinese as the verb *ai* 爱, ‘to love’, and the agentive morpheme *ren* 人, ‘person’, which together makes a new compound *airen* 爱人, *lover*. This borrowing strategy started its tradition in the 16th century when more and more Europeans travelled to China, both merchants and missionaries. Through calquing, neologisms that were clearly based on western terms came into the Chinese lexicon. But an abundance of new terms was unintelligible for the Chinese. Some of these terms survived through the centuries, though most of them are obsolete, for example, *university* was borrowed by calquing as *gongxue* 公学 lit. ‘common + school’ (Masini, 1997, pp. 548-551), which was later replaced by *daxue* 大学 lit. ‘big + school’. Masini states, “Some semantic loans or loan-translations [from Jesuit missionaries] ... have survived centuries of linguistic history and native speakers would see no difference between these terms and the rest of the traditional lexicon” (1993, p. 142).

## 3. Semantic loan/shift

In Haugen's loanword classification, a semantic loan is a subtype of loanshift. A semantic loan often concerns a simplex word, which means that an existing simplex word acquires a new meaning under the influence of a foreign word. It is caused by the loanword morphemic substitution of a native morpheme, that is, a native word's meaning is expanded by adding the meaning of the loanword. This way of integration of loanwords started as early as the Buddhist translators and the Jesuits. They borrowed the meaning of the conceptual schemes and represented them by using the redefined ancient terms (Kurtz, 2011). It is unsure if the semantics injected into the terms could be correctly understood by Chinese people as the meanings were from a totally different world. It was the same as loan translations; such cases are hard to identify if they have been in the Chinese lexicon for a long time, especially when the borrowed meaning and the native meaning are similar, termed loan synonym by Haugen (1950). Wiebusch and Tadmor (2009, pp. 590-591) term semantic borrowing as a "shift in meaning" happening to a native word: the meaning of a Chinese word or morpheme is expanded or modified under the influence of a foreign word. They give the example of *dian* 电 which meant *lightning* in the past, but nowadays carries the meaning of *electricity*. As Chinese scholars use *yiyici* 意译词 lit. 'semantic + translation + word' to include free translation, loan translation, and semantic loan, *yiyici* 意译词 is often confused with semantic loan. It is not clear what semantic loan really refers to for many people. Semantic shift is less prone to be confused with the Chinese term *yiyici* 意译词. It refers to specifically the type where only the meaning is shifted to a native word, for example, the word bridge is borrowed as *qiao* 桥 with the meaning of 'a card game' added to the native Chinese morpheme. Thus, it is recommended that "semantic shift" be used as a clearer term to indicate that the meaning of the original word has shifted to a native word.

#### 4. Hybrid borrowing/loanblend

This type is loanblend or hybrid, which is the same as loanblend by Haugen (1950), is also defined by Haspelmath as, "borrowings which consist of partly borrowed material and partly native

material” (2009, p. 39). This type of borrowing mainly happens with compound words, for example, *ice-cream* is borrowed as *bingqilin* 冰淇淋, in which *ice* is rendered with a native Mandarin morpheme meaning ‘ice’ while *cream* is borrowed phonetically. Loanblends can be borrowed from a compound word or a simplex word. Some other examples include: *tuopuxue* 拓扑学 ‘transliteration of topo + a branch of science’ > *topology*; *naixi* 奶昔 ‘milk + transliteration of shake’ > *milkshake*.

#### 5. Autochthonous neologisms/free translation

There are some cases of borrowing without the phonetic approximation to the original form or the structural preservation of the source word. In these cases, only the foreign concept is borrowed by using a native term to express it (Bloomfield, 1933, pp. 455-485). For example, Mandarin *diannao* 电脑 lit. ‘electric + brain’ for the English term *computer*. This type of borrowing is cited by Haugen as “autochthonous neologism” (1953, p. 403), who points out that the native word has no phonological similarities to the foreign word. This type is also called “loan creation” or “descriptive translation” where the invented words represent the foreign concepts which are new to the borrowing language of Chinese. But the meanings the words carry are pure Chinese: “pure” in the sense that there is no syntactic or semantic influence from English and they are formed from existent Chinese morphemes according to the rules of Chinese word formation. T’sou calls this category “descriptive labels”, as free translation is “the description of culturally non-compatible items in a Chinese way” (2001, pp. 48-49). More examples include *guohui* 国会 lit. ‘state + congress’ > *parliament*; *linggan* 灵感 lit. ‘intelligence + sense’ > *inspiration*. This type arguably does not constitute true loan words. In many cases, it is difficult to see whether the meaning of the word is due to foreign influence, or solely due to developments in the native language. As Jones states, “It is sometimes impossible to decide whether foreign influence is responsible, or whether the semantic extension is due solely to spontaneous and autonomous development within the native language” (2011, p. 24). Casalin also mentions the category of “autochthonous neologisms” (2008, p. 138): new

Chinese terms which are most probably based on a foreign word, but their relation is not explicitly clear. Examples of free translation/autochthonous neologisms are: *chukou* 出口, *export*; *jinkou* 进口, *import*; and *gongzi* 工资, *wages*. In this category of borrowing, Chinese morphemes are combined in a very creative way to give a description of a foreign term. Since there is no direct phonetic or semantic relation with the source word, the link to the original word is rather opaque. Therefore, this type will not be considered in this thesis.

## 6. Phono-semantic matching

This type of borrowing is not included in the traditional loanword taxonomy, but it is a branch in Zuckermann's loanword classification (2003, 2004). Zuckermann mainly separated loanwords according to whether the SL lexical item is the basic material or pre-existing RL roots/lexemes are used as the basic material for the borrowing.

- A. Using the SL lexical item as the basic material for the neologisation (in decreasing order of phonetic resemblance to the SL lexical item):
  - (A.1) Guest word, unassimilated borrowing/pure borrowing, e.g., the German word *Gastwort* borrowed into English;
  - (A.2) Foreignism, assimilated borrowing/phonetic adaptation, e.g., the English *restaurant* is a phonetic adaptation of French *restaurant*;
  - (A.3) Loanword, totally assimilated borrowing/morphemic adaptation, e.g., the American Italian *bosso* is a morphemic adaptation of English boss.
- B. If pre-existing RL roots/lexemes are used in the process of borrowing, they are classified into three subtypes: phonetic matching, semanticised phonetic matching, and phono-semantic matching. The definition of each subtype and examples are given below:
  - (B.1) Phonetic matching (PM), where the RL material is originally similar to the SL lexical item phonetically but not semantically, e.g., English *mayday* is from French *m'aider* '(to) help



me’.

(B.2) Semanticised phonetic matching (SPM), where the RL material is originally similar to the SL lexical item phonetically, as well as semantically in a loose way, e.g., Mandarin *benteng* 奔腾 lit. ‘run + rise’, English *pentium*.

(B.3) Phono-semantic matching (PSM), where the RL material is originally similar to the SL lexical item both phonetically and semantically, e.g., Mandarin *kekoukele* 可口可乐, English *Coca-Cola*.

Some factors need to be taken into consideration about the three subtypes. As boundaries between the subtypes SPM and PSM are vague, it is hard to judge whether the classification of a borrowing is a SPM or PSM. In both subtypes, the borrowing is semantically similar to the SL material, it only differs in degree, which is hard to measure as “loosely” is itself a vague term. Therefore, the two subtypes are treated as the same with the term phono-semantic matching (PSM) in this study. As for the subtype PM, this thesis argues that it is not very useful in examining Mandarin loanwords. According to the definition, it refers to loanwords which can be represented by pre-existing phonetically matching native material. First, most loanwords have to be phonologically adapted before entering the borrowing language. Second, even if there are some cases where the source form has a phonetic match in the borrowing language, it is not too different from the phonetic loan, as morphemic importation happens during its integration process. Therefore, this subtype is not included in the thesis.

Phono-semantic matching was claimed by Zuckermann (2003, p. 290) as an important mechanism of camouflaged borrowing which has not yet received scholarly attention. He used a Hebrew example to illustrate the formation of PSM. He claimed that Israeli word *dibuv*, ‘dubbing’, has two etymons: the English *dubbing*, and the (medieval) Hebrew [dib’bub] ‘speech’. This multi-

sourced word formation is motivated by covert cultural, social, and linguistic influences brought by language contact in this era of globalisation.

Zuckermann states that “in PSM, the phonetic fidelity to the original is often compromised for a better meaning on the basis of which could be argued that PSMs are a type of abstract calque” (2003, p. 5). He argues that PSM is a pervasive form of lexical borrowing, apparent in Israeli, Turkish, Chinese, Japanese, Yiddish, Hebrew, Arabic, creole, and many other languages. He identifies two categories of language in which PSM is particularly prevalent as a means of adopting words from a foreign language. One is in re-invented languages such as Israeli, or modern Hebrew, through which he studies the political aspect of motivational language creation. The other is in languages with a phono-logographic script, such as modern standard Chinese (2003, 2004).

PSM preserves both the meaning and the approximate sound of the reproduced expression in the SL with the help of pre-existent target language (TL) elements (Zuckermann, 2003). In the tradition of Chinese loanword studies, this type of borrowing is also mentioned by some scholars with different terms: *yinjianyi* 音兼意 lit. ‘sound + concurrent with + meaning’ by Luo (1950); and 音译兼意译 ‘phonetic translation along with semantic translation’ by Li (1990).

Zuckermann defines PSM as “a case of simultaneous substitution and importation” (2003, p. 6). PSM is distinct from calquing; while calquing includes semantic translation, it does not consist of phonetic matching. PSM retains the approximate sound of the borrowed word through matching it with a similar-sounding pre-existing word/morpheme in the target language. Thus, PSM can be regarded as a special kind of calquing, with only phonetic approximation to the original word. As Myers-Scotton points out: “Speakers try to find Chinese characters that stand for a similar reference to the borrowed words. But speakers also want the characters to sound like the borrowed word. They end up with some very imaginative ways of accommodating a borrowed word” (2006, p. 221). Zuckermann commented that Mandarin has an incredibly fertile ground for PSM because the

adaptation of foreign words cannot be separated from using indigenous characters, that is, pre-existing morphemes. Some of the examples are given in Tables 6 and 7.

**Table 6**

*Myers-Scotton's Examples of Phono-semantic Matching*

Original Form	Phono-semantic Matching	Literal Meaning
Benz	<i>benchi</i> 奔驰	run + race
gene	<i>jiyin</i> 基因	basic + element
vitamin	<i>weitaming</i> 维他命	keep + his + life

*Note.* Adapted from Myers-Scotton, 2006

**Table 7**

*Zuckermann's Examples of Phono-semantic Matching*

Original Form	Phono-semantic Matching	Literal Meaning
sonar	<i>shengna</i> 声纳	sound + receive
radar	<i>leida</i> 雷达	thunder + reach
laser	<i>leishe</i> 镭射	radium + shoot
neon	<i>nihong</i> 霓虹	female rainbow + male rainbow
tractor	<i>tuola (ji)</i> 拖拉(机)	haul + pull + (machine)
shock	<i>xiuke</i> 休克	inactive, stop, cease, dormant, rest + overcome, be able to, can, conquer
humour	<i>youmo</i> 幽默	secluded, deep and remote + silent, tacit, quiet
hacker	<i>heike</i> 黑客	black + visitor

*Note.* Adapted from Zuckermann, 2000

### 2.3 The Classification of English Borrowings in this Thesis

Based on what is transferred during the borrowing process, there are basically three broad types of lexical borrowing in the transmission process from SL into RL. As de Saussure (2011) postulated that as there is arbitrariness between the signifier and the signified (form and meaning), borrowing can be classified by the extent of retention of the form and the meaning. Theoretically, there are three possible outcomes of borrowing concerning the relation of form and meaning: 1) the form and the meaning of a unit is borrowed as a whole; 2) only the meaning is borrowed which is classified as covert borrowing; 3) only the form is borrowed, which is rarely found as meaning is always with the form. If the form is borrowed, usually, the meaning is borrowed, though the exact meaning is more or less modified. Thus, two broad borrowing outcomes will be identified.

The first outcome is the borrowing of form and meaning as a whole. This type consists of two categories: “overt borrowing” and “camouflaged borrowing”. The first category overt borrowing is so-called because the form is transferred from the SL to the RL. It includes phonetic loans and loanblends (Haugen, 1953).

The second category is camouflaged borrowing because the form is borrowed in a camouflaged way, that is, native material is used in the adaptation of the form, so it is not easily recognised. It refers to a special form of calquing in which the calque is phonetically similar to the source language material. That is to say, as soon as the foreign item is borrowed, it is immediately adapted into the RL because the recipient language uses an existing item to represent the borrowed item. As a subtype of camouflaged borrowing proposed by Zuckermann, phono-semantic matching forms the camouflaged borrowing. Zuckermann defines it as “covert, invisible borrowing, which is different from the case of classical guestwords [i.e., ad hoc creations], foreignisms and loanwords, and in which the SL lexical item is replaced by semantically, phonetically or phono-semantically related TL morphemes or lexemes” (2003, p. 37). Mailhammer commented that “Camouflaged borrowing is the most extreme form of receiving language agentivity, because the foreign nature of the borrowed material generally does not surface” (2008, p. 179).

In Mandarin, the earliest example of camouflaged borrowing (phono-semantic matching) can be traced back to the late Ming Dynasty. At that time, Xu Guangqi (1562-1633), a leading scholar and the first Chinese official who converted to Christianity, was translating *The original manuscript of geometry* from Latin with Matteo Ricci, an Italian Jesuit. They translated *geometry* as 几何 *ji.e* (this is the translator's dialect pronunciation), in effect retaining the sound shape of "geo-", and expressed the meaning "a science concerned with measuring the earth", combining sound and meaning into one word with the parts 几 *ji* 'how large' and 何 *e* 'what shape' (Chen, 1999, p. 101).

Overt borrowing and camouflaged borrowing are a bit hard to differentiate. They have common features in borrowing both the form and the meaning of the original word. They are different in that overt borrowing is realised by the imitation of the phonological shape of the SL material while camouflaged borrowing uses phonetically or phono-semantically related RL morphemes or lexemes to borrow the SL material. That is to say, in overt borrowing, the form is borrowed in an open way; the morpheme(s) representing the adapted syllable may have a combined meaning, which may or may not match the original meaning. While in camouflaged borrowing, the form and the meaning are borrowed together but in a disguised way. Often, the meaning matches the original word, but the phonological match may be sacrificed to a certain degree. Therefore, camouflaged borrowing can be seen as a special type of covert borrowing as both camouflaged borrowing and covert borrowing have the same purpose of hiding the borrowing process.

The third category is made up from the borrowing of only the meaning. It includes loan translation and semantic loan. In Fleming and Zuckermann (2013, p. 18), *ku* 酷 *cool* is regarded as a quasi-PSM because the existent morpheme *ku* matches the phonetics of the English *cool* and also has the appropriate meaning of 'extremely'. But now *ku* 酷 has the dominant meaning 'cool' in Chinese lexicon. This thesis argues that the original meaning of *ku* 酷 is 'cruel' and 'extremely', but 'extremely' is not an appropriate meaning to match the meaning of *cool*. In the *Oxford English*

*dictionary*, *cool* has mainly three meanings: 1) fairly cold; 2) calm, not excited, angry, or emotional; 3) used to show that you admire or approve of something or someone because they are fashionable, attractive, and often different. When *cool* is borrowed into Mandarin, it is often used with the third meaning. Therefore, *ku* 酷 should not be considered as a PSM, but only a quasi-PSM. In this thesis, cases such as *ku* 酷 are regarded as a phonetic loan. Cases where only the semantic is borrowed can be classified as covert borrowing.

**Table 8**

*A Unified Classification of Borrowing from English to Mandarin*

Transmission Process	Category of Borrowing	Examples
1 Borrowing of units of form and/or meaning		
1.1 Borrowing of form and meaning as a unit		
1.1.1 Phonetic loan	overt borrowing	<i>buding</i> 布丁 ‘cloth’ + ‘population’ < <i>pudding</i>
1.1.2 Loanblend	overt borrowing	<i>naixi</i> 奶昔 ‘milk + past’ < <i>milkshake</i>
1.2 Borrowing of form and meaning but in camouflage of native material		
1.2.1 Phono-Semantic Matching (PSM)	camouflaged borrowing	<i>kekoukele</i> 可口可乐 lit. ‘tasty + enjoyable, happy’ < <i>Coke Cola</i>
1.3 Borrowing of meaning		
1.3.1 Loan translation	covert borrowing	<i>miyue</i> 蜜月 ‘money + moon’ < <i>honeymoon</i>
1.3.2 Semantic loan/shift	covert borrowing	<i>bing</i> 冰 ‘ice’, also refers to the drug <i>ice</i>

## 2.4 Research Questions and Hypothesis

### 2.4.1 Research Questions

This study applies Van Coetsem's (1998, 2000) language contact model into the establishment of a new taxonomy of borrowing from English to Mandarin Chinese. This study aims to conduct a comprehensive theoretical analysis of the phonological adaptation of English loanwords in Mandarin and clear out the seemingly chaotic picture in the integration of English loanwords in Mandarin. The research questions are as follows:

1. What is the main way of integrating English loanwords in Mandarin?
2. How are English consonants and vowels mapped onto Mandarin and why?
3. What role do linguistic and extra-linguistic factors play in the adaptation process, such as the frequency of Mandarin syllables, semantics, and sociolinguistic factors? How do the borrowing factors affect the outcome?

The process of the study begins with a compilation of a corpus of English loanwords in Mandarin. The adaptation patterns of them are investigated on the segmental and the syllabic level. By analysing the data under the framework of Optimality Theory (OT) (McCarthy 2002), it supports the phonetic-phonology approach for loanword adaptation by providing evidence of how some English segments are mapped on their Mandarin phonological equivalents and how some unfaithful mappings occur because of other reasons such as vowel harmony, syllable inventory, and so on. Additionally, extra-linguistic factors are considered such as the degree of bilingualism, the channel of borrowing, the influence of dialects, orthography, etc. The semantic aspect of the characters used to record the borrowed words is another focus of the study. Aspects such as the frequency of use and sociolinguistic consideration are measured in relation to the choice of characters so that the claim that loanwords in Mandarin always seek simultaneous phonetic and semantic match to the English source is tested and challenged. With these considerations, this study proposes a model of loanword adaptation process. By doing so, we will be in a better position to understand the way Mandarin integrates loanwords and will also contribute to the literature on loanword phonology in general.

### 2.4.2 Data and Methodology

In this study, the data is composed of two parts. The first part of the data is the borrowings identified from the sources mentioned below and are put in the taxonomy to categorise their borrowings from English to Mandarin Chinese. They are collected from Chinese academic journal articles (e.g., Cao, 2006; Chen, 2002; Guo, 2007; Wang et al., 2004; Zhang J., 2005). Another important source of recent lexical developments in Mandarin is dictionaries of new words and expressions and loanwords (e.g., Kang, 2003; Song & Yang, 2002; Wang, 2006). While journal articles and dictionaries are valuable sources of data, it is worth noting that most seem to restrict themselves to a particular register or registers of language use. Specifically, formal written usage generally receives emphasis at the expense of informal spoken usage, and borrowings written using nonstandard script elements are often overlooked. Therefore, only established borrowings are recorded in dictionaries and used in standardised texts in education. Another important source of borrowing is found in the government report 《中国语言生活状况报告》 *The report of the language situation in China* (edited by Li Yuming and Li Wei) . The Chinese government has issued this report every year from 2005 to 2021. These sources contain the most up-to-date borrowings and neologisms, among which borrowings are picked out according to their etymology. The corpus might not cover the loanwords in specialized fields.

The corpus will be investigated in the following steps. First, the loanwords will be classified into different types. Second, the loanwords will be labelled with their pronunciation transcribed in both IPA and pinyin. Third, the loanwords will be given their original English meaning and the individual meaning of the characters representing them. As has been discussed about the classification of loanwords as overt borrowing, camouflaged borrowing and covert borrowing, the data will be dealt with concerning the criteria of the three types of borrowings. Covert borrowing presupposes that the meanings of the loanword and the original word match, whereas overt borrowing suggests there is mainly a phonological match between the outcome and the original



form. Overt borrowing will be represented by Chinese morphemes corresponding to the adapted syllables. Camouflaged borrowing can be seen as a special form of covert borrowing as the meaning and the phonological form are both borrowed; but camouflaged borrowing is phonetically represented by existing native material, thus it is not noticeable as overt borrowing.

This thesis will investigate the data according to semantic transparency, and how well the phonological matching is between the original English word and the adapted loan word. The structure of the thesis is laid out as follows: The first chapter is an introduction giving a general picture of the study on language contact and English loanwords in Mandarin. In the second chapter, the literature about borrowing and the classification of borrowing is reviewed. In Chapter Three, why and how Mandarin syllables and morphemes affect the outcome of loanword adaptation will be explained. Then, in Chapter Four, phonemic matching will be used to group the data into expected cases and deviant cases. If a loanword is not formally matched with its original word, it is not an overt borrowing, so it is classified as a deviant case. Such cases will be further analysed in Chapter Five, the adaptation process, in which Optimality Theory is used, and semantics obtained from the individual morphemes of the loanword is achieved to see if the deviated cases are caused by an effort to achieve semantic matching, or caused by other factors.

In the study of Mandarin loanwords, it is widely believed that Mandarin prefers to borrow the semantics of the foreign word. Linguistically, semantic borrowings are claimed to not comprise a discrepancy between the semantics of the loanword and the meanings of the individual characters (morphemes) while phonetic loans are considered exotic, barbarous, and uncultivated because the semantic meaning of the morpheme is often completely irrelevant (Kurtz, 2011, p. 40). From a sociolinguistic aspect, Chinese purists attempt to avoid the use of phonetic loans and make great efforts to bring up alternative translations. As Wang Li put it, "Semantic (rather than phonetic) translation reflects the national self-esteem of the Chinese speaking people" (1958, pp. 13-19, cited in Chen, 1999, p. 111). In this thesis, it is hypothesised and demonstrated that in contrast to the

traditional assumption and despite the national language purists' insistence, Mandarin isn't a language that predominantly borrows covertly; it borrows overtly in the majority of cases. Mandarin integrates loanwords in the same general trend as most languages, where the initial emphasis is on the phonetic rather than the semantic elements of the loanword and semantics is not a major factor that influences the outcome of loanwords. The fact that Chinese is morphosyllabic is the real reason that decides the loanword adaptation. By carrying out a thorough investigation on the phonetic assimilation of English loanwords in Mandarin, along with the analysis of the impact of the monosyllabification of Mandarin phonological system on borrowing this study will show the underlying mechanism that dominates the process of loanwords entering Chinese. Before the phonetic investigation of the loanwords is carried out, we will first have an explanation of Mandarin syllables and morphemes and analyse their impact on borrowing.

### **Chapter Three**

#### **Mandarin Syllables and Character/Morpheme Structure and their Impact on Borrowing**

This chapter is the theoretical background of the thesis. It gives a preliminary observation on the Chinese language, its syllables, its writing system and its morphemes, and the intertwined relation among them. In the first section, the difference in loanword adaptation between alphabetic languages, and loanword adaptation between an alphabetic language and Mandarin, is discussed.

The connection between the Chinese writing system and the adaptation of loanwords is set up. From this connection, we can hypothesise that the Chinese writing system/morpheme structure has an impact on the adaptation process. Therefore, the operation of the writing system/morpheme is added into the overall model of how a loanword is integrated into Mandarin. In the second and third sections, how Mandarin syllables and the writing system affect loanword adaptation is investigated. These aspects are fundamental to Mandarin loanword integration.

### **3.1 Difference Between the Adaptation Process in Mandarin and in Other Languages**

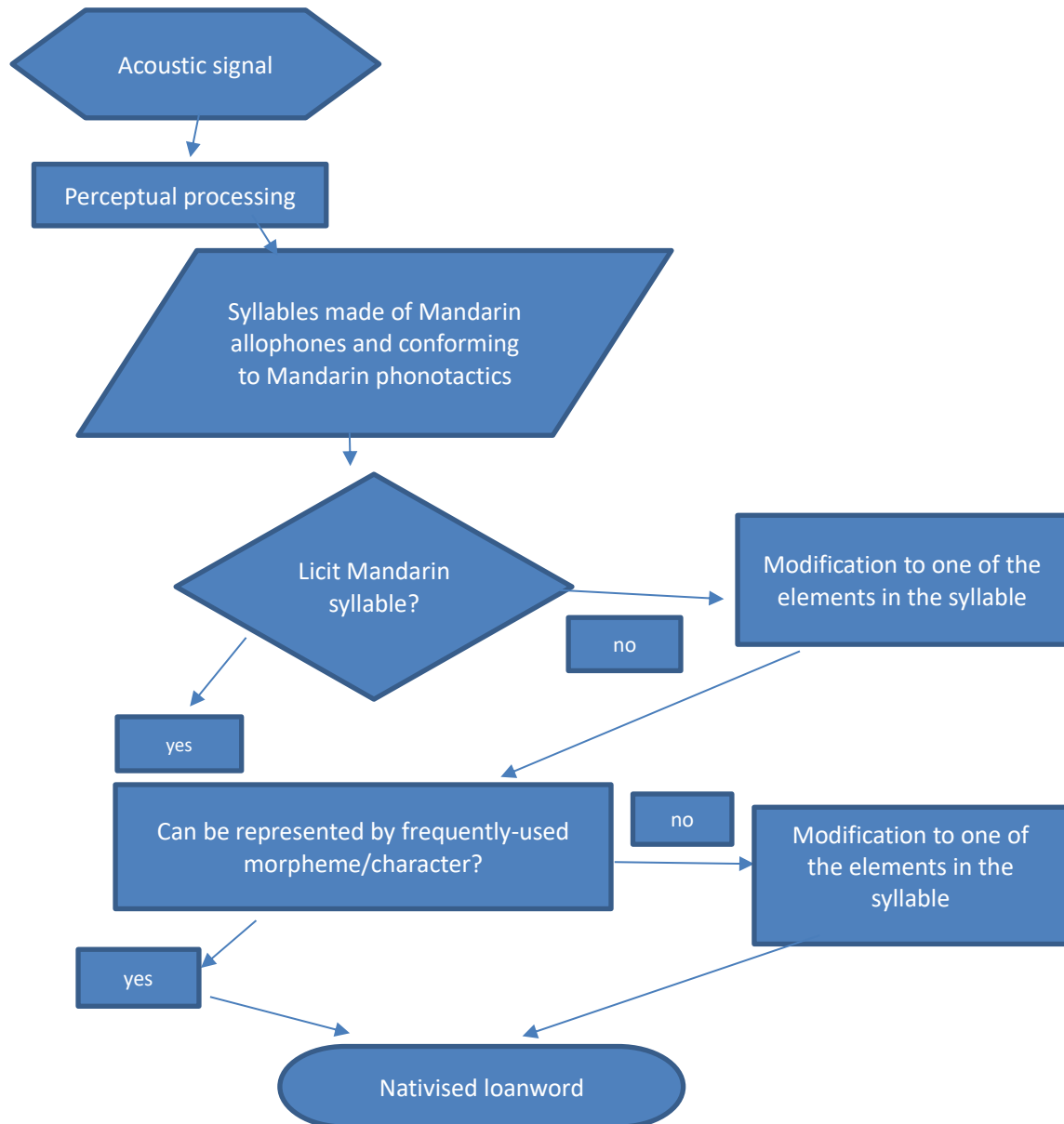
Ferdinand de Saussure divided the world's languages into two large writing systems: the ideographic system in which "each word is represented by a single sign that is unrelated to the sounds of the word itself"; and the phonetic system which "tries to reproduce succession of sounds that make up a word.... The classic example of ideographic system of writing," Saussure declared, "is Chinese" (2011, pp. 25-26). One significant difference between Mandarin and languages based on an alphabetic writing system is that an alphabetic system is a system in which graphic signs represent individual sounds or sound segments; while Mandarin is written down with a logographic writing system in which every sign (Chinese character) represents a morphological unit (Bussmann, 1998, p. 46). In other words, the characters are the morphemes in Mandarin, and the morpheme system is encoded in the characters. Such a system has a great impact on the adaptation of loanwords because when a word is borrowed and written down, the choice of character automatically entails the choice of meaning.

In the previous chapter, the adaptation of loanwords could be classified from two aspects, phonology and semantics. If loanwords are integrated overtly, the closest approximation of the original pronunciation is obtained, resulting in the phonological adaptation of the loanwords. This process happens with both alphabetic languages and Mandarin. For example, if an English L1 speaker borrows a loanword from Mandarin, Korean, Arabic, or any language with a different writing

system, the writing system of English doesn't play a role in the adaptation. The adapter would only care about how to approximate the original sound. But in Mandarin, the adaptation has to settle with syllable/syllables that are close to the original sound and are also licit in Mandarin. As Alleton argues, "To approximate the phonetic form of a foreign word, one has to break this word into segments corresponding to Chinese syllables" (2001, p. 21). The mandatory use of morphemes instead of phonemes puts serious limits on precisely reproducing the original pronunciation (Chan & Kwok, 1982, p. 16). Although some loanwords are written in Roman letters, or in Roman letters alongside characters, they are very limited. The general option for Mandarin to integrate a loanword is to write it down in characters. Different to alphabetic languages, for which the adaptation mechanism finishes its work after the phonological adaptation, Mandarin has a further operation in the adaptation mechanism, which is the operation of the writing system.

Imagine that a loanword has been adapted to a licit Mandarin syllable. The syllable may correspond to a morpheme/character which is little known or of low frequency. Then, representing the syllable with the character may not be a good choice because people may not be able to read the word. In such a situation, the adapter may seek a less phonetically matched syllable, corresponding to a more frequently used morpheme. Or the low frequency morpheme/syllable is not in the adapter's lexicon, and the result is that what he heard is a vaguely similar syllable which is a more common morpheme in his lexicon. To summarise, whether a morpheme will be used is dependent on how well it is recognised by Mandarin speakers. Such cognition of the usefulness of morphemes will impact the adaptation and cause loanwords to be not exact according to the phonetic similarities that are normally expected.

Before further discussion about how Mandarin syllables and the Chinese writing system affect loanword adaptation, a model of the adaptation process will be established to show how a loanword is adapted into Mandarin:

**Figure 2***How a Loanword is Adapted into Mandarin*

The model has two levels: the perception level and the modification level. At the perception level, the input of foreign sound sequence is perceived by the borrower. The input is the perception of the source language. This is neither the underlying form of the source language nor an underlying form of the borrowing language – it is a perceived form. It is a combination of perceptual and

phonological influence (Yip, 2002, 2006). The source-recipient correspondence relation ensures that the spoken form of the loan word is as faithful as possible to the perceived loan form. In other words, the borrower attempts to maximise perceptual similarity between the perceived source form and the loan form. At the modification level, the syllable and the morpheme of Mandarin decide whether the approximation of the perceived form is licit or not, and whether it corresponds to a frequently used Mandarin morpheme. If it is, a character representing the morpheme will be used to record the syllable. If not, it will be modified into a licit syllable that corresponds to a frequently used morpheme.

### **3.2 How Mandarin Syllable Affects Loanword Adaptation**

#### **3.2.1 Fixed Mandarin Syllable**

The Mandarin syllable inventory is very fixed caused by the restrictive phonotactics; a linguistic factor that hinders the convenience of phonetic borrowing. It can be understood in several levels. First, the overall number of syllables is rather stable, and the syllables are considered as licit only if they are morphemes and can be represented by characters. Every phoneme is strictly bound to its environment in the syllable, which means that the combination of an initial consonant and the final rhyme is not arbitrary. As Novotná put it, “the structure of the Chinese syllable is very precisely fixed and does not allow exceptions in the membership of phonemes in the initial, medial and final positions” (1967, p. 105). This fixed structure causes the imprecise phonetic matching between the original sound and the adapted sound although the English sounds can be matched to Mandarin phonemes. In fact, in Mandarin there exist nine consonant phonemes with a corresponding English phoneme sharing the same manner and place of articulation: /f/, /s/, /m/, /n/, /ŋ/, /p/, /t/, /k/. But not all the consonants can be followed by any vowels. For example, [mi] is a licit syllable in Mandarin, [fi] is not, though Mandarin has phonemes /f/ and /i/ and [fi] does not violate the phonotactic

constraints in Mandarin. [fi] is considered as illicit because it does not relate to any morphemes and does not have a character to represent it. So, if a sound sequence is [fi], it would be perceived as [fi], but not borrowed as [fi]. It has to be modified, generally on the rhyme part, to become some other syllable, such as [fei]. The adaptation outcome is greatly affected by the syllable inventory. Thus, the Mandarin phonemic system is considered impenetrable due to the strictly limited distribution of the phonemes.

Second, different phonemes have significant differences in their ability to combine finals. A Mandarin syllable can be described as composed of an initial consonant and a final part, which can be a vowel, or a diphthong, or a vowel with a nasal coda /n/ or /ŋ/. Among the 22 consonants, some can be followed by almost all the finals, while some can be followed by very few finals. For example, the most active consonant is /l/, which can be followed by 25 finals. On the other hand, the least active consonant is /f/, which can only be combined with nine finals. Therefore, the syllables beginning with /l/ are a lot more common than syllables beginning with /f/. This inconsistency of combinability among initials and finals can have an impact on the adaptation outcome. For example, Mandarin /ɹ/ is one of the less active consonants, only combining with 14 finals. The syllables beginning with /ɹ/ are /ɹʌ/, /ɹɿ/, /ɹu/, /ɹwei/, /ɹau/, /ɹou/, /ɹan/, /ɹən/, /ɹun/, /ɹaŋ/, /ɹəŋ/, /ɹoŋ/, /ɹwan/, /ɹwo/. An English sequence /ɹæ/, /ɹɛ/ /ɹai/, /ɹou/ cannot be matched to a Mandarin syllable beginning with /ɹ/, instead, they are matched to a Mandarin syllable beginning with /l/ because Mandarin had /la/, /lei/, /lai/, /lou/, etc., thus the combinability of /l/ is much higher than /ɹ/. Some examples are *rally* > *lali*, *reggae* > *leigui*, *rifle* > *laifu*, and *romantic* > *luomandike*.

Last, but not least, the syllables may have different tonal distribution, which means that some syllables may have four tones, while some may have only one tone, which causes further differences between the combinability among different consonants.

### **3.2.2 Simple Syllable Structure Causes Variation in Loanword Adaptation**

In Mandarin, syllables are simple units, most of them have the structure of CV, CVV, or CVC, (where C stands for consonant, V stands for vowel), the only two codas being /n/ and /ŋ/. There are about 400 syllables, disregarding tone, but about 1,200 tonal syllables. When the English words have coda consonants, there can be two ways to adapt them: deletion or paragoge. Therefore, there may be two different outcomes. For example, *mile* can be adapted as *mai.er* or just *mai*. As for consonant clusters, there may also be two ways to adapt them for one word. Usually, for onset consonant clusters, an epenthetic vowel is inserted between the members of the cluster, for example, *browning* > *bolangning* 勃朗宁. In some cases, the second member of the cluster can be omitted, such as *microphone* > *maikefeng* 麦克风. As for the coda clusters, there may also be several ways to modify them: the consonant cluster can be deleted, *index* > *yinde* 引得; the final consonant can be deleted, *toast* > *tusi* 吐司; a vowel can be inserted between the cluster; and a paragodic vowel can be added after the last consonant, *karst* > *kasite* 喀斯特. If the coda has a nasal or an approximant, the adaptation may be more varied. Coda /m/ may be substituted both by /n/ and /ŋ/, for example, *opium* > *yapian* 鸦片, *totem* > *tuteng* 图腾. If the approximant /l/ or /ɹ/ is in the coda, they may be adapted into a vowel or a retroflex syllable [ʐ]. All these different adaptation strategies are taken to fit the adapted sound sequence into the Mandarin phonotactic constraints.

### 3.3 How Chinese Writing System/Morphology Affects Loanword Adaptation

#### 3.3.1 Chinese Writing System and its Relation with Chinese Morphology

In order to understand how the Chinese writing system affects loanword adaptation outcomes, it is necessary to grasp the relation between Chinese characters and the morphemes they represent. Unlike languages written with alphabetic letters, Chinese is recorded with characters. The earliest known record of Chinese characters is the inscriptions found on oracle bones dating back to



1200 BC (Fisher, 2001) and the nature of the inscriptions are believed to be pictographic. Some characters taken from the oracle bones still retain their shape and form in their modern counterparts, making the writing system one of the oldest continuously used systems in the world. Yet, the majority of the characters have changed a great deal from their inception to their modern script, whereby the modern ones are not recognisable from intuition as the oracle ones are. Robinson also raises the question about “how particular characters have come to have the meaning they have” (2007, p. 185). Chinese characters were created and changed over time by different writers speaking different dialects (DeFrancis, 1984, 1989; Robinson, 2007; Fisher, 2001). A standard script was introduced in 211 BC with the unified China established by First Emperor of Qin, several thousand years after the first creation of Chinese characters (Robinson, 2007).

The total number of characters in Chinese also changes through history. In ancient China, the *Kangxi Dictionary* compiled in the 18th and 19th centuries contains more than 47,000 characters. However, the true size of a character inventory can never be clear. In modern China, after the movement to simplify classic Chinese characters in the 1950s, most authorities agree that there are more than 50,000 characters; dictionaries often trim the list to less than 20,000; yet knowing the 3,000 most frequently used characters is enough to read daily newspapers. In 1952, the Chinese Ministry of Education compiled a list of 1,556 commonly used characters based on their appearances in school primers, surveys, and statistical reference works. The list was checked against nine different types of current publications totalling 30,000 characters. The list was found to accommodate 95% of all appearing characters (Cao et al., 1955, pp. 107-108).

In classical Chinese, the ratio between word, character, and syllable is 1:1:1. Today, the majority of Chinese lexicon consists of bisyllabic or polysyllabic words. Still, the majority of morphemes in Mandarin are monosyllabic and literate speakers are aware of the meanings of the characters in the bisyllabic or polysyllabic words, that is, speakers are aware of the historical meanings of originally monosyllabic morphemes represented by characters. That is to say that

although the principle that a character is related to one meaning is violated, the Chinese characters still constitute a morphemic writing system. Chao (1968) asserted that even in the case of polysyllabic words, it is still the individual characters with which they are composed that serve as the primary unit of metalinguistic awareness for Chinese speakers.

When making comments on the characteristic of Sino-Tibetan languages, Li Fangkuei said: One of the characteristics of this family (Sino-Tibetan) is the tendency toward Monosyllabism. By Monosyllabism we do not mean that all the words in these languages consist of single syllables, but that a single syllable is an important phonological unit and often is a morphemic unit, the structure of which is rigidly determined by the phonological rules of the language, and serves as the basis for the formation of words, phrases, and sentences. (1973, p. 2)

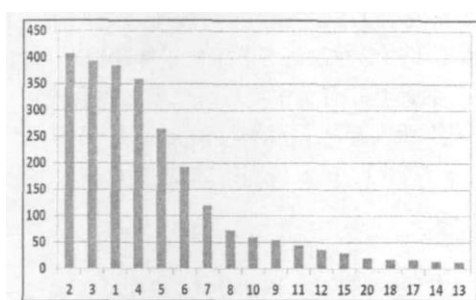
Chao (1968) also emphasised the monosyllabism of Chinese: “This is the sense in which Chinese has been called, and to a large extent is, a monosyllabic language — a language in which every syllable has a meaning” (p. 239). In other words, there is no syllable which contains no meaning in Chinese. “Completely meaningless monosyllables in Chinese are always felt as something of anomaly” (Chao, 1968, p. 139).

Another important feature of the writing system is the great number of homophonous characters. Mandarin has an extraordinarily high degree of homophony. As Mandarin is a morphosyllabic language (DeFrancis, 1984) and the vast majority of morphemes are monosyllabic, each syllable represents a morpheme. With only 402 syllables (without tone distinction) or about 1,200 syllables (with tone distinction), homophones are in quite a lot of syllables, the worst case being /i/ which has more than 100 characters. There are only 23 syllables which happen to have no homophones. A syllable commonly has ten to 20 different meanings borne by the homophonous characters. The phenomenon of such a high rate of homophonic characters undoubtedly brings difficulty to the daily use and information processing of Chinese characters.

Since Chinese has such high degree of homophony, a question might be raised about the frequency of the homophonic characters in Chinese lexicon. How frequently are different characters used in the Chinese lexicon? Do they show significant frequency differences? In a corpus study on the 2,500 commonly-used Chinese characters, Xie et al. (2013) report that there is a significant difference in the distribution of the 2,500 commonly-used characters and the number of homophones is inversely proportional to its total frequency. The distribution of homophonic characters is illustrated in Figure 3:

**Figure 3**

*Distribution of Homophonic Characters in Chinese Lexicon*



*Note.* Xie et al., 2013, p.36

The horizontal line indicates the number of homophonic characters; the vertical line shows the distribution frequency of the characters in the corpus. There is a general declining tendency for the frequency of homophonic characters, that is, if a syllable has more homophonic characters, the less frequently the characters are used in Chinese lexicon. One concern is that homophones will cause misunderstandings in communication. But in daily communication, there are few obstacles caused by homophones. It is achieved because most of the Chinese words are bisyllabic, which greatly reduces the possibility of coincidence of homophonic words. In another study on the relation of character and syllable, Dong (2020) points out that Mandarin speakers tend to use characters with

fewer homophones among synonymous characters. For example, Mandarin syllables *shuo* and *jiang* both mean ‘speak’. The syllable *shuo* only has one character 说 whereas the syllable *jiang* corresponds to six homophonic characters 讲、奖、浆、蒋、耩、疆. Among the six characters, four are commonly used. If a listener hears the syllable *shuo*, he will be quick to connect the sound with the meaning ‘speak’. But if he hears *jiang*, he will have to decide which meaning the syllable is referring to in the current context. It will cost time and may cause misunderstanding. The most frequently used characters among the homophones will be the first to come to the listener’s mind.

In summary, the fact that the majority Mandarin morphemic unit is monosyllabic written down by one character, that is, the Chinese has a morpho-syllabic writing system and high homophony in Chinese characters have impact on the borrowing of foreign linguistic element. When a foreign syllable is adapted into Mandarin, it will be written down as a character, which automatically carries a meaning with it. Chinese characters are claimed to contain six “myths” in *The Chinese language: Fact and fantasy* by John DeFrancis. One of the myths is the “Monosyllabic Myth: ... any syllable found in a Chinese dictionary can stand alone as a word” (1984, p. 177). Chao commented on the myths, saying that “the so-called ‘monosyllabic myth’ is in fact one of the truest myths in Chinese mythology” (1968, p. 239), which indeed emphasises the nature of the morphosyllabicity of the Chinese writing system.

How is the phonetic adaptation achieved, and how is the semantic of the character used (or avoided) in the integration of loanwords? In the next section, we will have a look at how Chinese characters are coined to be specifically used in loanwords to avoid the semantic interference of the native characters.

### **3.3.2 Special Characters Used in Loanwords**

The Chinese writing system is an open system, which means that it can be expanded by creating new characters or reduced by deleting or merging characters. In modern Chinese, the majority of characters are called “radical + phonetic character” 形声字 lit. ‘shape + sound + character’. The radical is a semantic indicator of the character, from which a general meaning of the character can be guessed. Thus, radical + phonetic character is also called “semantic-phonetic character”. For example, the radical /pei/ 贝 ‘shell’ indicates that the character is related to money as shells were used as money in ancient times. The phonetic part suggests the pronunciation of the character. For example, /tʂuŋ/ 中 ‘middle’ is a phonetic part for many radical + phonetic characters, such as 忠 ‘faithful’, 种 ‘seed’, 盅 ‘a cup’, 衷 ‘rectitude’, 仲 ‘second’, etc. These characters have the same pronunciation with 中 ‘middle’, only differing in tone, if there are any differences. In modern Chinese, most characters are not pictographs or ideographs, but semantic-phonetic characters accounting for 97% of Chinese characters (DeFrancis, 1989, p. 99).

Besides using the existent characters to transcribe the sounds of foreign words, Chinese also coins characters by combining a radical and a phonetic component. For example, the two characters 咖啡 *ka.fei* were coined to transcribe *coffee* by adding the radical 口 ‘mouth’ to characters 加 *jia* and 非 *fei*. A similar example is 啤酒 *pi*. The character 啤 is also coined just to transcribe the adapted syllable [p<sup>h</sup>i] > *beer*, and attained the meaning of ‘beer’. When the character 啤 is used as a bound root to form new words, it is always with the meaning ‘beer’, such as 干啤 *gan.pi* ‘dry + beer’, 黑啤 *hei.pi* ‘black + beer’, etc. But it is obvious that characters cannot be coined without limit to transcribe the vast possibilities of the combinations of foreign segments. The coinage of new characters will make the already serious homophony problem even worse. The new characters might also not be easily accepted by common Mandarin speakers. Therefore, the character creation has mostly been restricted to special or professional fields, such as chemistry and botany. Chemical elements are borrowed through the transliteration of the first syllable of the English word except for

a few most common elements such as mercury, gold, phosphorus, sulphur, aluminium, lead, carbon, iron, copper, tin, and silver. A few examples are provided in Table 9:

**Table 9**

*Chemical Elements and Corresponding Chinese Characters*

English	Chinese	Semantic Radical	Phonetic Part
Actinium	锕 a	钅 'metal'	阿 a
Barium	钡 bei	钅 'metal'	贝 bei
Vanadium	钒 fan	钅 'metal'	凡 fan
Helium	氦 hai	气 'gas'	亥 hai
Radium	镭 lei	钅 'metal'	雷 lei
Manganese	锰 meng	钅 'metal'	孟 meng
Boron	硼 peng	石 'stone'	朋 peng
Cesium	铯 se	钅 'metal'	色 se
Titanium	钛 tai	钅 'metal'	太 tai
Yttrium	钇 yi	钅 'metal'	乙 yi
Uranium	铀 you	钅 'metal'	由 you

As can be seen from Table 9, the newly coined characters made use of a character with the same pronunciation that already existed, so it is not difficult for Mandarin speakers to guess the pronunciation of the new characters. With the semantic radical pasted to the phonetic part, the readers can even get a hint of the class the chemical element belongs to: a metal, a non-metal, or a gas by the semantic radical 钅, 石, and 气.

This method of creating new characters was first employed in the late 19th century by John Fryer, a famous missionary translator who worked in China translating books for 江南制造局, The

Department for the Translation of Foreign Books at Jiangnan Arsenal Shanghai. The method was so successful that most of the characters are still used in modern Chinese.

Besides coining characters to meet the demand of recording foreign syllables, some characters with the 口 'mouth' radical are frequently used in loanwords. 口 'mouth' radical means they are only used for their phonetic value. Some characters are conventionally used to represent certain borrowed syllables, such as 特 for /tʰɿ/, 克 for /kʰɿ/, 曼 for /man/, 森 for /sən/, etc. The matching between the syllables and the characters might be stipulated by authorities, such as the translation chart in the appendix of *The English-Chinese dictionary*, and *A comprehensive dictionary of names in Roman-Chinese*, which lists the matching of syllables in 55 languages and the Chinese characters representing them. Some characters have been allocated with a syllable which is used specifically for loanwords. For example, the character 的 has two pronunciations *de* and *di*, among which *di* is used in recording loanwords as in 的士 *dishi* > *taxi*. 忒 also has two pronunciations *tui* and *te*, among which *te* is used in loanwords as in 阿尔忒弥斯 *a.er.te.mi.si* > *Artemis*.

These phenomena suggest that sometimes characters are only used for their phonetic value. For the coined characters, they are originally meaningless. For the characters which are used specifically to represent certain syllables, their true meanings are also intended to be suppressed. So are the characters which have multi-pronunciations and only one pronunciation is used in representing loanwords, which indicates that the meaning of the character is not used in loanword adaptation. The use of these characters shows that the phonology of the original sound is the more important element in loanword adaptation.

What should be kept in mind is that the above-mentioned ways of using characters are not the normal ways Chinese characters are used in loanword adaptation. The characters which are used only for their phonetic value are limited. The default operation is that existing characters are used for loanword adaptation. As characters are related to syllables and morphemes, when the

adaptation outcome is two (or more) syllables, the loanword will be written down with two (or more) characters, which is the same as the majority of Chinese complex words.

### 3.3.3 The Semantics of Phonetic Loanwords

How to get the semantics of phonetic loanwords? First, we need to know how Chinese lexicon is composed and processed. In classical Chinese, the great majority of morphemes coincide phonologically with a monosyllable and so do words. It is also right to say that almost every syllable matches a morpheme and is recorded by a character, which is also monosyllabic. That is to say, every character represents a monosyllabic word. In modern Chinese, there are far more polysyllabic words, mostly disyllabic and trisyllabic words, which can be composed of strings of monosyllabic morphemes (free root, bound root, derivational affix, and grammatical affix). In fact, more than two-thirds of modern Chinese words are disyllabic (Yip, 2000). These words, whether bisyllabic or trisyllabic, can all be called complex words or gestalt words (Packard, 2000), among which bisyllabic words take up the majority of the Chinese lexicon. In the combination of the component morphemes, there can be various combination choices. Packard (2000, p. 81) summarises the four combination types between root words, bound roots, word forming affixes, and grammatical affixes; yielding four types of complex words in Chinese. Examples of these four types of complex words are provided in the Table 10:

**Table 10**

*Four Combination Types in Chinese Complex Words*

Word Constituents	Word Type	Examples
Two root words	Compound word	冰山 bingshan 'iceberg'
Root word plus bound root, or two bound roots	Bound root word	橡皮 xiangpi 'rubber'
Bound root or root word plus word-	Derived word	房子 fangzi 'house'



forming affix		
Root word plus grammatical affix	Grammatical word	我们 women 'we/us'

*Note:* Packard, 2000, pp. 80-81

From the table, we can see that only the two root words are true compounds. Yet the four types of complex words all combine two syllables, written with two characters. Therefore, they all look like compound words. The normal expectation for compounds is that they are compositional, or have some degree of compositionality. The kind of expectation that people have with compounds is that both syllables have some meaning, and they have some structural relation. Thus, when a loanword is adapted into two syllables and represented with two characters, people will think that there are two morphemes in the word, which is especially strengthened by the fact that characters are associated with morphemes.

Mandarin complex words can have a range of possible inner structures. The most frequent structures are noun + noun, verb + verb, verb + noun, adjective + noun. Packard (2000, p. 127) supports the "Headedness Principle", indicating that nouns predictably have nouns on the right and verbs predictably have verbs on the left. This conclusion is drawn from the frequency calculation of different complex word structures.

**Table 11**

*Complex Noun, Verb, and Adjective Structures*

Word Structure	Nouns	Verbs	Adjectives	Total
NN	6,910	21	90	7,021
NV	306	446	72	824
NA	168	?	209	377
VV	276	3,730	103	4,109
VN	1,581	2,940	378	4,899
VA	?	434	?	434

AN	2,961	?	198	3,159
AV	116	707	173	996
AA	163	?	1,609	1,772
*	257	72	66	395
TOTAL	12,738	8,350	2,898	23,986

\*indicates unanalysable words, e.g., phonetic loans

*Note.* Huang, 1997, cited in Packard, 2000, p. 127

Li and Thompson comment on the transparency of the complex words, saying that “As time moves on, this semantic connection begins to recede from the realm of the knowledge of the native speakers until, finally, it is totally lost” (1989, pp. 46-8). From this statement, we can infer that generally, complex words are semantically transparent when they are first made. The untransparent complex words tend to be old words. This assumption also applies to loanword adaptation. As loanwords are new words when they are adapted into bisyllabic words in Chinese, if their semantics are transferred, they are also expected to be compositional, that is, the meaning of the loanword will be determined by the component morphemes.

The structures of complex noun words in Chinese will be briefly reviewed, as nouns constitute the majority of words in the data of the study and are easily the most borrowed elements. Although some researchers (Jespersen, 1954; Downing, 1977) argued that noun compounds encode an infinite set of semantic relations, many agree (Levi, 1978; Finin, 1980) there is a limited number of relations that occur with high frequency in noun compounds.

First, we will look at the possible component combinations within a complex noun word in Chinese. Most complex noun lexical items in Chinese take the form of Noun1 + Noun2 (N1+N2). The relation between the N1 and N2 can be a hierarchical “modifier-modified” relation, or it can be a non-hierarchical, parallel relation (Packard, 2000, p. 85). The hierarchical relations between N1 and

N2 can be nearly without limit, constrained only by pragmatic, “real world” considerations (Li & Thompson, 1989). The major hierarchical relations are listed as follows:

**Table 12**

*Major Hierarchical Relations in Chinese Complex Noun Words*

Hierarchical Relations Between N1 and N2	Examples		
	Character&Pinyin	Literal Meaning	English Gloss
N1 is the place where N2 operates or is located	眼镜 yanjing	eye-lens	‘glasses’
N2 indicates a medical condition of N1	肺炎 feiyan	lung-inflammation	‘pneumonia’
N1 depicts the form of N2	砂糖 shatang	sand-sugar	‘granulated sugar’
N2 depicts the form of N1	雪花 xuehua	snow-flower	‘snowflake’
N2 is used for N1	菜刀 caidao	vegetable-knife	‘cleaver’
N1 is the habitat of N2	水鸟 shuiniào	water-bird	‘aquatic bird’
N2 is caused by N1	水灾 shuizai	water-disaster	‘flood’
N2 is a container for N1	茶杯 chabei	tea-cup	‘teacup’
N2 is produced by N1	鸡蛋 jidan	chicken-egg	‘(chicken) egg’
N2 is made from or composed of N1	皮鞋 pixie	leather-shoe	‘leather shoes’
N1 is a type or subclass of N2	兰花 lanhua	orchid-flower	‘orchid’
N1 is a metaphorical description of N2	银行 yinhang	silver-business	‘bank’
N2 is a source of N1	电池 dianchi	electricity-pool	‘battery’
N1 is a source of N2	海盐 haiyan	sea-salt	‘sea salt’
N2 is something that N1 has or contains	票根 piaogen	ticket-root	‘ticket stub’
N1 is something that N2 has or contains	名片 mingpian	name-strip	‘name card’

*Note.* Packard, 2000, p. 86

When N1 and N2 are semantically equivalent to each other, or they are semantically disparate, they can be in a non-hierarchical relationship. If N1 and N2 are synonymous, the complex noun is usually also a synonym to N1 and N2; if N1 and N2 are not synonyms, the meaning of the gestalt noun is usually a superordinate class that includes both N1 and N2. Table 13 gives some examples for N1 and N2 in parallel relation:

**Table 13**

*Parallel Relations of N1 and N2 in Chinese Complex Noun Words*

Parallel Relations Between N1 and N2	Examples		
	Character & Pinyin	Literal Meaning	English Gloss
N1 and N2 are synonyms	盗贼 daozei	thief-thief	‘thief’
N1 and N2 are not synonyms	刀枪 daoqiang	knife-gun	‘weapons’

*Note.* Packard, 2000, p. 86

When loanwords are adapted into Mandarin syllables, the representing characters’ meaning will decide the semantics of the loanword, which will be achieved by either the hierarchical or the parallel relation between the two morphemes.

Different characters can be seen as different morphemes, and they can be homonyms if they are of the same syllable. If one character has multiple meanings, it is polysemy. When a syllable is phonologically adapted, the corresponding Mandarin syllable may be represented by several Chinese morphemes. If there is one morpheme which can match the original meaning of the word, then there is a possibility to achieve the semantic transparency of the loanword. But for the possibility to be realised, the frequency of the meaning should also be considered. If the meaning is very rare, normal people will not be able to know and make the connection between the word and the meaning. Therefore, if a character has multiple meanings, only the most frequently used

meaning will be recognised. The phenomena of homonym and polysemy will be explained in the following example of the morpheme *yi*.

All of the five characters 易、亿、译、异、艺 correspond to the same syllable *yi* /i/, but each of them has a different meaning, that is, each represents different morphemes. The same character may also be used to write different meanings: 易 *yi*, for instance, has many meanings. It means 'easy' in 容易 *rong.yi* 'easy'; it means 'change' in 移风易俗 *yi.feng.yi.su* 'change the custom'; it means 'exchange' in 交易 *jiao.yi* 'make a deal'; and it means 'amiable' in 平易近人 *ping.yi.jin.ren* 'easy to approach'.

What makes things more complicated is that a character can have not only different meanings, but also different pronunciations. It is estimated that there are over 5,000 characters with more than one pronunciation. Even in the most frequently used 500 characters, there are 250 characters with more than one pronunciation. For example, 传 has two pronunciations: *chuan* in 传递 *chuan.di* 'pass + deliver'; and *zhuan* in 传记 *zhuan.ji* 'biography + written'. 冠 also has two pronunciations: *guan1* in 冠冕 *guan.mian* 'crown + official hat'; *guan4* in 冠军 *guan.jun* 'first place + army' meaning 'champion'. The characters are called polyphones.

For loanwords, their meanings are expected to be obtained from the component morphemes based on the complex noun structures. Yip summarises the various loanword outcomes by saying that "The inherent meaningfulness and moldability of the Chinese language's phonetic and graphitic elements enables translators to adopt diverse strategies in the production of optimally acceptable forms" (2000, p. 327). Yip hereby refers to the meaningfulness nature of Chinese characters, the efficiency of word-formation techniques, and the abundance of homophones. As complex nouns can be compositional or non-compositional, a Mandarin speaker will be fine with the non-sensical meaning, which means that the loanword does not have a transparent meaning. For example, *koala* is borrowed as *kaola* 考拉 'test, exam + pull'. Packard argues that as phonetic loans

generally do not follow the Headedness Principle, just as *kaola* 考拉 ‘test, exam + pull’ does not have a noun on the right even though it is a noun, the characters representing the adapted syllables are “meaningless, used for their phonetic content alone” (2000, p. 230). This view is criticised by some scholars, who label this as very “un-Chinese”, as Chinese readers expect words in which there is at least an indication of meaning (Chan & Kwok, 1982, p. 19). This thesis argues that the real meaning of the loanwords can be learned as a whole, despite the non-sensical combination of component meanings. Mandarin speakers have no difficulty in relating *kaola* 考拉 with the adorable animal. There is no problem for such loanwords to be integrated in Mandarin lexicon. In this sense, the semantic transparency is not so important in the borrowing process.

Yet the choice of the morphemes/characters for the adapted syllable is not totally arbitrary. Semantic transparency does influence the borrowing process in the sense that the component meanings will be good if they don't interfere with the original meaning. For example, if the meaning of a loanword is derogative, a character with positive meaning is not a good choice in representing the loanword. Furthermore, if a character can have some association with the loanword's semantic field, it will be chosen. This can be seen from the priority of meaning over sound in the character choosing found in loanwords in some specialised fields. For example, characters with the meaning of good, health, peace, fine, etc. are often chosen to represent the sounds in medicine, such as 平 ‘peace’, 泰 ‘safe’, 宁 ‘tranquil’, 安 ‘peace’, 乐 ‘happy’, 利 ‘beneficial’, 妥 ‘proper’, and 灵 ‘effective’. Characters with the meaning of ‘kill’ are often used to record poison or pesticide, such as 毒 ‘poison’, 杀 ‘kill’, 灭 ‘put out’, 敌 ‘resist, oppose’. Besides the intentional choosing of characters, some of the phonetic loans do exhibit several versions of homophonic characters, which may cause disunity and misunderstanding. For example, even for some well-known names such as Disney (Disneyland), there does not seem to be a generally consistent name. Disney is either borrowed as *disini* 迪斯尼 or *dishini* 迪士尼 and the two names are both widely used without discrimination. Another example is

the borrowing of *Heimlich Manoeuvre*, which is borrowed as a loanblend, the first part is a phonetic loan *haimulike* while the second part is a semantic description *jijiufa* 急救法 ‘emergent + save + method’. *Heimlich* is phonetically borrowed as *haimulike*, which is written with four characters and the last two characters can be either 里克, or 立刻, or 立克, or 里克. The characters to record the adapted syllable *li.ke* are frequently used characters and people have no problem using any one of the versions. In these examples, the semantics of the characters do not really matter in recording loanwords.

### 3.3.4 Does Mandarin Prefer Covert Borrowing or Overt Borrowing?

As Mandarin is written in morphosyllabic characters, it is considered to be a language that prefers borrowing of semantics because its writing system does not allow mere phonetic adaptation (Fleming & Zuckermann, 2013). Scholars in China have always resorted to historical evidence to show that phonetic loans are not long-lived (e.g. Hu & Xu 2003, Chen 2013). They believe that an English word may be borrowed first into a phonetic loan, which will be later replaced by a free translation (Hu & Xu, 2003, pp. 310-311). Yan Chen posits that “transliterations are prone to semanticization”, since Chinese prefer an alternative where “each character makes sense” (2013, p. 3). Chan & Kwok similarly state that there is a strong preference for free translation: “The general opinion seems to be that if a translation equivalent is easily available and does not entail elaborate circumlocution, this translation is to be preferred because it has the advantage over phonetic loans of being meaningful” (1990, p. 20).

Frequently quoted examples of terms which were initially transliterated, but after some time replaced by a free translation, include English source word *democracy*, which was first borrowed phonetically as *demokelaxi* 德漠克拉西 ‘virtue + strategy + overcome + pull + west’, later replaced by *minzhu* 民主 ‘people + master’; *parliament* was first borrowed as *balimen* 巴力门 ‘expect +

strength + door', later replaced by *yihui* 议会 'discussion + meeting'; *kangaroo* was first borrowed as *genggelu* 更格卢 'change + woodstick + a surname', later replaced by *daishu* 袋鼠 'bag/pouch + mouse'. In such cases, the phonetic loans are generally loanwords with multiple syllables and written with obsolete characters. The free translations that later replaced the phonetic loans were labelled "semantic loans" by Chinese scholars (the Chinese term *yiyici* 意译词 lit. 'semantic + translation + word' is a broad term in Chinese, with different connotations to the same English term).

This thesis argues that the free translations are created by creative combinations of native Chinese morphemes to transfer the meaning, also called loan creation or loan innovation. In free translations, the borrowers resort to some of the most appealing characteristics of the source word and produce a neologism, which is often a very concrete descriptive noun. Therefore, there is a great difference between free translations and other forms of borrowing in which the semantic is transferred, such as loan translation, semantic shift, and phono-semantic matching. As mentioned by Hu & Xu (2003, p. 310), free translations are noticeably "naturalized" in the Chinese language. This can cause complications for etymological research as the exact origin is quite difficult to detect for both Chinese and non-Chinese scholars; while for loan translation, semantic shift, and phono-semantic matching, the semantic or phonetic origin can be traced as they have a "discoverable foreign model" (Haugen, 1950, p. 215). Thus, if phonetic loans are compared to free translations and conclude that Mandarin does not prefer phonetic loans, it is prejudiced because it is just like comparing phonetic loans with native words. This thesis clarifies the misunderstanding and proposes that the long-existing belief that Mandarin prefers semantic loan is because the range of (Chinese) semantic loan is too wide, including free translation, loan translation, and semantic shift. Free translations are not strictly considered loans because they are not direct imitations of a foreign model but are secondarily created within the borrowing language (Haugen, 1950). Free translations are termed loan creations and should be separate from loanwords. It is true that in phonetic loans,



the “string of characters that constitute a word does not make much sense when the reference is made to the inherent meaning of the graphic forms” (Chen, 1999, p. 105), which has led scholars to falsely believe that if the loanwords constitute irrelevant morphemes, they are not borrowed successfully; and if semantic transparency can be obtained from component morphemes, the loanwords are good and well accepted.

This thesis aims to see whether Mandarin truly prefers the semantic transparency in the adaptation of loanwords by investigating what is transferred in the adaptation of loanwords and whether semantic transparency is present there, that is, how the phono-semantic relationship inherent in Chinese is exploited in loanword adaptation. In the analysis part of the thesis (Chapters Four and Five), the phonological adaptation of English words will be analysed closely. The adaptation of English phonemes will be dealt with on the basis of the “Perceptual Assimilation Model” to see whether English phonemes are borrowed as their corresponding matching Chinese equivalents. How the illicit syllable structures are modified will be discussed with OT analysis as the adaptation process is also important in understanding loanword adaptation. In Chapter Six, the different reasons for the deviant cases will be explored and summarised.

## **Chapter Four**

### **Phonological Matching Between English and Mandarin**

After the background of English borrowings in Mandarin was introduced in Chapter Two and the theoretical framework explained in Chapter Three, Chapter Four will focus on the phonological

aspect of loanword adaptation. It will first review the literature on loan phonology, the theories of loanword adaptation, the issues of the perception of non-native speech sounds, followed by a detailed discussion of the related theoretical framework to give a solid foundation for the way English words are expected to be perceived and borrowed into Mandarin by L1 Mandarin speakers. Then, the phoneme systems of English and Mandarin will be compared and the expected matching according to phonetic similarities will be predicted. The predictions of L2 speech perception models serve to provide a baseline expectation of what an English word might be adapted as in Mandarin when it is borrowed. The predictions are used to assess borrowed words as to whether their form aligns with the predictions or not. If the borrowed words align with the predictions, they are normal phonetic loanwords. If not, they are deviated loanwords. The phonetic adaptation of English segments in Mandarin will be summarised by checking the normal phonetic loanwords and the deviated loanwords. Further reasons for the deviation will be analysed so that a full picture of the classification of loanwords in Mandarin will be obtained.

#### **4.1 Review of Theories of Loanword Adaptation**

Loanwords are words borrowed from one language by another. These borrowed words usually undergo adaptation processes to conform to the structural constraints of the borrowing language phonology. Such adaptation affects all facets of phonological structure, reflecting the segmental, phonotactic, suprasegmental, and morphophonological restrictions of the borrowing language. In general, the loanword adaptation process is considered a scenario where perception and production play equal roles (Silverman, 1992; Yip, 1993; Kenstowicz, 2007), where the borrowing language's phonology works at both levels — processing the acoustic information in perception and adjusting the underlying representation in production.

The patterns that emerge in loanword adaptation often reveal aspects of native speakers' knowledge that are not necessarily obvious in the data of the native language and, as a result,

loanword data can inform our analysis of the native phonology (Hyman, 1970; Holden, 1976; Ahn & Iverson, 2004; Kawahara, 2008; Wetzels, 2009). In this respect, loanword adaptation can be considered a real-life “Wug Test” (Berko, 1958) which can enable us to probe into the grammatical knowledge of speakers in ways that native data alone cannot. Conversely, however, such emergent patterns in loanword adaptation present a learnability puzzle (cf. Broselow, 2009): if a loanword pattern is underdetermined by the native phonology, where does the pattern come from? Also, what type of representation does the adaptation process refer to as it searches for licit forms in the borrowing language that most closely match the foreign language input? Is it an abstract phonological representation, a detailed phonetic representation, or a combination of the two? Are there any universal preferences for certain types of repairs over others (e.g., epenthesis over deletion, or retention of a vocalic feature over a consonantal feature)? These are some of the major recurring questions in recent studies in loanword phonology and we will address them in this chapter.

Over the past decades, the study of loanwords has evolved from a curious exploration to a serious and sustained analysis. In adapting a loanword, the speaker tries to remain faithful to the source word while still making the word conform to the native language segmental inventory, phonotactic constraints, and prosodic structures. Loanword adaptation is about obeying the constraints of the native phonology and making repairs to the illicit structure of the borrowing at the same time. One important issue concerns the input in the adaptation process and the nature of the repairs. Three positions on this question have emerged in recent literature: one; loanwords are altered in production only; two, adaptations occur in perception only; three, adaptations occur both in perception and production.

#### **4.1.1 Production Approach**

A production-only approach of loanword adaptation is the traditional point of view, also called the phonological approximation view. It is defended by Carole Paradis and her collaborators (Paradis & LaCharité, 1997, 2008; LaCharité & Paradis, 2005). They contend that L2-to-L1 mapping occurs on the basis of phonological distance, rather than phonetic distance, between categories: a foreign L2 segment is replaced by the L1 segment that is the closest phonologically (in terms of features), which is not necessarily the segment that is the closest perceptually. They base their argument on the view that loanword adaptation is largely performed by bilinguals who draw on their native-like competencies in both the donor and recipient languages. They believe that bilinguals discern equivalences between phonological categories and structures that abstract away from the details of their phonetic realisation in each grammar. Thus, the underlying representation of an L2 form, the phonemic value constitutes the input to L1.

Paradis et al. (1997, 2008) claim that humans possess a “universal phonological vocabulary”, which enables borrowers to analyse the foreign word as spoken by native speakers, and translate it into their own representation, which matches the output of the source language exactly. Whether the native language has the sounds and features in question in its inventory or grammar is irrelevant, as the speakers’ competence includes all possible sounds of both languages equally. This model believes that there is one grammar which can account for both native words and loanwords, and bilinguals need not pay attention to non-distinctive allophonic information of L2 structures (Calabrese & Wetzels, 2009).

LaCharité and Paradis (2005) point out several cases of loanword adaptation where an L2 segment is replaced by the phonologically closest L1 segment instead of the phonetically closest one. For example, English voiced stops, when in initial position, are typically realised with no voicing during closure and simply a short-lag voice onset time (VOT). Phonetically, they are closer to Spanish voiceless stops than to Spanish voiced stops. Spanish voiceless stops are unaspirated with short-lag VOT while Spanish voiced stops are strongly prevoiced with negative VOT. Therefore, if English

voiced stops are adapted phonetically, they would be expected to be mapped to Spanish voiceless stops. But they are mapped to the voiced stops instead, which is the phonologically closest category. From this point of view, the input to the adaptation process requires access to the source language's phonology, and loanword adaptation follows category preservation/proximity principles where segment matching is based on phonological categories (see Paradis & LaCharité, 1997; LaCharité & Paradis, 2005; Paradis, 2006; Rose & Demuth, 2006; Uffmann, 2006). The process of phonetic approximation is used only if the borrowers are not bilinguals (Paradis & LaCharité, 2008). Another such pattern is found in the adaptation of English lax vowels /ɪ/ and /ʊ/ into Mexican Spanish, Paris French, and Quebec French. English /ɪ/ and /ʊ/ are modified into phonologically closer segments /i/ and /u/ respectively in all three RLs instead of into their correspondently phonetically closer segments /e/ and /o/. Although phonetically, vowels are distinguished by their F1 and F2 formants, the vowels /ɪ/ and /ʊ/ are mapped to /i/ and /u/ which share the same phonological feature [+high] in the borrowing languages.

#### **4.1.2 Perception Approach**

An opposing position, the phonetic approximation view, was developed by Silverman (1992) and later taken up by Peperkamp and Dupoux (Dupoux et al., 1999; Peperkamp, 2003). They argue that not just some, but all, transformations in loanwords result from unfaithful L2 perception and thus, these transformations are phonetic in nature. Drawing parallels between the loanword literature and the cross-linguistic speech perception literature, Peperkamp argues that “loanword adaptations are basically phonetic rather than phonological in nature, and originate in the process of phonetic decoding during speech perception” (2005, p. 350), though she acknowledges that this hypothesis is “a strong one that might be overly simplistic” (2005, p. 349). Perceptual assimilation (the source of loanword adaptations) occurs at the phonetic encoding phase and the changes of non-native sounds in loanwords are made purely at the perceptual level without involving

phonology (Peperkamp & Dupoux, 2003; Peperkamp, 2004; Peperkamp, Vendelin & Nakamura, 2008).

According to this view, the surface form of the foreign loan is mapped to L1 phonological categories based on acoustic similarity. As borrowers are non-native speakers of L2, they hear the L2 forms unreliably and “the input to loanword phonology is merely a superficial non-linguistic acoustic signal” (Silverman, 1992, p. 289). They cannot have access to the underlying representation of L2 structures, so they draw on the acoustic surface signal which is also called “nativisation through perception” according to Calabrese & Wetzels (2009, p. 2). The role of phonological grammar is hence indirect: loanword adaptations are influenced rather than computed by phonological grammar in the sense that phonology “determines which sounds and sound structures are available for the non-native ones to map onto” (Peperkamp, Vendelin & Nakamura, 2008, p. 131). Proponents of this view have different opinions on how much perception can do in loanword adaptation. One group of scholars believes that loanword adaptation is carried out only in perception. They consider “loanword adaptation that do not represent generalizations to a default pattern...originate in perceptual assimilation” (Peperkamp, Vendelin & Nakamura, 2008, p. 160). The other group considers that there are two steps involved in loanword adaptation, and perception is just the first step. This will be discussed in the next section.

#### ***4.1.3 Perception-Phonology Approach***

Under the Perception-Phonology Approach, perception is relevant but cannot explain all adaptation patterns in adaptation. The input to the adaptation process is based on how the borrowers perceive the acoustic signals of the source language, and then the perception-based input is modified/adapted by the borrowing language’s phonological grammar (see Silverman, 1992; Yip, 1993, 2002, 2006; Steriade, 2001; Kang, 2003; Kenstowicz, 2003; Kenstowicz & Suchato, 2006; Miao, 2005).

For some authors (e.g., Silverman, 1992; Yip, 2006; Kenstowicz, 2003), there are loanword-specific rankings of rules in the loanword adaptation process. Perception happens to the salient input sounds. Before loanwords enter production, less salient segments are usually deleted, and more salient ones are retained. In the view of Broselow (2009) and Boersma and Hamann (2009a), on the other hand, perception is simply grammatical. The different views on loanword phonology of Silverman (1992), Yip (1993, 2006), Broselow (2009) and Boersma and Hamann (2009) will now be compared.

**4.1.3.1 Silverman (1992).** Silverman investigates English loanwords in Cantonese and makes several suggestions. First, he argues that loanwords do not enter the borrowing language with their own phonological representation; instead, loanword input consists of a sequence of non-linguistic acoustic signals. Behind this view is the assumption that speakers of the borrowing language have no access to the phonological system of the source language.

The second suggestion Silverman makes is that loanword phonology contains two distinct, ordered levels. The first level, termed the “Perceptual Level”, is a stage at which the acoustic signals are parsed into segment-sized chunks for which the native feature matrices that are closest to their articulatory and/or acoustic properties are provided. In addition to feature matrices, prosodic representations such as syllable nodes and, in the case of Cantonese, a binary foot template, are provided at this level as well. When the output of the Perceptual Level enters the “Operative Level”, phonological operations are carried out guided by native syllable structure constraints. Various phonological operations, like epenthesis and deletion, are triggered so that the preliminarily processed materials can surface in conformity with the native syllable and metrical structure constraints.

To exemplify the distinction of the Perceptual Level from the Operative Level, Silverman refers to the preservation and deletion of post consonantal liquids, as illustrated in Table 14.

**Table 14***Deletion of Post Consonantal Liquids in Cantonese*

	English	Cantonese
a. Preservation of liquid	<i>break</i>	[pik.lik]
	<i>print</i>	[p <sup>h</sup> i.lin]
	<i>cream</i>	[key.lim]
b. Deletion of liquid	<i>printer</i>	[p <sup>h</sup> ɛn.t <sup>h</sup> a]
	<i>broker</i>	[puk.k <sup>h</sup> a]
	<i>freezer</i>	[fi.sa]

*Note.* Adapted from Silverman, 1992

In Table 14, all the English words begin with a stop-liquid cluster. As it is not likely that Cantonese speakers perceive the liquid in *print* but not the one in *printer*, Silverman suggests that the liquids in Table 14a) are retained because the retention makes the output forms bisyllabic. In Table 14b), on the other hand, since the retention of the liquids would make the output forms exceed bisyllabicity, they are deleted, and the resulting output forms are, again, bisyllabic. The analysis of the adaptation of stop-liquid cluster shows that the liquids in Table 14(a) and Table 14(b) must be perceived first, and it is at the second level that the decision of whether they are retained or deleted is made.

Furthermore, Silverman assumes less “salient” segments are usually not perceived. The segments perceived as syllabic include vocalic sonority peaks and phonetically salient consonants. Silverman’s work is based on rule-based theory, so loanword special phonological rules are needed for these adaptations. Consequently, he argues that the operative process of loanword grammar exists as a separate grammar from the native phonology. This suggestion is based on the observation that those phonological processes applying at the Operative Level are hardly found in the native phonology.



**4.1.3.2 Yip (1993, 2006).** Yip (2006) follows some of Silverman's ideas about loanword adaptation. First, she suggests that the processes loanwords undergo are divided into two levels; and second, perceptively more salient segments tend to be parsed whereas less salient ones tend to be deleted. In this approach, the L1 grammar prioritises what can be replicated, or the salient segments. Salient segments such as English fricative [s] are always parsed in Cantonese. Conversely, post-consonantal stops are deleted. For example, *cast* is borrowed as /k<sup>h</sup>a.si/ in Cantonese. However, the adaptations of English liquids [l] and [ɹ] are more complex. They are parsed depending on the context. The liquid [l] is parsed when it is in the onset position as a simplex onset or when it follows an onset stop, e.g., *lift* is borrowed as /li:p/; *plum* is adapted into /pow.lem/. On the other hand, it is deleted when it is in a #sCl-cluster, as in *spleen* becoming /sipin/. The liquid [ɹ] is deleted in any clusters: *friend* is borrowed as /fɛn/; and *strawberry* is borrowed as /si:.tɔ:.pɛ:.lɛj/. The different treatments of English [l] and [ɹ] in stop-liquid clusters are due to perception. The former is perceived so maintained whereas the latter is not perceived so lost. The deletion of English [l] and [ɹ] following a #sC-cluster is suggested to be due to Cantonese speakers perceiving no liquids in either case and therefore the liquids are lost in both cases. Based on this observation that liquids are prone to being deleted, she argues that liquids are less salient than stops and this relative unsalience makes liquids more vulnerable to deletion unless other factors such as the pressure of bisyllabicity are involved.

Yip (1993) started applying a constraint-based instead of rule-based theory to the adaptation of English loanwords in Cantonese. A loan-specific element is adopted into her analysis: a loanword-specific constraint MIMIC, which preserves information about the SL forms for RL interpretation. She observed the variation of the adaptation of English vowels [æ] and [ə]. Acoustically, the best match for English [æ] are Cantonese [ɛ:] and [a:]. It is adapted to Cantonese [ɛ:] and [a:] in open syllable or before nasals. It is adapted to Cantonese [ɪ] when it is in closed stop-final syllables. Yip argues that for each vowel the adapter has more than one option. The constraint MIMIC-VOWEL selects these

two vowels [ɛ:] and [a:] since they match the quality of the input vowel best. According to her, “either of the two long vowels may be chosen, on a word-by-word basis” (2006, p. 967).

Yip (2006) suggests that loanword phonology should not be viewed as a separate grammar from the native phonology. She shows that the phonological processes found at the Operative Level can actually be motivated in the native phonology. In order to explain why some phonological processes observed in the loanword phonology are never found in the native phonology, Yip suggests that the input for which such processes are needed are never present in the native phonology.

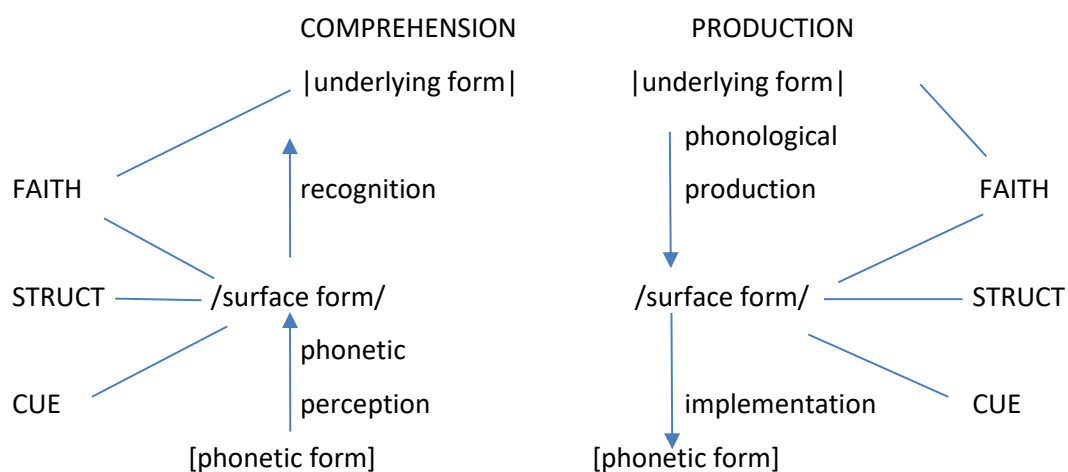
**4.1.3.3 Broselow (2009) and Boersma and Hamann (2009).** On the other hand, Broselow and Boersma and Hamann see perception as simply grammatical. They believe that when borrowers perceive non-native sounds/sound sequences, their native grammar applies in the adaptation process just as it does with native sounds/sound sequences. Thus, no loanword-specific rankings are needed. Peperkamp and Dupoux (2001) and Broselow (2009) point out that it is not feasible for L1 borrowers to have two sets of grammars, one for native words and another specifically for loanwords. Borrowers don’t have the access to loanword-specific rankings, which could also cause learnability problems.

Boersma and Hamann (2009) proposed a “bidirectional model with three-level representations” which can account for both native phonology and loanword adaptation. In this model, each part — the comprehension part and the production part — incorporates three kinds of constraints: cue, structural, and faithfulness constraints. In the comprehension part, the interaction between cue and structural constraints are responsible for the mapping from a phonetic form to a phonological surface form; and the interaction between structural and faithfulness constraints determine how the surface form is recognised as an underlying form.

The bidirectional grammar model (Boersma, 1998, 2000, 2009a, 2009b) is shown in Figure 4. Phonetic forms are indicated by square brackets ([ ]), surface forms by slashes (/ /), and underlying forms by pipes (| |).

**Figure 4**

*Bidirectional Model: A Single Model for L1 Grammar and Loanword Adaptation*



*Note.* Boersma and Hamann (2009, p. 12)

In this model, illegal structures of loanwords are repaired in perception where cue and structural constraints interact, whereas native alternations occur in production where faithfulness and structural constraints interact. Most crucially, the grammar in perception and production is the same grammar. The loanword adaptation process is automatic, and no loanword specific constraints or rankings are assumed.

## 4.2 Introduction of Adult L2 Speech Perception

This section presents an overview of current thinking among scholars who seek to explain non-native speech perception in adults. The way adults perceive sounds is different from infants/children. Infants undergo an auditory perceptual reorganisation during their first year of life

(Eimas, 1978), going from a general ability to discriminate virtually any pair of phonemes to an enhanced sensitivity, through a kind of sensory narrowing, that permits them discriminate the sounds of their native language, that is from language universal to language specific. As this perceptual enhancement is occurring, the ability to discriminate the phonemes of non-native sound system decreases (Werker & Tees, 1984). This perceptual reorganisation — consisting of the specification of the native speech sound and becoming highly sensitive to specific native speech cues — results in the formation of a native phonological system that will influence the perception of L2 speech sounds later in life. The auditory perceptual system remains flexible enough to allow the incorporation of new non-native sound categories (Flege et al., 1995; Kuhl, 2000). However, this flexibility differs between children and adults. There is evidence to show that young children can achieve native-like perception and production of non-native sounds (William, 1979; Flege, Yeni-Komshianm & Liu, 1999), while adult learners may not reach native-like levels at least to perceive and produce L2 sounds (Werker & Tees, 1984; Flege et al., 1995; Best, 1995; Strange, 1995).

#### ***4.2.1 Monolingual Speakers' Language-specific Speech Perception***

When infants grow in their first year, they change from universal speech listeners to L1-specific listeners because they have increased exposure to their native language and become more attuned to it. This results in efficient, automatic, and rapid perception and processing of the L1. When infants gradually become competent language users, they develop perceptual sensitivity to the phonetic and phonological distinctions used in their L1 (Best et al., 2009). From birth to a one year old, the process by which infants develop their speech perception can be described as constructing a multi-dimensional perceptual space in which the sounds of their mother language are located. For monolinguals who have no exposure to foreign languages, the space become more fine-tuned as the infant grows to adulthood. This gives the monolingual greater perceptual sensitivity for important phonetic details in their native language but also comes at a cost to the perception of

non-native speech, that is, the attenuation of phonetic dimensions that are non-functional in their L1 (see Kuhl et al., 2006; Ko, Soderstrom, & Morgan, 2009; Bohn, 2017). These phonetic characteristics can be understood also as auditory properties/cues (duration, static and dynamic spectral features, periodicity, noise, and intensity) in speech perception. Cross-linguistic studies have proved that adult speakers of different languages have attention paid to varied cues that signal a contrast in their native language (Bradlow, 1995; Fox, Flege & Munro, 1995; Gottfried & Beddor, 1988). Therefore, during the process of becoming competent speakers in their native language, infants learn what aspects of the phonetic signal serve as cues in their language and how much importance to attach to each cue (Scobbie, 1998). Indeed, several studies have shown that the use of the cues that signal a certain phonological contrast can be different for infants, children, and adults (Gerrits, 2001; Nittrouer 1992, 1996; Nittrouer & Miller, 1997). For instance, Gerrits (2001) showed that 4-year-old Dutch children attend to duration cues much more than adult listeners do, for vowels as well as consonants.

What really is the nature of an infant's developmental change in speech perception? Several theories tried to account for the nature and are summarised by Aslin and Pisoni (1980) into four types: Universal Theory, Attunement Theory, Perceptual Learning Theory, and Maturational Theory. Aslin et al. (2002) point out that there is not one specific theory that provides a solid description of the development of all sounds, but a hybrid theoretical framework could probably account for specific classes of phone perception and discrimination.

#### ***4.2.2 Adult L2 Speech Perception: The Influence of L1 Experience***

Near-universal speech perception sensitivity enables infants to acquire any language that is their mother tongue spoken to them in their surrounding environment (see Aslin & Pisoni, 1980; Werker et al., 1981; Werker & Tees, 1984). But adults often have difficulty discriminating between a

pair of foreign language contrasts that are not phonologically distinctive in their native language.

What is the role of L1 experience on non-native speech perception in adults?

As evidence shows, as infants get older, they have increasing difficulties distinguishing non-native contrasts. Basically, many studies have documented a strong L1 effect on the ability of adults to perceive non-native speech sound contrasts (e.g., Abramson & Lisker, 1970). There are various accounts proposed to explain the role of L1 experience on non-native speech perception. The traditional view indicates a sieving effect from native language when an adult tries to perceive non-native speech sounds (Polivanov, 1931; Trubetzkoy, 1939, 1969), which means that adults “hear with an accent” (Jenkins, Strange, & Polka, 1995) with the L1 phonological system being a “filter” through which non-native speech is perceived. A widely-cited example is of adult Japanese speakers having difficulty discriminating English /ɹ/-/l/ (e.g., Gillette, 1980; MacKain, Best & Strange, 1981; Yamada & Tohkura, 1992). They found that there is no “contrastive function” between /ɹ/ and /l/ in Japanese and both the English phonemes are perceived as Japanese /r/. In a similar study, Michaels (1974) looked at the pronunciation of English /θ/ by Russian and Japanese learners and found that while Russian speakers replaced this sound with /t/ (a non-strident sound), Japanese speakers replaced it with /s/ (a continuant sound), despite the fact that both /t/ and /s/ exist in Russian and Japanese.

This apparent difficulty faced by adults has led some to point to a lack of exposure to an L2 early in life as the cause. According to such researchers (Aslin & Pisoni, 1980; Eimas, 1978), the sensorineural mechanisms are responsible for speech sound discrimination. They are tuned by the exposure to language in early life. Another group of researchers (e.g., Eilers, Gavin & Wilson, 1979), on the other hand, believe that infants come prewired with certain “psychophysical” mechanisms (no longer active in adults) which are tuned and reinforced when infants are exposed to certain acoustic features in the environment. This in turn causes a particular response to those acoustic features. In that sense, such researchers have taken a rather acoustic approach than a linguistic one

in an attempt to explain young children's seemingly effortless process of mastering and discriminating the speech sounds that they are exposed to.

Such accounts, however, have failed to give a complete picture of non-native segmental perception by adults. Many studies (see for example: Lively, Logan & Pisoni, 1993; MacKain, Best & Strange, 1981; Strange & Dittmann, 1984) have demonstrated the ability of adults to perceive non-native segmental contrasts, some of which have not been encountered previously. For example, consider the click consonants of Zulu, which native English listeners perceive as non-speech sounds (e.g., finger clicks, coughs). American English speaking adults are able to discriminate Zulu click contrasts relatively well despite their lack of experience with such clicks (Best, McRoberts, & Sithole, 1988). This implies that early life exposure is not a must in non-native segmental perception and discrimination. Also, adults can be trained to be competent listeners. Perceptual training has been shown to be efficient in improving learners' ability to perceive L2 sounds (Iverson & Evans, 2009; Lacabex et al., 2008; Strange & Dittmann, 1984; Thomson, 2012, among others). These phenomena led some researchers (e.g., Werker & Tees, 1984) to propose that exposure to an L2 mainly engages higher-level processes (e.g., phonological encoding or memory retention) which are adaptable even in adults. This is contrasted with lower-level sensorineural processes which will not remain as adaptable for long and are largely affected by language experience early in life. This also disputes the view that speech perception is by some "psychophysical" mechanisms; that is, it is not neurological maturation which causes the flexible child brain to change into an inflexible adult brain, as posited by Lenneberg's (1967) Critical Period Hypothesis (CPH). Rather, the adult brain retains the capacity to change, with age differences in non-native speech perception reflecting experience-based differences in the development of non-native phonological systems.

Research has shown that not all non-native contrasts are equally difficult to discriminate. Instead of looking at the issue from a non-linguistic aspect such as the aforementioned Critical Period Hypothesis, a more plausible view is from the language experience itself. It posits that when

perceiving non-native speech, “new processing activities are hampered by the strength of heavily utilized patterns or processing routines” (Cochrane, 1980, pp. 332-333) in native language processing. In other words, L1 influence. To get a full picture of the discrimination performance of L2 adult speakers, a number of methods have been used to examine how the sounds of an L2 are perceptually assimilated to native categories. The comparison of phonetic symbols across languages is the easiest, but also the least valid method. The comparison of the acoustic properties of speech sounds also cannot yield valid information on how native listeners and L2 learners map the sounds of the non-native to the native language. Strange (2007, p. 54) concludes that “if researchers want to know how...listeners are perceptually assimilating L2 segments to L1 phonological categories, direct measures of those perceptual assimilation patterns are probably the most reliable indicators of L1/L2 perceptual relationships” (see also Rochet, 1995; Bohn, 1995).

### **4.3 Speech Perception Models**

Several researchers in the field of speech perception have sought to describe and predict how adult listeners behave in the process of non-native sounds perception. There are various patterns in adult non-native speech perception in terms of perceptual difficulty and several theoretical models have been proposed to explain the variability. Two of these models: Best’s (1995) Perceptual Assimilation Model (PAM) and its extension to L2 learning, PAM-L2 (Best & Tyler, 2007); and Flege’s (1995) Speech Learning Model (SLM), are the most appropriate ones, as these models have been tested in several cross-language and L2 perception studies on many different segment types (e.g., vowels, stop consonants, and approximants).

#### **4.3.1 Perception Assimilation Model (PAM) and PAM-L2**

The Perceptual Assimilation Model (PAM), proposed by Best (1995a), is based on the “Direct-realist approach” to speech perception (Fowler, 1986; Gibson & Gibson, 1955). It assumes



that perceivers obtain information about the world directly from the environment, instead of through mental constructs. Therefore, a mental representation of phonetic categories is not required in order to yield perceptual learning according to PAM. Speech perception is multi-modal because perceivers detect auditory, visual, and tactile information. With regards to the auditory modality, the primitives of speech perception are the distal articulatory gestures, that is, the various articulatory constrictions formed by the different articulators along the vocal tract. The acoustic energy is shaped by, and provides information about, the articulatory gestures. Each sound is presented by a group of gestures. Perceptual learning, in the sense of Gibson and Gibson (1955), is regarded as an attunement to the phonetic-articulatory gestural patterns used in the L1 from the infant stage. However, when a perceiver establishes this fine-tuned perception of grouped speech gestures, it becomes more difficult for him to perceive speech sounds that differ from those in terms of gestures and their combinations, such as some non-native sounds. In Best's words, non-native segments are the ones whose "gestural elements... do not match precisely any native constellations" (1995b, p. 193).

PAM makes predictions on the assimilation performance of the individual non-native phones based on their similarities and differences to L1 categories (Best, 1995). Individual non-native phones may be perceived and assimilated to the L1 phonological system in one of three ways:

1. Categorized as an L1 category if they are identified with an L1 phoneme and may be perceived as a good, an acceptable, or a deviant exemplar of the category;
2. Uncategorised if they are perceived as speech-like but fail to resemble any single L1 category, and in such instances, the non-native segment falls in an untuned region within the native phonological space; or
3. Non-assimilable if the non-native phones are heard as non-speech (e.g., a clicking or choking sound) and will be assimilated outside of the listener's native phonological space.

The PAM assimilations are established using a perceptual assimilation task in which participants are required to identify non-native/L2 phones in relation to those in their L1. The distinction between categorised and uncategorised assimilations is based upon the use of a predetermined assimilation criterion, which provides an indication of the consistency with which participants assimilate a particular non-native phone to an L1 category label. Generally, studies testing PAM have employed a criterion of either 50% or 70%, but other categorisation thresholds have also been used. The use of a more stringent criterion (e.g., 90%) may result in a large number of uncategorised assimilations (see Harnsberger, 2001). To get the categorisation responses by all the participants, an average response score will be calculated for a specific sound. A non-native/L2 phone is deemed categorised to a particular L1 category if the responses are above the pre-set threshold but are deemed uncategorised if responses are below this threshold. It is important to consider the categorisation threshold to be used as it has implications for the assimilation type identified.

A sound contains phonetic features that signal higher-order phonological structures as well as fine-grained phonetic information. These two levels of features are both perceived in non-native speech perception. If a non-native phone is assimilated to an existing L1 category (i.e., categorised), it suggests that the listener perceives phonological similarities between a non-native phone and an L1 category. Conversely, if a non-native phone is assimilated as uncategorised, it suggests that there is a weak phonological similarity between a non-native phone and any L1 phonemes. For uncategorised assimilations, the non-native phone may be perceived in terms of fine-grained phonetic features, which may be similar to those employed in the L1. Given the complexity of speech perception, it is worthwhile investigating further how language users make use of both phonological and phonetic features when perceiving non-native phones.

Non-native phones that are categorised as an L1 phoneme may be perceived as a good, acceptable, or deviant exemplar of that L1 category, as when L1 Danish listeners assimilate English [p<sup>h</sup>] to Danish /p/ in 100% of all instance, and rate the match at 7.4 on a 9-point scale, which is a

(near-) perfect match (Horslund, Ellegaard & Bohn, 2015). When English [ʃ] is assimilated to Danish /ç/ in 82.5% of the instances with a mean rating of 4.3 (Horslund et al., 2015), it is a less than perfect match. Non-native phones that are uncategorised as any L1 phoneme may display different relations with L1 phonemes. Some non-native phones are perceived as primarily similar to a single L1 phoneme but are assimilated below the categorisation threshold. Some non-native phones are perceived as moderately similar to two or more L1 phonemes and assimilated to several L1 categories. A last scenario predicted by PAM is that a non-native sound is perceived as a non-speech sound, and thus patterning as “non-assimilated” to any L1 category as for click sounds produced with an ingressive velaric airstream.

PAM predicts that whether it is difficult or easy for a L1 speaker to perceive L2 language speech depends on how contrasting phones are assimilated, which can be reflected in discrimination levels for non-native contrasts. Listeners’ experience with L1 “phonological equivalence classes” is emphasised as heavily influencing their perception of non-native speech sounds. There are several assimilation types for non-native segment contrasts and these types have differences in discrimination accuracy (Best, 1995):

1. Two-Category assimilation (TC): the two non-native phones are assimilated to two separate L1 phonological categories. Discrimination is predicted to be excellent.
2. Category-Goodness assimilation (CG): both non-native phones are assimilated to the same native category but one of the non-native phones is perceived as a better exemplar of the native category than the other. Discrimination is expected to range from moderate to very good, depending on the degree of category goodness.
3. Single-Category assimilation (SC): both non-native phones are assimilated to the same L1 category, with both perceived as equally good (or poor) exemplars of that category. Discrimination is expected to be poor.
4. Uncategorised-Categorised assimilation (UC): one non-native phone is assimilated to a

native category while the other phone is assimilated as uncategorised. Discrimination is expected to be very good.

5. Uncategorised-Uncategorised assimilation (UU): both non-native phones fall within the listener's native phonological space but fail to be categorised to a native category. Discrimination is predicted to range from poor to moderate/very good, depending on the phonetic distance between the two phones to one another and native categories.
6. Non-Assimilable (NA): both non-native phones fall outside the native phonological space and are both perceived as non-speech. Discrimination is predicted to range from good to very good, depending on the phonetic distance between the two phones.

Compared to other competing theories of cross-language speech perception which often provide holistic predictions of cross-language perception (e.g., the Natural Language Magnet, proposed by Iverson & Kuhl in 1995; and the Speech Learning Model, proposed by Flege in 1995, which is discussed in 4.3.2 ), PAM provides several detailed predictions of perceptual pattern which reflect different types of interaction between L1 and L2 categories in an assimilatory event. Therefore, PAM is chosen in the present study to make predictions of the mapping of English consonants and vowels into Mandarin.

#### **4.3.2 Speech Learning Model (SLM)**

The Speech Language Model (SLM) was proposed by Flege in 1995, primarily motivated by production errors observed in experienced adult L2 users. Even though SLM is an L2 production model, it can also be extended to L2 perception. It assumes that the primitives of speech perception are acoustic features (e.g., formant frequencies, silent gaps, and noise bursts). The goal of the model is to explain age-related constraints in native-like production of L2 vowels and consonants. According to SLM, categories must be created for L2 sounds for successful acquisition. The difficulty of creating these categories depends crucially on the perceived similarity of L2 and L1 sounds. L2

speech acquisition requires the adjustment of the perception system to the contrastive L1 phonetic elements, and the L1 phonetic system is the basis for L2 sound learning. L1 and L2 categories share a common acoustic-phonetic space with both languages influencing one another in a bidirectional manner (Bohn & Flege, 1992). Specifically, L1 attunement influences L2 acquisition, and L2 acquisition causes perceptual changes to the pre-existing L1 categories (e.g., reorganisation of L1 categories due to category deflection). L1 and L2 unavoidably influence each other in a bidirectional manner.

The model states that phonetic systems are flexible and can be reorganised over the lifespan to accommodate new L2 sounds. It challenges the validity of the canonical “Critical Period Hypothesis” (CHP) for L2 acquisition. Yet because of the L1 influence, it is proposed that those acquiring a L2 later in life will not perceive or produce L2 phones in exactly the same way as native speakers of that language, or as those who acquire the L2 earlier in life. SLM does not question the fact that early learners are able to form new L2 categories with more ease than late learners (Flege, 1995; Flege & Mackay, 2004); rather it posits that the perceptual system is not static and L2 perception and production change over time with experience. The overall level of L2 proficiency differs between early learners and late learners. For early learners, the degree of L1 attunement is still low, thus a new language will be better acquired and will be produced and perceived more accurately.

The model posits that learners perceive the L2 sounds in relation to the phonetically nearest sound of the L1. In classifying L2 sounds, the model postulates that it is easier for an L2 learner to perceive and produce speech sounds that are dissimilar from native sounds. With respect to the nearest L1 phoneme, an L2 phone might be perceived as “identical”, “similar”, or “new”. If an L2 sound is sufficiently different from any native categories, it is the “new” sound or “dissimilated” sound. The learner will be able to distinguish the native and the new sound, and establish a new

category. The new sound will be easy to acquire and produced in a native-like manner (Bohn & Flege, 1992).

However, if the L2 sound is too close to a category in L1, it is perceived as an identical sound and will be perceptually assimilated to the native sound. In this case, the formation of a new category is unlikely, and the production of that sound is the same as the L1 phoneme, which is called “equivalence classification”. An identical L2 phone will be perceptually linked with an L1 phoneme, and they will be referred to as “diaphones”. Diaphones are predicted to have a mixture of the properties of the L1 and L2 phones. If an L2 sound is perceived as similar to an L1 sound with some dissimilarity, a new category may or may not be established depending on the dissimilarities between the sounds. SLM suggests that when the L2 speaker has more experience and can detect relevant phonetic differences between the L2 phone and the L1 category, a separate L2 category may eventually be developed.

**Table 15**

*SLM Classification of L2 Sounds*

	Identical L1 and L2	Similar L1 and L2	New L2
Perception/ production	Inaccurate L2 sound perception L1 and L2 sound production resemble each other	Depends on the degree of perceived phonetic dissimilarity between L1 and L2 sounds	L2 sound has no L1 counterpart; easy to perceive; native-like production
New category formation	No new category	New category or not	New category

*Note.* Adapted from Flege, 1995

For example, as seen in Table 15, French /y/ falls in the group of “New L2” for English learners, since English inventory does not contain this phoneme. French /u/, on the other hand, is a phoneme in both French and English but with different phonetic realisation, with a different F2. Thus, English speakers are less successful at producing the French /u/ sound correctly.

It is important to note that the L1-L2 phonetic relationships exist on a continuum from “identical” over “similar” to “new”. Based on the relationship, the learning success (production accuracy, perception accuracy) can be predicted with the function of age of learning (AOL). Like PAM-L2, SLM assumes that “the mechanisms and processes used in learning the L1 sound system...remain intact over the life span, and can be applied to L2 learning” (Flege, 1995, p. 239). Table 16 is adapted from Bohn (2017) to illustrate the SLM predictions of L2 adult learners’ perception and production accuracy and L1-L2 sound relation.

**Table 16**

*SLM Predictions of L2 Adult Learners’ Perception and Production Accuracy and L1-L2 Sound Relation*

	L1-L2 Sound Relation				
	Identical	Very similar	Similar	Very dissimilar	New
	English [m]	English [t <sup>h</sup> ]-	English [i], [ɪ]-	English [ʃ]-	English [ɹ]-
	Korean [m]	Danish [t <sup>sh</sup> ]	German[i:], [ɪ]	Danish[ɕ]	Japanese[r]
Adult perception & production accuracy	+	-	-	-/+	+

*Note.* “+” indicates successful learning, “-” incorrect perception and accented production, and “-/+” and “+/-” intermediate degrees of accuracy. Table adapted from Bohn, 2017.

The two models, PAM and SLM, with some non-overlapping foci, converge on an emphasis on the role of prior L1 learning and use in L2 speech perception and production.

#### **4.4 The Relationship Between Perception and Production**

As both the PAM and SLM models place more emphasis on the perceptual assimilation or dissimilation of the L2 sound categories to the L1 sounds, a question about the relationship between L2 speech perception and production arises. Previous research on L2 speech perception and production has led to different conclusions. For example, Rochet (1995) found that native Portuguese speakers produced French /y/ as /i/ while native English speakers produced /y/ as /u/, although both English and Portuguese have /i/ and /u/ in their vowel systems. The subsequent perceptual test using synthesised high vowel continuum revealed the assimilation pattern of French /y/ to /i/ by Portuguese listeners and /y/ to /u/ by English listeners (Rochet, 1995). Similarly, Mandarin speakers’ production problems were related to their faulty perception of the voiced stops that do not exist in the Mandarin sound system (Rochet, 1995). In a study on English front vowels /i ɪ e ε æ /, Wang (1997) found that Mandarin speakers had problems with both the perception and production of English lax vowels /ɪ ε æ/, but they performed better in perception than in production of these three vowels. In contrast, they performed better in production than in perception of English /i e/ categories.

Such performance discrepancies between the perception and production on the English front vowels suggest that native Mandarin ESL (English as a Second Language) learners may have used different cues or strategies in their perception and production of English vowels. Gass’ (2004) study suggested that non-native speakers perceived stop consonants continuously rather than



categorically. Also, non-native speakers' perception of phonemes appeared to be influenced by the location of phoneme positional boundaries in both the native and target language. However, non-native speakers' production showed a greater similarity to native speakers' production. Flege (1999) also reported a series of studies that showed partial alignment between L2 perception and production.

Therefore, though future research needs to be done to re-evaluate the relationship between perception and production, it is generally agreed that non-native speakers' perception differed from that of native speakers due to their L1 influence.

#### **4.5 English and Mandarin Phonology**

This section is organised as follows: 4.5.1 provides a comparison of English and Mandarin consonants, 4.5.2 provides an analysis of English and Mandarin vowels, and 4.5.3 compares the syllable structure of English and Mandarin, with a focus on Mandarin phonotactic constraints, which is necessary to understand loanword adaptation processes from English to Mandarin.

When the phonological inventories of these two languages are compared, many identical phonemes can be found. However, there is a significant difference in terms of phonemic placement, phonotactic constraints, and syllable structure between the two languages. Many studies such as those by He (2002) and Chang (2009) have analysed and compared the phonological systems of English and Mandarin in detail. In this chapter, the phonological system of the two languages will be discussed, which provides a background for the adaptation of English loanwords in Mandarin.

As the most widely spoken language in the world, English is spoken in many countries. With so many variations historically spoken, various English pronunciations exist according to different dialects. In the history of China's contact with the western world, British English initially was influential in the early 20th century. But the power has shifted to American English over the last few decades (Yip, 1993). General American English (henceforth GA) is considered to be the variety of

pronunciation in North America that is the least marked by region (Ball & Müller, 2005), and the variety that serves as a second language model for learners of English in Asia and Latin America (Cruttenden, 2014).

As the language spoken by the largest population, Mandarin is not only widely spoken in many areas in China, but also throughout southeast Asia where there are many Chinese immigrants. Therefore, there are various accents of Mandarin. Standard Chinese is based on the Beijing dialect of Mandarin, which is also called “Common Accent” *putonghua* 普通话 in mainland or the “National Speech” *guoyu* 国语 in Taiwan (DeFrancis, 1984, p. 39).

#### 4.5.1 English Consonants and Mandarin Consonants

**4.5.1.1 English Consonants.** The general view about the total number of English consonants is that English has 24 consonants (Clemente, 2016), which can be classified by three features: manner of articulation; place of articulation; and whether they are voiced or non-voiced. English voiceless stops have allophonic variation between an aspirated and unaspirated sound. The aspirated allophone occurs at the initial position of a word or a stressed syllable, e.g., /p/ in English *pig* [p<sup>h</sup>ig], and *repeat* [ɪˈp<sup>h</sup>it]. The unaspirated sound occurs elsewhere, e.g., as the second element in a word initial cluster as in *spit* [spɪt] and word-final position as in *gap* [gæp]. English consonants can be presented as shown in Table 17.

**Table 17**

##### *Inventory of English Consonants*

		Bilabial	Labial- dental	Dental	Alveolar	Post- alveolar	Palatal	Velar	Glottal
Stop	-voice	p			t			k	

		+voice	b		d		g
Affricate		-voice				tʃ	
		+voice				dʒ	
Fricative		-voice		f	θ	s	ʃ
		+voice		v	ð	z	ʒ
Nasal		+voice	m		n		ŋ
Liquid	Lateral	+voice			l		
	Rhotic	+voice				ɹ	

*Note.* Deterding, 2015

The reason that /tʃ/ and /dʒ/ are listed as single consonants is because /tʃ/ and /dʒ/ are the only affricates that can occur at the start of a syllable, and they are generally felt by users of English to be single consonants (Wells 1982: 48).

**4.5.1.2 Mandarin Consonants.** Researchers generally agree that Mandarin has 21 consonants, if including the three alveolo-palatals [tɕ][tɕʰ][ç] (Li & Thompson, 1989). The palatal consonants [tɕ][tɕʰ][ç] are called “consonant-glide combinations” in Duanmu (2007, p. 23), transcribed as [tsʲ][tsʰʲ][sʲ]. These palatal consonants occur only when one of the glides /j/, /ɥ/ or high front vowels /i/, /y/ follows. Due to this constraint, some phonologists treat the palatals as allophones of consonants /ts/, /tsʰ/, /s/. [tɕ][tɕʰ][ç] also have the relationship of complementary distribution with retroflex /tʂ/, /tʂʰ/, /ʂ/ and velars /k/, /kʰ/, /x/. The reason is that unlike the alveolar, retroflex, or velar series, they are the only series that can appear before high vowels or high glides. Therefore, the palatals [tɕ][tɕʰ][ç] can be considered as allophones of the alveolar, retroflex, or velar series (Norman, 1988, p. 140). In the standard pinyin system, they are represented as separate phonemes, written as <j> <q> <x>. Therefore, this study follows the majority of researchers and considers Mandarin [tɕ][tɕʰ][ç] as independent phonemes.

The distinction between Mandarin pairs of stops and affricates is not voiced vs. voiceless, but unaspirated vs. aspirated. Such pairs are represented in the pinyin system mostly using letters which in romantic languages denote voiceless/voiced pairs. For example, /p<sup>h</sup>/ and /p/ are represented with *p* and *b* respectively. All Mandarin consonants can be syllable onsets except /ŋ/.

Another issue to be mentioned is the classification of the consonant *r*. Some researchers argue that Mandarin *r* is a voiced fricative /ʒ/ (Wang, 1979; Duanmu, 2007) because it can be treated with /ʃ/ as a pair of voiceless/voiced fricatives/ʃ ʒ/, similar to the relationship of /s z/. As it can be followed by the retroflex apical vowel [ɯ] just as the other three retroflex sibilants [tʂ, tʂ<sup>h</sup>, ʂ], it is reasonable to treat it as a sibilant. But it seems unreasonable for a voiced fricative to emerge since all the other obstruents in Mandarin are voiceless and it is not like a fricative because it doesn't have much friction in its pronunciation. Other researchers thus think that it is a retroflex approximant /ɻ/ (Lee & Zee, 2003; Lin, 2007), considering that Mandarin *r* is perceptually similar to English *r* but with a retroflex articulation. I argue that the Mandarin has two allophones [ʒ] and [ɻ], appearing in different contexts, with [ʒ] occurring more frequently than [ɻ]. In this thesis, it is transcribed as [ʒ]. In this study, I follow Duanmu (2007) as the retroflex series [tʂ, tʂ<sup>h</sup>, ʂ, ʒ] is a major characteristic of Mandarin speakers in the north of China. As they behave similarly, phonetically, they are all fricatives. Duanmu thinks that in the syllable for *shi* 'history', the rhyme part is considered as a fricative, the voiced version of the onset. So, it is transcribed as [ʂʒ]. In casual speech, the rhyme can undergo devoicing and become [ʂʂ]. In this study, the fricatives are not used in transcribing the rhyme of a syllable; instead, the apical vowel [ɯ] is used. For the description of apical vowels, see Section 4.5.2.2 Mandarin Vowels.

## Table 18

### *Inventory of Mandarin Consonants*

		Bilabial	Labial-dental	Dental	Retroflex	Palatal	Velar
Stop	-aspirate	p		t			k
	+aspirate	p <sup>h</sup>		t <sup>h</sup>			k <sup>h</sup>
Affricate	-aspirate			ts	tʂ	tɕ	
	+aspirate			ts <sup>h</sup>	tʂ <sup>h</sup>	tɕ <sup>h</sup>	
Fricative			f	s	ʂ ʐ	ç	x
Nasal		m		n			ŋ
Liquid	Lateral			l			
	Retroflex				(ɭ)		

*Note.* Lin, 1989

In comparing English consonants and Mandarin consonants, we found that there are some identical phonemes, which are: the stops /p/, /t/, /k/; the nasals /m/, /n/, /ŋ/; the fricative /f/; and the liquid /l/. The nasals /m/, /n/, /ŋ/, the fricative /f/, and the liquid /l/ are expected to be matched from English words to Mandarin words as they are perceptually similar to their Mandarin counterparts. As for the stops, as both English and Mandarin have three pairs of stops, phonologically, one English stop pair will be perceptually matched to a Mandarin stop pair with the same place of articulation. If phonetic details are taken into consideration, English voiced stops should be matched to Mandarin unaspirated stops and English voiceless stops should be matched to Mandarin aspirated stops.

#### **4.5.2 English and Mandarin Vowels**

The quality of a vowel is usually described in terms of three basic variables: open/close; front/back; and rounded/unrounded.

**4.5.2.1 English Vowels.** English monophthongs can be divided into three groups: five front unrounded vowels; five back vowels; and two central vowels. In the high-front and high-back, mid-front and mid-back region, GA has four pairs of vowels — /i-ɪ/, /u-ʊ/, /e-ɛ/, /o-ɔ/ — which are

traditionally distinguished by the parameter of tenseness, although alternative frameworks have been also employed (see Crothers, 1978; Ladefoged & Maddieson, 1996). Being tense or lax is a relative property that is determined by tongue root position. Generally acknowledged tense vowels include /i/, /e/, /ɑ/, /o/, /u/, while lax vowels are /ɪ/, /ɛ/, /æ/, /ʌ/, /ʊ/. Among the central vowels /ʌ-ə/, /ʌ/ occurs only in stressed syllables and /ə/ only in unstressed ones. Therefore, they could be treated as allophones of a single vowel. Thus, in some studies, /ə/ is chosen to represent both.

**Table 19**

*Inventory of English Monophthongs*

		Front/Unrounded	Mid/Unrounded	Back/Rounded
High	Tense	i		u
	Lax	ɪ		ʊ
Mid	Tense	e	ɜ ʌ	o
	Lax	ɛ	ə	ɔ
Low		æ (lax)		ɑ(tense) /ɔ/merged into /ɑ/ for GA speakers

*Note.* Jensen, 1993

In order to perceive their native vowels, English speakers use two spectral dimensions: high-low (F1 formant), and front-back (F2 formant), derived from spectral cues and durational information. English diphthong is one of the most significant factors that cause different opinions about English vowels. Typically, diphthongs are considered vowels that have two separate articulatory targets. But to differentiate from long vowels, the two separate targets should be different. Based on Ladefoged (2005) and Ball and Müller (2005), GA's vowel inventory consists of 12 monophthongs and five diphthongs. Cruttenden (2014) suggests seven diphthongs, which are diphthongal glides: [eɪ] [aɪ] [ɔɪ] [aʊ] [oʊ] [iə] [ɛə] [uə]. Since the first element in the diphthong has

the prominent feature, and the pure long vowels also have some glides in the final position, the diphthong vowels [eɪ] [oʊ] [iə] [ɛə] [uə] are treated as pure long vowels of its first sound in the analysis of loanword adaptation in this study. Thus, only [aɪ] [ɔɪ] [aʊ] are treated as full diphthongs.

**4.5.2.2 Mandarin Vowels.** There are different opinions about the number of Mandarin vowels, depending on whether the two apical vowels are included. Duanmu (2007, pp. 34-35) argues that Mandarin has five underlying vowels, since he treats the apical vowels [ɿ] and [ʅ] after the alveolar series [ts ts<sup>h</sup> s] and the retroflex series [tʂ tʂ<sup>h</sup> ʂ ʐ] as syllabic consonants [z] and [ʐ]. The five phonemic vowels are listed in Table 20:

**Table 20**

*Mandarin Phonemic Vowels*

	Front Unrounded	Front Rounded	Central	Back Rounded
High	i	y		u
Mid			ə	
Low			a	

*Note.* Lin, 1989; Duanmu, 2000

The vowel system in Mandarin consists of five vowels, which is a small inventory compared to the 11 vowels of English. The mid and low vowels /ə/ and /a/ are unspecified for backness and have several surface representations. The mid vowel /ə/ has four allophones: [e, ə, ɤ, o]. Following Lin (1989), the mid vowel becomes [e] when it is combined with [i], [j]; stays central schwa in closed syllables; become a tense mid back vowel [ɤ] in a CV or V syllable; and turns into [o] when combined with [u], [w]. The low vowel /a/ has similar surface representation in terms of backness. When it is before [i], [n], it surfaces as a front low vowel [a]; when it is in an open syllable, it is a central low [A]

(Xu, 1980; Chao, 1968); it turns into a back vowel [ɑ] before [u], [ŋ]. It is raised to [ɛ] when it follows a high glide and precedes [n], but because [jɛn] and [an] form a rhyming group (Duanmu, 2007), it is transcribed as [a] in this thesis. In summary, the mid vowel has four phonetic variants — [e], [ə], [ɤ], and [o] — and all are in complimentary distribution. The low vowel also has three allophonic variants [a], [ɑ], and [A]. Mandarin has three glides [j, w, ɥ], which are the allophones of high vowels [i, u, y].

Mandarin vowels are not called tense or lax, but they can be rounded and un-rounded. Moreover, they only differ in spectral features, and do not have as much formant movement as English vowels and may not be distinguished from one another by vowel duration differences.

**Table 21**

*Mandarin Surface Vowels*

	Front Unrounded	Front Rounded	Central	Back Unrounded	Back Rounded
High	i	y			u
Mid	e		ə	ɤ	o
Low	a		A	ɑ	

*Note.* Lin, 1989; Duanmu, 2000 ([A] is used to transcribe central low vowel in open syllables)

In addition to the five underlying vowels, Mandarin has two apical vowels in the Chinese phonological literature, which are often represented with two non-IPA symbols /ɿ/, /ʅ/. The term “apical vowel” and the symbols [ɿ, ʅ], which have been widely adopted in the field of Chinese phonology, are from Karlgren’s (1915) *Etudes sur la phonologie chinoise*. /ɿ/ only appears after the dental sibilants /ts, tsʰ, s/ to form /tsɿ/, /tsʰɿ/, /sɿ/; /ʅ/ only appears after the retroflex sibilants /tʂ, tʂʰ, ʂ, ʐ/ to form /tʂʅ/, /tʂʰʅ/, /ʂʅ/, /ʐʅ/. /ɿ/ is like /ʊ/, namely /u/ without lip rounding; /ʅ/ is similar to Russian /ɨ/. Different analyses have been proposed on the nature of these two sounds. They are described as syllabic fricatives instead of vowels, that is, the voiced extension of the preceding



fricatives (Duanmu, 2007). Lee and Zee (2003) and Lin (2007) treat them as syllabic approximants. Another approach is to regard them as an empty nuclear slot in these syllables, described as an “empty rhyme” 空韵 *kongyun* in Chinese.

### 4.5.3 English and Mandarin Syllables

**4.5.3.1 English Syllables.** English has a rather complex syllable structure, which can be formulated as  $C_{0-3}VC_{0-4}$ . Both the onset and coda can be composed of consonant clusters. In the onset position, up to three consonants can occur. In the coda position, up to four consonants can occur. What needs to be addressed is that besides vowels, which are the peaks in a syllable and act as a nucleus to form a syllable, some sonorant consonants can also form syllables with the preceding consonant. Such consonants are /n, m, ŋ, l, r/ (Hammond, 1999), also called “syllabic consonants”.

The syllable constraints have been developed based on the notions of sonority since the 19th century (Whitney, 1865). Sonority is decisive in that syllables tend to have their sonority peak at the nucleus, with the sonority of the surrounding elements decreasing towards the syllable edges. Various sonority hierarchies have been proposed, including those by Ladefoged (2001), Steriade (1982), Clements (1990), and Selkirk (1984). They may vary in detail but agree that stop consonants are the least sonorous, followed by (or are equal to) fricatives, then nasals, liquids, and finally glides and vowels. The 6-step scale proposed by Steriade (1982) is illustrated as follows:

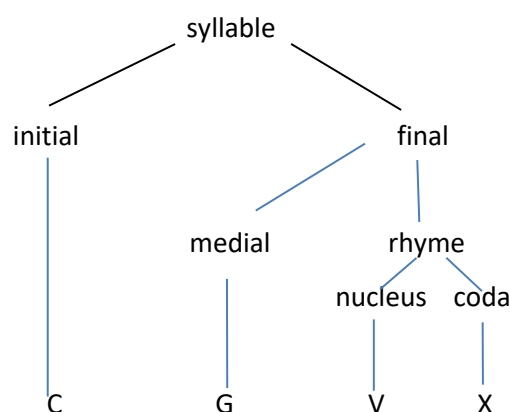
Vowels > Glides > Liquids > Nasals > Fricatives > Stops

The syllable onset constraint is based on the Minimal Sonority Distance (MSD), which determines how many steps further up the sonority hierarchy the following consonant must at least be to create a well-formed cluster (see Harris, 1983; Steriade, 1982). For English, the MSD value is set at 2 (Archibald, 1988). This means that no obstruent-obstruent or fricative-nasal clusters are possible. Additionally, plosive-nasal clusters are also prohibited. The largest group of well-formed

clusters is plosive plus liquid, for which all combinations are allowed except homorganic /dl/ and /tl/. The fricative-liquid group is more limited in that the fricative must be voiceless so that they are less sonorous. For this group, the only full set of clusters exist in the labial place of articulations with /fl, fr/, while /θ/ is subject to the same restrictions as /t/ and only combines with /r/ to form /θr/. Furthermore, /s/ behaves exceptionally in that it combines freely with voiceless plosives and nasals (/sp, st, sk, sm, sn/), as well as combining with well-formed clusters to form CCC onsets (e.g., /spr/). Therefore, initial /s/ has received special attention in the literature and been treated as being outside of the syllable structure proper, seen variously as extrasyllabic, an adjunct to the syllable, or as forming a complex segment with the following consonant (Selkirk, 1984).

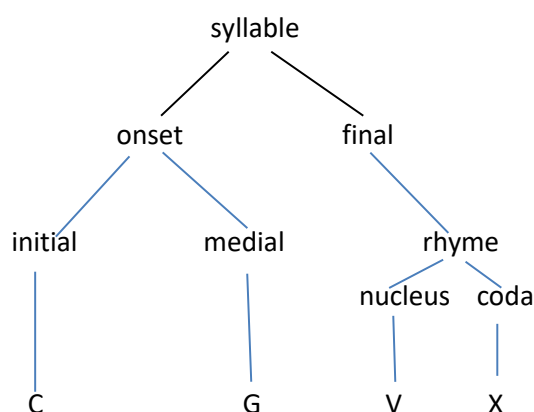
Furthermore, English permits CC onsets with glides (e.g., /kw/), again restricted to some extent by avoidance of homorganicity (e.g., \*/pw/). English also allows single onsets, as well as onsetless syllables. For further literature on English onsets and codas, see for example Hammond (1999), Giegerich (1992), and Algeo (1992).

**4.5.3.2 Mandarin Syllables.** Syllable structure plays a pivotal role in Mandarin phonology. Mandarin syllables are composed of an onset and a rhyme, also called an initial and a final, which are particular concepts used in Mandarin phonology, with the maximal form CGVX (C=consonant, G=glide, V=vowel, X=coda consonant or coda vowel). Initial consonants can be all the consonants except [ŋ], while finals are all possible combinations of a medial (one of the glides [j], [w], [ɥ]), and a rhyme (Miao, 2005, p. 40). A rhyme is composed of a nucleus vowel and a coda, which can be a consonant [n] or [ŋ] or a vowel [i] [u] [ə]. ([ə] is a retroflex vowel which occurs very occasionally and will not be dealt in this thesis.) Any one of C, G, and X may be absent. Mandarin is also a tonal language, with a tone as a feature of an entire syllable (Lin, 2007, p. 106). The syllable structure is illustrated in Figure 5:

**Figure 5***Mandarin Syllable Structure 1*

*Note.* Adapted from Li and Thompson, 1989

The position of a medial is the most controversial topic in Mandarin syllables. Some researchers claim that a medial should be placed in the onset position of a syllable with an initial, while other researchers argue that a medial should be under a final. The syllable structure from the latter opinion can be presented as the traditional description of Mandarin syllable structure. On the other hand, the Mandarin syllable structure could also be drawn as in Figure 6, with a medial placed under the onset position (Duanmu, 2007; Lin 2007). This analysis is more truthful to the real pronunciation of glides in Mandarin as a glide is shorter in articulation and has a fixed combination with the preceding consonants.

**Figure 6***Mandarin Syllable Structure 2*

G=j, w, ɥ

X=n, ŋ, i, u, ə

*Note.* Adapted from Duanmu, 2009

The aim of phonotactics study focuses on uncovering co-occurrence restrictions in specific languages. Many possible combinations of Mandarin syllables are actually missing in its syllable inventory. With 19 consonants, three glides, and five vowels, the actual combinations are only about 400 (Duanmu, 2007) because there are many constraints governing the syllable formation between the initials and finals. The initials are 22 consonants plus 29 licit CG initials. In the final combinations, there are nucleus-coda harmony (NC-harmony or rhyme harmony) and glide-nucleus harmony (GN-harmony) to follow in terms of frontness and rounding, resulting in only 35 existing GVX forms out of 100 possible combinations.

The judgement of well-formedness in Mandarin syllables is a gradient instead of an all-or-nothing classification, claimed by some studies on the world-likeness judgement on Chinese

languages (Kirby and Yu, 2007 [on Cantonese]; Myers, 2002; Myers & Tsay, 2005). There is a nuanced relationship between word-likeness judgements and phonotactic knowledge. It can be influenced by the speaker's knowledge of the lexicon, strongly influenced by the number of lexical items similar to a test item. Therefore, the illicit syllables rejected by phonotactics may not be perceived as illicit by speakers, and the licit syllables admitted by phonotactics may be felt as unacceptable.

The 18 consonants, 29 CG combinations, and 35 GVX forms (also called “finals”) are the basic building blocks of Mandarin syllables.

**Table 22**

*Mandarin Consonants and CG combinations*

	<b>c</b>	<b>c<sup>j</sup></b>	<b>c<sup>w</sup></b>	<b>c<sup>u</sup></b>
labial	p	p <sup>j</sup>	-	-
	p <sup>h</sup>	p <sup>hj</sup>	-	-
	m	m <sup>j</sup>	-	-
	f	-	-	-
dental	t	t <sup>j</sup>	t <sup>w</sup>	-
	t <sup>h</sup>	t <sup>h</sup>	t <sup>hw</sup>	-
	n	n <sup>j</sup>	n <sup>w</sup>	n <sup>u</sup>
	l	l <sup>j</sup>	l <sup>w</sup>	l <sup>u</sup>
	ts	tɕ	ts <sup>w</sup>	tɕ <sup>w</sup>
	ts <sup>h</sup>	tɕ <sup>h</sup>	ts <sup>hw</sup>	tɕ <sup>hw</sup>
	s	ɕ	s <sup>w</sup>	ɕ <sup>w</sup>
velar	k	-	k <sup>w</sup>	-
	k <sup>h</sup>	-	k <sup>hw</sup>	-
	x	-	x <sup>w</sup>	-
retroflex	tʂ	-	tʂ <sup>w</sup>	-
	tʂ <sup>h</sup>	-	tʂ <sup>hw</sup>	-
	ʂ	-	ʂ <sup>w</sup>	-
	ɻ	-	ɻ <sup>w</sup>	-

*Note.* “-” indicates a missing CG. Adapted from Duanmu, 2007

The final is the part of the syllable excluding the initial. There are 37 finals in Mandarin:

**Table 23**

*37 Finals in Mandarin*

ə	A	ə	o		ai	ei	au	ou	an	ən	aŋ	əŋ
i	iA			iɛ			iau	iou	iɛn	in	iaŋ	iŋ
u	uA		uo		uai	uei			uan	uən	uaŋ	uŋ
y				yɛ					yɛn	yn		

*Note.* Adapted from Li and Thompson, 1989

The velar nasal [ŋ] never occurs as an initial. The finals are composed mainly of vowels. The only two consonants that occur in a Mandarin syllable final are the velar nasal [ŋ] and the alveolar nasal [n] and they only occur at the end of a final.

There is one more important issue to note about Mandarin syllables. Some syllables are missing not because of systematic principles but are accidental gaps probably due to historical reasons, such as sound changes. Therefore, it might be difficult to find the reason for them. For example, the retroflexes /tʂ tʂʰ ʂ/ are supposed to be able to form syllables with the vowel /ei/. But \*[tʂʰei] happens to be non-existent. In fact, the majority of expected syllables are missing. Given there are 22 initials and 37 finals, more than 800 syllables are expected in the Mandarin syllable inventory. But only about 400 are used.

The phonological restrictions of Mandarin that apply to the adaptation of English borrowings are simple to formalise and analyse in the constraint-based framework of OT (Prince & Smolensky,

2004). The central tenet of OT is that the surface outputs result from the interaction of markedness constraints against disfavoured structures and faithfulness constraints against departures from the input, with the form of the ultimate output depending on how well it satisfies the most important (i.e., highest ranking) constraints in the phonology.

There are several constraints against illicit structures. The phonotactic markedness constraints in Mandarin are summarised as follows:

1. \*CC: consonant clusters are not allowed in Mandarin syllables.
2. \*Onset [ŋ]: [ŋ] cannot be a Mandarin initial.
3. Coda [n, ŋ]: only [n, ŋ] can be in the coda position of Mandarin syllables if it ends in nasals.
4. Nucleus-coda harmony:
  - a. The nucleus and the coda must agree in frontness.
  - b. The nucleus and the coda must agree in rounding. (Duanmu, 2007)
5. Glide-nucleus harmony:
  - a. The prenuclear glide and the nucleus must agree in frontness.
  - b. The prenuclear glide and the nucleus must agree in rounding. (Duanmu, 2007)

These markedness constraints are counterbalanced by a set of faithfulness constraints penalising alterations to the input. The faithfulness constraints that are active in English loanword adaptation are summarised below and fall into three main families of constraints: DEP(ENDING), militating against additions to the input; MAX(MIMIZE), militating against subtractions from the input; and IDENT(ITY), militating against featural changes to the input:

1. DEP: Output segments have input correspondents (i.e., no epenthesis).
2. MAX-ONSET: Input onsets have output correspondents.
3. MAX-CODA: Input codas have output correspondents.
4. IDENT [place]: Input segments keep the same specification for [place] in the output (i.e., no debuccalisation, no changing of place).

#### 4.5.4 English Stress and Mandarin Tones

**4.5.4.1. English Stress.** English is a lexical stress language. The stressed syllables are longer, can be louder and higher in pitch, or contain more pitch movement than unstressed syllables. As English words are borrowed into Mandarin, a tone language, is there any adaptation pattern of the suprasegments (i.e., stress and tone) between the two languages? Wu (2006) concludes that there is no consistent matching relationship between English stress and Mandarin tones. But in Silverman (1992), English stressed syllables are adapted into the Cantonese high tone without exception.

**4.5.4.2 Mandarin Tones.** Mandarin is a tonal language, which means that in addition to consonants and vowels, the pitch contour of a syllable is used to distinguish words from each other. It has four main tones and one neutral tone.

In Table 24, the tone system in Mandarin is presented with each column showing one of the four tones: high-level tone; rising tone; low tone; and falling tone. Line (a) gives one example of each tone in Mandarin pinyin with tone feature. Line (b) is Mandarin pinyin with Chao digits (1930), where 5 represents the highest pitch and 1 the lowest. Line (c) is Mandarin pinyin with a tonal diacritic marked above the main vowel to indicate the pitch movement. The diacritic is also called a “tone marker”. Line (d) provides one example of each tone represented by a character with an English gloss.

**Table 24**

*Tone System of Mandarin*

	<b>Tone 1 (High)</b>	<b>Tone 2 (Rising)</b>	<b>Tone 3 (Low)</b>	<b>Tone 4 (Falling)</b>
(a)	maHH	maMH	maL	maHL



(b)	ma55	ma35	Ma214	Ma51
(c)	mā	má	mǎ	mà
(d)	妈 ‘mum’	麻 ‘hemp’	马 ‘horse’	骂 ‘to scold’

*Note.* Adapted from Zheng and Druvasula, 2015

The number of lexical words in each tone and the frequency of the four tones in Mandarin are different. Table 25 presents the number of words within each tone and the frequency of each tone in a Mandarin vocabulary corpus based on the modern Chinese dictionary.

**Table 25**

*Distribution of Mandarin Tones*

Tone	National Standard Corpus of Mandarin		Chinese Vocabulary Corpus	
	Words			
	number of words	percentage	frequency	percentage
T1	1959	25.19	24690	23.71
T2	1972	25.35	25130	24.13
T3	1300	16.71	17853	17.15
T4	2849	32.00	33560	32.23

*Note.* Adapted from Liu and Ma, 1986

As shown in Table 25, the most common tone for Mandarin is T4, and the least common is T3. T4 words occur 32.23% of the time in the Chinese vocabulary corpus, while T3 occurs only 17.15% of the time. Besides the number of actual words of each tone and tone frequency, T3 may exhibit a variation such as a sandhi (Duanmu, 2007), where T3 becomes T2 when the following word is T3.

In Mandarin, two different syllable types occur: full syllable and weak syllable (also called major syllable and minor syllable). Full syllables are heavy, containing any vowel except schwa and bearing tone. Most Chinese words are full syllables. Weak syllables are light, contain schwa and another vowel, do not bear tone or have a neutral tone, and have a shorter vowel length than the

full syllable. Weak syllables are usually located on grammatical words, which can be aspect markers or question markers, etc. Content words can also have weak syllables. The syllables in compound words have various degrees of strength and weakness depending on their syntactic structures. The second syllable of a disyllabic compound is often weak, for example:

[ti]+[fan] 'land+direction' → [ti.fə̃] 'place'

[nau] + [tai] 'head+bag' → [nau.te] 'head'

In disyllabic loanwords, the second syllable is often weak too, for example: [p<sup>h</sup>u.t<sup>h</sup>au] 'grape', [pwo.lɿ] 'glass', etc. where the second syllable of the word bears a neutral tone.

#### ***4.5.5 Predictions of Phonemic Mapping Based on Speech Perception Models***

During the process of loanword adaptation from English into Mandarin, it is inevitable to see the phonemic mapping on the phonological level and the phonotactic adaptation that changes a loanword into conformity with Mandarin syllable construction rules. In the borrowing of an English loanword, if a segment is preserved, it is mapped into a Mandarin phoneme which sounds to the L1 Mandarin speaker as the closest one to the English segment.

In terms of the features of consonants, Spencer (1996) concludes three major distinctive features: (1) feature of articulation manner: consonancy, approximancy, sonorancy, stridency, continuancy, nasality, and laterality; (2) feature of articulation place: labial, coronal, and dorsal; (3) feature of voicing. Spencer's system does not include the feature of aspiration, which is not contrastive in English. But as it is contrastive in Mandarin, aspiration should be added as one feature of consonant articulation in the system.

In assessing phonetic distances between L1 and L2 speech sounds, the commonly used method of phoneme inventory comparisons as the perceptual element, the IPA, is not applicable as the phonetic symbols do not provide the detailed phonetic properties of sounds; using acoustic

properties of phones across languages may not be sufficient either, as such measurement may not capture the most crucial phonetic cues of category formation.

Perceptual mapping concerns phonetic similarity as well as functional equivalence at the phonological level (relationship between phonetic details and phonological categories). Based on the speech perception model PAM with an ecological direct-realist premise, among the multi-modal system through which perceivers obtain information of sounds, the auditory modality is the most primitive one. Therefore, the articulatory gestures in speech production, that is, the articulators that are active in producing the sounds of the source language and the recipient language, are the basics for the perception performance.

#### Saliency of features

Various proposals have been made concerning the appropriate inventory of features for describing phonetic distinctions across languages. For the purposes of the present discussion, this list of features (adopted from Stevens & Keyser, 1989) has been selected:

VOCALIC	NONVOCALIC
high	sonorant
low	continuant
back	coronal
round	strident
nasal	consonantal
spread glottis	anterior
constricted glottis	lateral
distributed voice	

There is a set of distinctive features for consonants that are the most salient; the sonorant, continuant, and coronal.

#### Prediction of consonant mapping from English to Mandarin

##### Prediction on mapping of stops

English stop pairs /p b/, /t d/, and /k g/ have the same feature of place with the Mandarin stop pairs /p<sup>h</sup> p/, /t<sup>h</sup> t/, and /k<sup>h</sup> k/. English voiceless stops /p t k/ surface as the aspirated allophone [p<sup>h</sup> t<sup>h</sup> k<sup>h</sup>] which are phonetically very similar to Mandarin /p<sup>h</sup> t<sup>h</sup> k<sup>h</sup>/. So, English /p t k/ will be predicted to be mapped to Mandarin /p<sup>h</sup> t<sup>h</sup> k<sup>h</sup>/ as a good exemplar of the category. As for the voiced stops /b d g/, they are similar to Mandarin /p t k/ in features of manner and place, but not in voicing. They can be perceived as acceptable exemplars of the category. Also, in pinyin, a Romanisation used as a tool for Mandarin learning for mainland students from the beginning of schooling, voiceless stops are written with letters that represent voiced consonants in English, and aspirated stops with letters that represent voiceless consonants. Thus <d> represents /t/, and <t> represents /t<sup>h</sup>/. Hence there is a possibility that the coincidences of orthography of Chinese pinyin and English may play a part in the confusion of L2 sounds in actual perception. Whether the pinyin Romanisation will have an orthographic influence on the perception will be further discussed.

#### Prediction on mapping of fricatives and affricatives

In the labial place, English has a fricative pair /f v/ while Mandarin has only one voiceless fricative /f/. English /f v/ is expected to be mapped into Mandarin /f/ with /f/ as a good exemplar and /v/ as an acceptable exemplar. In the interdental place, English has a fricative pair /θ ð/ while Mandarin has no dental fricative. As /θ ð/ don't resemble any Mandarin category, they will fall in an untuned region and perceived as uncategorised sounds. In terms of place of articulation, the closest Mandarin sounds are /t<sup>h</sup> t/ as they are in the nearest place of articulation to English /θ ð/. Chao (1968) treats [ts, ts<sup>h</sup>, s] and [t, t<sup>h</sup>, n, l] as dentals as the tongue tip is usually on the lower teeth. In the X-ray and palatographic study of D. Zhou and Wu (1963, p. 22), the tongue tip in [ts, ts<sup>h</sup>, s] can be on either the upper or the lower teeth. In [t, t<sup>h</sup>, n, l] the tongue tip is generally on the upper teeth, although sometimes it is on the lower teeth, such as in the [n] of [an] (D. Zhou & Wu, 1963, p. 39). Among the Mandarin fricatives, as there are no voiceless-voiced fricative pairs, /θ/ may be perceptually matched to labio-dental voiceless fricative /f/ or dental fricative /s/, while /ð/ may not

be expected to be mapped into Mandarin fricatives but Mandarin affricate /ts/ may be an option as it is one member of the alveolar series /ts ts<sup>h</sup> s/ written in pinyin as <z>, which is in contrast with the fricative /s/.

Besides the labial and the dental places, Chinese phonology has a rich inventory of fricatives and affricates in coronal places: the dental series /ts/, /ts<sup>h</sup>/, /s/; the retroflex series /tʂ/, /tʂ<sup>h</sup>/, /ʂ/, /ʐ/; and the palatal series /tɕ/, /tɕ<sup>h</sup>/, /ç/; among which most are voiceless sounds (except /ʐ/) in alveolar, retroflex, and palatal places of articulation. Such rich density of phonemic categories in the L1-L2 common perceptual space is believed to be beneficial in learning a language with fewer similar categories (Major, 2001).

The retroflex consonants in Mandarin are actually apical rather than subapical, and so are considered by some researchers not to be truly retroflex; they may be more accurately called post-alveolar (Ladefoged & Wu, 1984). Therefore, it is primarily the shape of the tongue rather than their position that distinguishes the English fricatives /ʃ ʒ/, and Mandarin fricatives /ʂ ʐ/. Therefore, the English fricative contrast /ʃ ʒ/ would be predicted to be mapped into Mandarin fricative contrast /ʂ ʐ/ as they have the same features of articulation manner and place.

English alveolar fricative /s z/ have no mapping pair in Mandarin, as Mandarin has only one voiceless fricative /s/ in the place near alveolar. Thus, English /s z/ might be mapped into Mandarin /s/ with /s/ as a good exemplar and /z/ as an acceptable exemplar.

The English affricates /tʃ dʒ/ have no mapping pair in Mandarin as Mandarin has no voiced affricate but a pair of retroflex affricate /tʂ<sup>h</sup> tʂ/ which are both voiceless and differentiated by aspiration. As mentioned above, the retroflex consonants in Mandarin are accurately post-alveolar, and English /tʃ dʒ/ shares the same feature of manner and place with Mandarin /tʂ<sup>h</sup> tʂ/. The only difference is that the English pair differs in voicing while the Mandarin pair differs in aspiration. Phonologically, English /tʃ dʒ/ can be mapped into Mandarin /tʂ<sup>h</sup> tʂ/ as acceptable exemplars.

In the glottal place, English has a voiceless fricative /h/ and Mandarin has a voiceless fricative /x/ in velar place. As they are the closest fricative in terms of place, they are expected to be perceived most similar. Thus English /h/ is mapped into Mandarin /x/.

#### Prediction on mapping of nasals

English has three nasals /m n ŋ/. So has Mandarin. Therefore, the mapping pattern of nasals is predicted to be a one-to-one pattern.

#### Prediction on mapping of approximants

Approximants fall between fricatives, which do produce a turbulent airstream, and vowels, which produce no turbulence (Martínez-Celdrán, 2004). English has a rhotic approximant /ɹ/ while Mandarin has a retroflex fricative /ʐ/. Phonetically they are similar with the common feature of retroflex. But English /ɹ/s in onset are predominantly adapted into Mandarin /l/. Miao (2005) claims that one possible reason is the unmarkedness of /l/-initial syllables in Mandarin. To get a more convincing conclusion, the syllable inventory with /l/ and /ɹ/ as onset needs to be studied. Mandarin syllables with the onset /l/ and syllable with the onset /ʐ/ show overlapping finals and distinct finals, which cannot prove that Mandarin/l/-initial syllables are the unmarked form. Phonetically, /ʐ/, as a fricative, also has the feature of stridency and can be perceptually more like the English fricative /ʒ/. English /ɹ/, phonetically without the feature of stridency, may be perceived more like the Mandarin /l/.

## **4.6 Consonant Adaptations**

### **4.6.1 Adaptation of Onset Stops**

Some languages, such as Mandarin, have two series of voiceless stops (voiceless aspirated and voiceless unaspirated), and aspiration is the phonemic feature contrasting the two groups of stops. There are six stops in Mandarin with three different places of articulation, which are bilabial

stops /p<sup>h</sup>/-/p/, alveolar stops /t<sup>h</sup>/-/t/, and velar stops /k<sup>h</sup>/-/k/. All Mandarin stops are voiceless, and aspiration is the primary feature of the laryngeal contrast. The Mandarin stops are typically termed as voiceless unaspirated and voiceless aspirated stops (Xu & Xu, 2003; Duanmu, 2007; Luo, 2018). VOT was predicted to be the most important cue for the Mandarin listeners to distinguish aspiration, as VOT is a primary cue for aspiration in Mandarin (Lisker & Abramson, 1964; Duanmu, 2007). The mean VOTs of Mandarin stops from three previous studies are summarised in Table 26.

**Table 26**

*Mean VOTs of Mandarin Stops from Three Previous Studies*

	Rochet & Fei (1991)	Liu et al. (2008)	Li (2013)	
Gender	Not reported	Male	Female	Male
/p <sup>h</sup> /	99.6ms	96.5ms	NA	NA
/t <sup>h</sup> /	98.7ms	97.8ms	93.3ms	77.9ms
/k <sup>h</sup> /	110.3ms	104.6ms	90.8ms	78.8ms
/p/	13.0ms	NA	NA	NA
/t/	13.7ms		12.5ms	17.5ms
/k/	26.3ms		22.5ms	29.5ms

*Note.* Adapted from Rochet & Fei, 1991; Liu et al., 2008; Li, 2013

English stops are often considered as a contrast in voicing (e.g., Lisker, 1986; Francis et al., 2006). However, the distinction is mainly a phonological one especially for syllable-initial stops. The voicing contrast in onset position is primarily realised with aspiration, so the stop distinction is between voiceless unaspirated stops and voiceless aspirated stops (Lisker & Abramson, 1964; Zlatin, 1974; Keating, 1984; Francis et al., 2006). In intervocalic position, voicing tends to occur during stop closure of voiced stops, which makes it a true voicing contrast (Deterding & Nolan, 2007). Mean VOTs of English stops from Lisker and Abramson (1964) are summarised in Table 27.

**Table 27***American English VOT Means and Ranges*

<b>Stops</b>	<b>/p/</b>	<b>/t/</b>	<b>/k/</b>	<b>/b/</b>	<b>/d/</b>	<b>/g/</b>
Mean VOT	58ms	70ms	80ms	1ms	5ms	21ms
Range	20-120ms	30-105ms	50-135ms	0-5ms	0-25ms	0-35ms

*Note.* Lisker and Abramson, 1964

According to the framework proposed by Cho and Ladefoged (1999), languages can be divided into four different phonetic categories along the VOT continuum: the unaspirated stops with VOT around 30 ms; the slightly aspirated stops with VOT around 50 ms; the aspirated stops with VOT around 90 ms; and the highly aspirated stops with VOT above 100 ms. Chao and Chen (2008) note that Mandarin aspirated stops have longer VOT values than English aspirated stops, and they suggest that Mandarin should be categorised into the highly aspirated group and English into the aspirated group. However, Lisker and Abramson (1964) suggest Mandarin and English belong to the same two-way contrast language group with voiceless unaspirated stops ranging from 0 to 25 ms along the VOT continuum and 60 to 100 ms for voiceless aspirated stops. Deterding and Nolan (2007) also suggest that Mandarin and English should be categorised into the same group as when L1 Mandarin and British English speakers produce isolated stops in their L1, there are no significant VOT differences between the corresponding syllable initial stops in the two languages. However, in the intervocalic position, there is a significant difference of voicing between English and Mandarin. The English stop with a short lag VOT in the intervocalic position exhibits a significantly longer voicing duration. English stops exhibit different behaviours in syllable-initial and intervocalic positions. In summary, though the Mandarin stops are referred to as unaspirated stops and aspirated stops (e.g., Xu & Xu, 2003; Luo, 2018) and the English stops are referred to as voiced and voiceless stops (e.g., Lisker & Abramson, 1964), they are phonetically very similar syllables initially. Phonologically, English stops /b d g/ are voiced, though they are phonetically voiceless in syllable onset. Thus English /b d g/



and Mandarin unaspirated stops /p t k/ are comparable. English voiceless stops and Mandarin aspirated stops are comparable too, as English stops /p b/ /t d/ /k g/, Mandarin stops /p<sup>h</sup> p/ /t<sup>h</sup> t/ /k<sup>h</sup> k/ form contrastive pairs in each language. Thus, initially, Mandarin aspirated stops /p<sup>h</sup> t<sup>h</sup> k<sup>h</sup>/ are the perceptually closest segment to English voiceless stops /p t k/; Mandarin unaspirated stops /p t k/ to English voiced stops /b d g/. Voicing contrasts in English are expected to be replaced by Mandarin aspirated contrasts of the same place feature. Tables 28-31 show the mapping distribution of English stops to Mandarin phonemes in the corpus.

**Table 28***Mapping Distribution of English Voiceless Stop /p/ to Mandarin Phonemes*

	English /p/ in syllable initial position		English /p/ in intervocalic position	
	Mandarin /p <sup>h</sup> /	Mandarin /p/	Mandarin /p <sup>h</sup> /	Mandarin /p/
Times	24	24	7	9
Percentage	50	50	43.8	56.2
Cases	<i>pace</i>	<i>Pampers</i>	<i>Kallipygos</i>	copy
	<i>Pandora</i>	<i>pancake</i>	<i>OPEC</i>	Cupid
	<i>Paracetamol</i>	<i>papaw</i>	<i>Opium</i>	Gestapo
	<i>park</i>	<i>passion</i>	<i>Papaw</i>	shaping
	<i>parkour</i>	<i>pence</i>	<i>Shopping</i>	Utopia
	<i>partner</i>	<i>penny</i>	<i>Topology</i>	Dopamine
	<i>party</i>	<i>Pentium</i>	<i>Yuppies</i>	Rupee
	<i>penicillin</i>	<i>Pepsi</i>		Dupont
	<i>pickup</i>	<i>Pest</i>		cappuccino
	<i>pie</i>	<i>Polka</i>		
	<i>ping-pong</i>	<i>pop art</i>		
	<i>pint</i>	<i>Porsche</i>		
	<i>pizza</i>	<i>port</i>		
	<i>poker</i>	<i>Pound</i>		
	<i>poncho</i>	<i>pudding</i>		
	<i>proletariat</i>	<i>pump</i>		

<i>puff</i>	<i>pasteurize</i>
<i>punk</i>	<i>Podcast</i>
<i>palace</i>	<b><i>Polaroid</i></b>
<i>Polaroid</i>	<i>Puma</i>
<i>pizza</i>	<i>Esperanto</i>
<i>Olympic</i>	<i>Shampoo</i>
<i>ampere</i>	<i>Alps</i>
<i>ampoule</i>	

*Note.* Based on the findings in this study

**Table 29**

*Mapping Distribution of English Voiceless Stop /t/ to Mandarin Phonemes*

	English /t/ in syllable initial position		English /t/ in intervocalic position	
	Mandarin /t <sup>h</sup> /	Mandarin /t/	Mandarin /t <sup>h</sup> /	Mandarin /t/
Times	32	16	19	11
Percentage	66.7	33.3	63.3	36.7
Cases	<i>talk show</i>	<i>taboo</i>	barbital	Cretin
	<i>tango</i>	<i>tannin</i>	Beatles	karting
	<i>tank</i>	<i>tart</i>	butter	lithopone
	<i>tanta</i>	<i>taxi</i>	cartoon	motor
	<i>Thames</i>	<i>telephone</i>	DDT	nicotine
	<i>tips</i>	<i>ton</i>	cheetah	Paracetamol
	<i>title</i>	<i>dictator</i>	guitar	Proletariat
	<i>tittup</i>	<i>Valentine</i>	Jitterbug	Satan
	<i>toast</i>	<i>pasteurize</i>	Lolita	Latin
	<i>TOEFL</i>	<i>Fanta</i>	lottery	valitin
	<i>TOEIC</i>	<i>Hamilton</i>	martini	Manhattan
	<i>Toffee</i>	<i>Kentucky</i>	metre	
	<i>topology</i>	<i>Lipton</i>	mojito	
	<i>Tory Party</i>	<i>hysteria</i>	motor	
	<i>totem</i>	<i>romantic</i>	party	
	<i>toucan</i>	<i>Esperanto</i>	Utopia	
	<i>Trojan</i>		vitamin	

<i>turbine</i>	Waterloo
<i>tween</i>	Motorola
<i>twitter</i>	
<i>typhoon</i>	
<i>tyre</i>	
<i>Byzantine</i>	
<i>Antisterone</i>	
<i>Atropine</i>	
<i>filibuster</i>	
<i>Gestapo</i>	
<i>Internationale</i>	
<i>Internet</i>	
<i>Montage</i>	
<i>Pentium</i>	
<i>Intel</i>	

*Note.* Based on the findings in this study

**Table 30**

*Mapping Distribution of English Voiceless Stop /k/ to Mandarin Phonemes*

	English /k/ in Syllable Initial Position				English /k/ in Intervocalic Position			
	Mandarin				Mandarin			
	/k <sup>h</sup> /	/k/	/tɕ <sup>h</sup> /	/tɕ/	/k <sup>h</sup> /	/k/	/tɕ <sup>h</sup> /	/tɕ/
Times	50	7	3	10	14	1	1	5
Percentage	71.4	10	4.2	14.2	66.7	4.8	4.8	23.8
Cases	<i>cacao</i>	<i>calcium</i>	<i>Cupid</i>	<i>cannon</i>	<i>acapella</i>	<i>bacon</i>	<i>cookie</i>	<i>bikini</i>
	<i>calorie</i>	<i>cognac</i>	<i>kiwi</i>	<i>carnival</i>	<i>acre</i>			<i>Buckingham</i>
	<i>camera</i>	<i>curry</i>	<i>cream</i>	<i>Carrefour</i>	<i>hacker</i>			<i>IKEA</i>
	<i>canon</i>	<i>kangaroo</i>		<i>currant</i>	<i>jacket</i>			<i>eucalyptus</i>
	<i>cappuccino</i>	<i>Columbia</i>		<i>kallipygos</i>	<i>marker</i>			<i>khaki</i>
	<i>car</i>	<i>Colgate</i>		<i>kiwi</i>	<i>parkour</i>			
	<i>carat</i>	<i>Quaker</i>		<i>pancake</i>	<i>pickup</i>			
	<i>carbine</i>			<i>Whisky</i>	<i>poker</i>			
	<i>card</i>			<i>Witkey</i>	<i>rococo</i>			
	<i>carnation</i>			<i>Eskimo</i>	<i>snooker</i>			
	<i>cartoon</i>				<i>dacron</i>			

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<i>cashmere</i>	<i>baccarat</i>
<i>caste</i>	<i>Coca-Cola</i>
<i>Clean &amp;</i>	<i>cacao</i>
<i>Clear</i>	
<i>clone</i>	
<i>Coca-Cola</i>	
<i>cocaine</i>	
<i>coffee</i>	
<i>caffeine</i>	
<i>cologne</i>	
<i>cool</i>	
<i>coolie</i>	
<i>copy</i>	
<i>cracker</i>	
<i>cretin</i>	
<i>karat</i>	
<i>karst</i>	
<i>karting</i>	
<i>koala</i>	
<i>caffeine</i>	
<i>cassette</i>	
<i>collotype</i>	
<i>combine</i>	
<i>crown</i>	
<i>coulomb</i>	
<i>Kremlin</i>	
<i>Converse</i>	
<i>Kentucky</i>	
<i>Kmart</i>	
<i>Kodak</i>	
<i>Acryl</i>	
<i>disco</i>	
<i>encore</i>	
<i>Oscar</i>	
<i>polka</i>	
<i>Ankara</i>	
<i>Podcast</i>	
<i>khaki</i>	

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*Note.* Based on the findings in this study

**Table 31***Mapping Distribution of English Voiced Stop /b d g/ to Mandarin Phonemes*

	English /b/		English /d/		English /g/	
	Mandarin /p/	Mandarin /p <sup>h</sup> /	Mandarin /t/	Mandarin /t <sup>h</sup> /	Mandarin /k/	Mandarin /tɕ/
Times	78	5	61	3	36	5
Percentage	94	6	95.3	4.7	87.8	12.2
Cases	(omitted)	<i>Bacon</i> <i>Bagel</i> <i>beer</i> <i>Bushel</i> <i>turbine</i>	(omitted)	<i>Donald</i> <i>mandolin</i> <i>media</i>	(omitted)	<i>Garfield</i> <i>guitar</i> <i>Safeguard</i> <i>Colgate</i> <i>Gallop</i>

*Note.* Based on the findings in this study

As the data shows, the English stops /k/ /g/ are mapped to Mandarin affricate /tɕ<sup>h</sup>/ /tɕ/ besides /k<sup>h</sup>/ and /k/. The pattern is not observed in other stop pairs. In these cases, mostly, the following vowel is a high front vowel/glide. Phonetically, the articulation of English onset /k/ and /g/ tend to be somewhat palatalised before a high front vowel. Thus, a palatal phoneme in Mandarin is chosen to replace the stop to achieve the perceptual similarity between the source and the output. More importantly, in Mandarin phonology, velar stops /k<sup>h</sup>/ and /k/ cannot be followed by a high front vowel /i/ or /y/ (or the glides /j/ /y/) (e.g., \**ki* [k<sup>hi</sup>] \**gi* [ki]). The same applies to the velar fricative /x/. When the velar series /k<sup>h</sup> k x/ is followed by a high front vowel, they are palatalised into an affricate series /tɕ<sup>h</sup> tɕ ɕ/. Therefore, the palatal affricates /tɕ<sup>h</sup> tɕ/ are the best substitutes for /k<sup>h</sup> k/. Note that in the data, the syllable /k/+ low vowel /a/ or /ʌ/ is also adapted into /tɕ<sup>h</sup> tɕ/+ high front vowel, for example, *cannon*, *carnival*, *Carrefour*, *kallipygos*, *eucalyptus*, *Garfield*, *Safeguard*, *Colgate*, *Gallop*. This thesis argues that though the syllable [k<sup>h</sup>a] and [ka] exist in Mandarin, they correspond to low frequently used morpheme, while [tɕ<sup>h</sup>a] is a very frequently used morpheme. This

frequency distribution is a factor in how loanwords are borrowed. In addition, some of the above cases might be graphically borrowed from Cantonese, where they are pronounced as [ka]. For instance, the word *pancake* is borrowed as *banji* 班戟. The two characters are pronounced as *banji* [pan. tɕi] in Mandarin, but as [pan.kɛ] in Cantonese, which indicates that it is more likely to be borrowed first into Cantonese. The same character's pronunciation changes from [kɛ] in Cantonese to [tɕi] in Mandarin. *Gap* is adapted into either [tɕʰa.pʰu] or [kai. pʰu], which indicates that it either changes the onset stop into an affricate and maintains the vowel quality, or it changes the vowel to make the corresponding morpheme more frequent.

#### 4.6.2 Adaptation of Onset Fricatives and Affricates

Mandarin has a rich inventory of fricatives and affricates, which are /f/ /ts/ /tsʰ/ /s/ /tɕ/ /tɕʰ/ /ç/ /tʂ/ /tʂʰ/ /ʃ/ /ʒ/ /x/, including both voiceless and voiced sounds in labio-dental, dental, retroflex, palatal, and velar places of articulation. Such rich density of phonemic categories in the L1-L2 common perceptual space is believed to be beneficial in learning a language with fewer similar categories (Major 2001). In the adaptation process, the perception of English fricative /θ ð/ /s z/ /ʃ ʒ/ might be difficult for Mandarin speaker as Mandarin has only three fricatives /s ʃ ʒ/ in the coronal place.

**4.6.2.1 Adaptation of English /f v/.** English has a pair of labiodental fricatives /f v/, while Mandarin has only one voiceless labiodental fricative /f/. Based on the prediction of PAM, the two English fricatives /f/ and /v/ might be perceived as one Mandarin category /f/, with one presenting as a better candidate than the other, forming the Category Goodness type (CG) (Best, 1995).

**Table 32**

*Mapping Distribution of English Onset Fricatives /f v/ to Mandarin Phonemes*

	English /f/		English /v/
	Mandarin /f/	Mandarin /f/	Mandarin /w/
Times	48	5	8
Percentage	100	38.5	61.5
Cases	(omitted)	<i>vanilla</i>	<i>carnival</i>
		<i>vaseline</i>	<i>Valentine</i>
		<i>volt</i>	<i>Viagra</i>
		<i>valve</i>	<i>vitamin</i>
		<i>valitin</i>	<i>voodoo</i>
			<i>Venus</i>
			<i>Converse</i>
			<i>Levi's</i>

*Note.* Based on the findings in this study

The cases where /v/ is mapped into /w/ are more than the cases where /v/ is mapped into /f/ despite /f/ and /v/ only differing in voicing. One possible reason is that in Mandarin, when [w] occurs initially without a consonant, many Beijing speakers pronounce it as a labio-dental approximant [ʋ] (Shen, 1987; Hu, 1991). According to Hu (1991, p. 244–245), at least 90% of Beijing speakers use [ʋ] to replace /w/ in various degrees. Therefore, perceptually, English /v/ can be similar to Mandarin [ʋ] as they both involve the labial articulator and the feature [+voice]. The choice between [w] and [ʋ] depends on the following vowel. Shen (1987) reports that [ʋ] can occur before any vowel except [o]. Some examples of alternate pronunciation with [w] and [ʋ] as initial is shown below (adapted from Duanmu, 2007, p. 23):

[wo]/\*[ʋo] 'I'

[wei]/[ʋei] 'tail'

[wən]/[ʋən] 'literary'

[wəŋ]/[ʋəŋ] 'Weng' (a name)

[wa]/[ʋa] 'tile'

[wai]/[uai] 'outside'

[wan]/[uan] 'late'

[waŋ]/[uaŋ] 'king'

It is reasonable that English /v/ is mapped into Mandarin /f/ and /w/ as both have some resemblance to /v/ but neither is a good candidate. /f/ lacks the feature of [+voice] while /w/ lacks the stridency. But the distribution isn't random: /w/ is chosen significantly more often than /f/. The reason can be that /w/ is the onset of more syllables than /f/, that is, /w/ has a greater distribution in Mandarin syllable inventory.

**4.6.2.2 Adaptation of English /θ ð/.** English /θ ð/ are non-existent in the Mandarin consonant inventory. Mandarin [s] is phonetically pretty much the closest consonant. Like many languages that lack /θ ð/, in which the English dental fricatives are often replaced by [s], native Mandarin speakers replace the interdental fricatives /θ ð/ with /s ts/, respectively (Wang, 2015), which is evidence that Mandarin native speakers perceive English interdental fricatives /θ ð/ as phonetically similar to Mandarin dental fricative /s/ and Mandarin dental affricate /ts/. /θ/ and /s/ share the same manner of articulation and the place of articulation is the nearest. Although in L1 language acquisition, English native speakers may use /f/ to replace /θ/ and many English dialects actually pronounce /θ/ as /f/, not one case where /θ/ is borrowed into Mandarin /f/ is found. One possible reason is that there is limited distribution of Mandarin syllables with /f/ onset. Mandarin does not have a voiced fricative /z/ but has a dental fricative pair: the aspirated affricate /ts<sup>h</sup>/ and the unaspirated affricate /ts/. The unaspirated /ts/ is phonetically more similar to the voiced fricative /ð/ as it is a sibilant affricate with high-frequency turbulence. Moreover, it is written in Mandarin pinyin with the letter <z>, which may be an orthographic factor for a native Mandarin speaker to phonologically consider it as a voiced fricative, forming a voiced-voiceless pair with /s/. Thus, English /θ ð/ are expected to be phonemically perceived as Mandarin /s ts/.



**Table 33**

*Mapping Distribution of English Onset Fricatives /θ ð/ to Mandarin Phonemes*

	English /θ/*			
	Mandarin /s/	Mandarin /t <sup>h</sup> /	Mandarin /t/	Mandarin /ɕ/
Times	1	2	2	1
Percentage	16.7	33.3	33.3	16.7
Cases	<i>marathon</i>	<i>ether</i> <i>gothic</i>	<i>Athena</i> <i>lithopone</i>	<i>Matthew</i>

*Note.* \*/ð/ does not appear in the corpus. Based on the findings in this study

As the table shows, English /θ/ is mapped into four Mandarin phonemes, which indicates that /θ/ is can't be categorised easily in Mandarin. English /θ/ has the following phonetic features: [-sibilant], [+continuant], which is not possessed by any Mandarin phoneme. It is interesting that /s/ isn't the most frequent match but two stops /t<sup>h</sup> t/ are. Similar phenomenon can be found in Irish English where /t/ and /d/ replace the dental fricatives /θ ð/, which shows that perceptually the stops and the fricatives are similar probably because the stops /t d/ are dentals too.

**4.6.2.3 Adaptation of English /s z/.** According to PAM, English /s/ should be assimilated to Mandarin /s/ since the acoustic and articulatory details of English /s/ and Mandarin /s/ are almost identical. But as Mandarin has no voiced alveolar fricative, English voiced alveolar fricative /z/ might be perceived as a not so good candidate of the Mandarin alveolar fricative category. Thus, English /s/ and /z/ might be perceived as Mandarin /s/, with one as a better candidate than the other, forming the CG type.

**Table 34***Mapping Distribution of English Onset Fricatives /s z/ to Mandarin Phonemes*

	English /s/				English /z/		
	Mandarin /s/	Mandarin /ʃ/	Mandarin /ɕ/	Mandarin /s/	Mandarin /tʃ/	Mandarin /ʃ/	Mandarin /ɕ/
Times	20	11	4	2	1	5	1
Percentage	57.1	31.4	11.4	25	12.5	62.5	12.5
Cases	<i>salad</i>	Safeguard	Simmons	liaison	Byzantine	<i>laser</i>	<i>Amazon</i>
	<i>salami</i>	salon	sirloin			<i>jazz</i>	
	<i>salmon</i>	sardine	syndicate			<i>loser</i>	
	<i>samba</i>	sari	cigar			<i>organza</i>	
	<i>sandwich</i>	sauce					
	<i>Satan</i>	smart					
	<i>sauna</i>	sofa					
	<i>saxophone</i>	sonar					
	<i>science</i>	sundae					
	<i>scone</i>	gasoline					
	<i>snooker</i>	Pepsi					
	<i>soda</i>						
	<i>sphinx</i>						
	<i>Subway</i>						
	<i>bassoon</i>						
	<i>gypsy</i>						
	<i>Messiah</i>						
	<i>Missa</i>						
	<i>mosaic</i>						
	<i>mousse</i>						

*Note.* Based on the findings in this study

As the data show, the English /s/ is not completely mapped to Mandarin /s/ as predicted but is in the majority of cases. The other two candidates are /ʃ/ and /ɕ/, differing from the faithful substitute /s/ in place of articulation. From a quick glance, Mandarin /s/ and /ʃ/ has a mapping

distribution where /s/ outnumbers /ʃ/ almost 2:1 in terms of percentages. But there are some rules in the mapping pattern. First, all the /s/ in clusters are faithfully mapped to Mandarin /s/: *scone* *snooker sphinx* are adapted into *sikang sinuoke sifenkesi*. Second, the vowels in the adapted forms following /s/ and /ʃ/ don't overlap, which indicate that there might be a frequency dominated rule regulating the choice of either /s/ or /ʃ/. All the cases of /s/ > /ç/ are in the environment which the following vowel is a high-front vowel as when /s/ is followed by a high-front vowel in Mandarin, it is palatalised into /ç/.

The adaptation of /z/ has more variation. Besides the three fricatives /s/ /ʃ/ /ç/, it is also mapped to affricate /tʃ/. The *Amazon* case where /z/ is borrowed as /ç/ raised the etymological question of the original word. As the Portuguese pronunciation of *Amazon* is [amaçon], it may be suspected that *Amazon* was first borrowed into Mandarin from Portuguese. When English pronunciation of *Amazon* is used as the input, it is borrowed as *yamasun* 亚马孙 or *amazong* 阿玛宗. Mandarin has a tradition of using the etymological pronunciation of a proper name in the borrowing process. Such operation can be found in many borrowings of person and place names. For example, *Putin* is borrowed as *pujing* in Mandarin which is closer to its Russian pronunciation [pu.tsin] where [ts] is matched to Mandarin [ts] and palatalised before a high front vowel to become [tɕ].

**4.6.2.4 Adaptation of English /ʒ ʒ/.** English post-alveolar fricatives /ʒ ʒ/ are not existent in the Mandarin consonant inventory, but it has a similar Mandarin fricative pair /ʃ ʒ/, which is phonologically retroflex fricative but in the nearest place of articulation with English /ʒ ʒ/. The pair /ʃ ʒ/ are actually apical rather than subapical, and so are considered by some researchers not to be truly retroflex; they may be more accurately called post-alveolar (Ladefoged & Maddieson, 1996,

pp. 150–154). Based on PAM, English /ʃ ʒ/ are expected to be mapped into Mandarin /ʃ ʒ/ and form a TC adaptation type.

**Table 35**

*Mapping Distribution of English Onset Fricatives /ʃ ʒ/ to Mandarin Phonemes*

	English /ʃ/*		
	Mandarin /ʃ/	Mandarin /ç/	Mandarin /s/
Times	7	15	1
Percentage	33.3	62.5	4.2
Cases	<i>bushel</i>	<i>passion</i>	<i>shaman</i>
	<i>delicious</i>	<i>milkshake</i>	
	<i>Porsche</i>	<i>shampoo</i>	
	<i>fashion</i>	<i>sherry</i>	
	<i>share</i>	<i>shilling</i>	
	<i>shark</i>	<i>shimmy</i>	
	<i>shaping</i>	<i>shirt</i>	
		<i>shock</i>	
		<i>shopping</i>	
		<i>short</i>	
		<i>show</i>	
		<i>fascist</i>	
		<i>champagne</i>	
		<i>chanson</i>	
		<i>chiffon</i>	

*Note.* \*/ʒ/ does not appearing in the corpus. Based on the findings in this study

In the adaptation of English /ʃ/, it is expected that the majority is adapted into Mandarin /ɕ/ but not the best candidate /ʃ/. The syllables of Mandarin have an impact as syllables with onset /ʃ/ and with onset /ɕ/ are in complimentary distribution. /ɕ/ can be followed by front high vowels /i/ and /y/ while /ʃ/ is followed by the other vowels. In the place of articulation, English /ʃ/ is close to both Mandarin /ʃ/ and /ɕ/. The thesis argues that the more important reason is that the frequency of the syllables beginning with /ɕ/ is higher than the syllables beginning with /ʃ/. A palatalisation process is observed for the fricative /ʃ/ as it is for the dental fricative /s/ and velar fricative /x/ before a front high vowel. Therefore, there is no doubt that syllables with onset /ɕ/ are used much more frequently than syllables with onset /s/ /ʃ/ or /x/. Thus, even English syllables with /ʃ/ + [-high, front vowel] may also be perceived as /ɕ/ + [high, front vowel].

**4.6.2.5 Adaptation of English /tʃ dʒ/. Mandarin has three pairs of affricates /ts<sup>h</sup>/-/ts/ /tʂ<sup>h</sup>/-/tʂ/ /tɕ<sup>h</sup>/-/tɕ/ differing in aspiration. In dental place /ts<sup>h</sup>/ and /ts/ form a contrast; /tʂ<sup>h</sup>/ /tʂ/ are the retroflex pair; and /tɕ<sup>h</sup>/ /tɕ/ are the palatal pair. English post-alveolar affricates /tʃ dʒ/ are phonetically most similar to Mandarin palatal affricates /tɕ<sup>h</sup>/ /tɕ/ with the voiceless affricate /tʃ/ phonemically similar to /tɕ<sup>h</sup>/ and the voiced one /dʒ/ phonemically similar to /tɕ/.**

**Table 36**

*Mapping Distribution of English Onset Affricates /tʃ dʒ/ to Mandarin Phonemes*

	English /tʃ/				English /dʒ/		
	Mandarin /tɕ <sup>h</sup> /	Mandarin /tʂ <sup>h</sup> /	Mandarin /tʂ/	Mandarin /tɕ/	Mandarin /tɕ <sup>h</sup> /	Mandarin /tʂ/	Mandarin /j/
Times	8	3	1	12	6	4	2
Percentage	66.7	25	8.3	50	25	16.7	8.3
Cases	<i>anarchy</i>	<i>cheddar</i>	<i>cheese</i>	<i>bogey</i>	<i>angel</i>	<i>banjo</i>	<i>Jew</i>
	<i>cha-cha</i>	<i>cherry</i>		<i>boogie</i>	<i>engine</i>	<i>jar</i>	<i>Judas</i>
	<i>chaconne</i>	<i>cheetah</i>		<i>bungee</i>	<i>bourgeois</i>	<i>jelly</i>	<i>Jurassic</i>
	<i>check</i>			<i>jacket</i>	<i>Johnson</i>		

<i>chocolate</i>	<i>jazz</i>	<i>margarine</i>
<i>Michelin</i>	<i>logic</i>	<i>georgette</i>
<i>poncho</i>	<i>geek</i>	
<i>cappuccino</i>	<i>gene</i>	
	<i>gin</i>	
	<i>gypsy</i>	
	<i>jeep</i>	
	<i>jitterbug</i>	
	<i>joule</i>	

*Note.* Based on the findings in this study

The adaptation of English /tʃ/ and /dʒ/ basically conforms to the prediction, in which the majority of /tʃ/ is borrowed as Mandarin /tʃʰ/ and most English /dʒ/ is borrowed as Mandarin /tʃʰ/. There are 25% of cases where English /dʒ/ is borrowed as Mandarin /tʃʰ/. It is argued that the aspirated palatal fricative /tʃʰ/ may correspond to syllables with higher frequency morphemes.

**4.6.2.6 Adaptation of English /h/.** English /h/ is a voiceless glottal fricative, which is phonetically similar to Mandarin velar fricative /x/. Although they differ in the place of articulation, they are the only fricatives that are produced at the back of the vocal tract. English /h/ is expected to be mapped to the phonemically nearest Mandarin /x/ as they are both the only after-palatal fricative in their phonology.

**Table 37**

*Mapping Distribution of English Onset Fricative /h/ to Mandarin Phonemes*

	English /h/			
	Mandarin /x/	Mandarin /ç/	Mandarin Ø	Mandarin /f/
Times	14	5	1	1
Percentage	66.7	23.8	4.8	4.8
Cases	<i>hacker</i>	<i>hip hop</i>	<i>humour</i>	<i>Holmes</i>

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<i>hallelujah</i>	<i>hippies</i>
<i>hamburger</i>	<i>Dunhill</i>
<i>harem</i>	<i>hysteria</i>
<i>hello</i>	<i>Hawaii</i>
<i>heroin</i>	
<i>hi</i>	
<i>high</i>	
<i>Hollywood</i>	
<i>hormone</i>	
<i>LOHA</i>	
<i>Yahoo</i>	
<i>Hamilton</i>	
<i>Manhattan</i>	

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*Note.* Based on the findings in this study

In the adaptation of /h/, the majority of cases are borrowed into Mandarin /x/ as expected. The cases where it is borrowed into /ç/ is also involved with the palatalisation due to the following high front vowel. The other few deviant cases are *humour* and *Holmes*. In *humour*, it is adapted into an onsetless syllable probably because the original pronunciation is from a dialect in which the [h] is silent. In the adaptation of *Holmes*, it is believed that the translator himself speaks a southern Chinese dialect in which the fricatives [f] and [x] are free allophones.

#### **4.6.3 Adaptation of Onset Nasals /m n/**

Both English and Mandarin have three nasals /m n ŋ/. In syllable initial position, both English and Mandarin can have /m/ and /n/. In coda position, English can have /m n ŋ/ but Mandarin can only have /n/ and /ŋ/, which will be discussed in the coda adaptation section. Thus, in syllable initial position, English nasals /m n/ are expected to be mapped faithfully to Mandarin /m n/ respectively.

**Table 38**

## Mapping Distribution of English Onset Nasals /m n/ to Mandarin Phonemes

	English /m/		English /n/
	Mandarin /m/	Mandarin /w/	Mandarin /n/
times	86	4	40
percentage	95.6	4.4	100
cases	(omitted)	<i>Marlboro</i> <i>Master card</i> <i>salmon</i> <i>Longman</i>	(omitted)

*Note.* Based on the findings in this study

The predicted pattern of faithful adaptation for onset /m/ and /n/ are confirmed by the corpus data, where an English nasal is mapped to its counterpart in Mandarin. There are rarely any deviations, except four instances of English /m/ adapted to Mandarin [w]. Miao (2005) analyses that the adaptation of /m/ to /w/ cases has semantic effects: *Marlboro* ['maɪlbəɹo] > 万宝路 *wan.bao.lu* [wan.pao.lu] lit. 'ten thousand + treasure + road', creating a brand name that is associated with fortune; *Master* [mæstə] > 万事达 *wan.shi.da* [wan.ʃi.ta], lit. 'ten thousand + thing + to attain', arousing the credit card's function as very convenient. This thesis proposes another reason, which is that the four words are first adapted into Cantonese and the correspondent Cantonese syllable for the onset /m/ actually begins with /m/, faithfully mapping it accurately. When they first enter Cantonese, the onset consonant is faithfully preserved as [m]. When they later enter Mandarin, they are graphically borrowed. The character remains but the corresponding pronunciation of the character changes from [man] to [wan]

#### 4.6.4 Adaptation of Onset Approximants



**4.6.4.1 Adaptation of English /l/. English /l/** is described as a lateral liquid, which is the sound of the flow of air out of the body, redirected around the tongue and toward the sides of the mouth, before exiting through the lips. English /l/ occurs in five different syllable positions, which are: syllable-initial /l/, as in *lip* /lɪp/; syllable final /l/, as in *peel* /piːl/; syllabic /l/, as in *people* /piːpl/; the second element of onset clusters, as in *cling* /kliŋ/; and penultimate element in codas, as in *melt* /mɛlt/. According to Sproat and Fujimura's study:

All productions of /l/ involve two gestures, one gesture corresponding to the apical extension, henceforth termed the apical gesture, and the other corresponding to the dorsal retraction and lowering, the dorsal gesture. The apical gesture of /l/ is a consonantal gesture and the dorsal retraction gesture is a vocalic gesture since it does not produce a radical constriction in the vocal tract.... Consonantal gestures tend to be stronger in syllable initial position and weaker in syllable final position. Vocalic gestures tend to be weaker in syllable initial position and stronger in syllable final position. (1993, pp. 304-305)

English /l/ has two allophones based on the different proportion of the two gestures in the syllable initial position and the syllable final position, the alveolar lateral approximate [l] and the velarised alveolar lateral approximate [ɫ].

Mandarin has a lateral liquid /l/, which is phonetically similar to English /l/ in syllable initial position. Therefore, English onset /l/ is expected to be mapped to Mandarin /l/. In the corpus, 100% of the initial English /l/ is adapted into Mandarin /l/. While in syllable final position, as Mandarin does not allow consonant coda except /n/ and /ŋ/, coda /l/ will be modified, which will be discussed in the next chapter.

**4.6.4.2 Adaptation of English /ɹ/. English has two liquids, one is /l/ and the other is /ɹ/.** Different from /l/, /ɹ/ is a non-lateral liquid. English has three non-lateral liquid allophones, with most dialects having two (rhotic), some having a third (trill), and some having only one (R-dropping).

In syllable-initial as in *rabbit*, *run*, and *borrow*, /ɹ/ is often referred to as a retroflex approximant as the tongue is brought forward then curled backward toward the roof of the mouth, which gives it the feature of a retroflex. This is the most common *r*-sound in English. In the syllable final position, the *r*-sound may be different depending on the accent of the speaker, realised either as an alveolar approximant or a retroflex approximant. The primary difference between syllable-initial and syllable-final forms is that the syllable-final sound begins and ends with the tongue and jaw in the approximate position. This differs from the syllable-initial position which ends with the jaw lowering and the tongue returning to the resting position. Some dialects of English, (for example, Scottish) possess a third non-lateral approximant [ɹ] known as a *trill* (and in lesser form a *flap*). This sound is often referred to as a *rolled-r*. In producing this sound the tongue is quickly and lightly (and in longer trills, repeatedly) brought into contact with the alveolar ridge.

Phonologically, it patterns like a liquid in English as it appears obligatorily adjacent to the nuclear vowel, either prevocalic or postvocalic, under the government of the Sonority Sequencing Principle (SSP) (Selkirk, 1984). In English, [ɹ] appears in several situations. In the onset position, it can appear as a simplex onset as in [ɹei] *ray*; it can also appear as the second segment in a consonant cluster following an obstruent as in [pɹei] *pray*; or it can appear as the third segment in a consonant cluster following [s]+[obstruent] as in [spɹei] *spray*. In the coda position, it can appear as a simplex coda as in [aɹ] *are*; or as the first consonant in a complex coda as in [aɹt] *art* or [aɹts] *arts*.

In Mandarin, there is a sound written as *r* in pinyin, the value of which has always been a controversial issue. The earliest opinion from Chinese phonology defines it as a voiced retroflex fricative, which is transcribed as [ʐ] and has been widely accepted by many scholars (Howie, 1976; Lin, 1989; Wan, 1999, etc.) This opinion is advocated in Duanmu (2003) as being a voiced fricative is contrastive to [ʃ] in [voice]. [ʐ] is among the set /ts, ts<sup>h</sup>, s, tʃ, tʃ<sup>h</sup>, ʃ, z/ that allows the spreading of the feature [coronal], all of which share the features [coronal]-[+fricative] and can be followed by a syllabic consonant/retroflex apical vowel. Other opinions on the value of it basically see it as a voiced

retroflex approximant [ɻ] or a voiced retroflex tap [ɽ]. The three values are allophones of the consonant and the frequency of [ɻ] is much higher than the other two (Ran & Shi, 2008).

When /z/ is in the position of the onset, it can appear either as a simplex one as in [ʐan] 染 ‘dye’ or followed by a labial glide [w] as in [ʐwan] 软 ‘soft’. In the syllable final position, Mandarin has a retroflex sound which is similar to an English retroflex approximant in the final position and is also transcribed as [ɻ]. When it stands by itself, it is a free morpheme; therefore, it is also called a retroflex vowel, transcribed as [ə].

From the above discussion, we can see that English /ɹ/ and Mandarin /z/ are phonetically very similar and they may make a close match. English /ɹ/ is expected to be adapted into Mandarin /z/.

**Table 39**

*Mapping Distribution of Onset Liquids /l ɹ/ from English Loanwords to Mandarin Phonemes*

	/l/	/ɹ/	
	[l]	[l]	[ɻ]
Times	88	25	3
Percentage	100	89	10
Cases	(omitted)	<i>baroque</i> <i>calorie</i> <i>camera</i> <i>carat</i> <i>Carrefour</i>	<i>robustness</i> <i>Reebok</i> <i>paracetamol</i>

---

*cherry*  
*currant*  
*curry*  
*durian*  
*Fahrenheit*  
*harem*  
*heroin*  
*hysteria*  
*Jurassic*  
*kangaroo*  
*karat*  
*Labrador*  
*macaroon*  
*marathon*  
*Marlboro*  
*Pandora*  
*radar*  
*rally*  
*reggae*  
*rifle*  
*rococo*  
*romantic*  
*rum*  
*rumba*  
*sari*  
*sherry*

---

*Note.* Based on the findings in this study

It is very surprising that almost 90% of English /ɹ/ is adapted into Mandarin /l/. Phonologically, in the Mandarin syllable inventory, syllables with onset /ʒ/ have a much smaller distribution compared to other onsets. There is a great discrepancy between the syllables beginning with /l/ and /ʒ/. First, the all the onset [ʒ] syllables correspond to morphemes that are not frequently used while the syllables with [l] onset and the same nucleus correspond to frequently used

morphemes. Second, the syllables \*[ʐa] \*[ʐai] \*[ʐei] \*[ʐi] do not exist in Mandarin but [la] [lai] [lei] [li] do. Any nucleus with a front high vowel/glide cannot be combined with [ʐ]. So, the syllables \*[ʐi] \*[ʐa] \*[ʐao] \*[ʐɛ] \*[ʐou] \*[ʐan] \*[ʐin] \*[ʐaŋ] \*[ʐiŋ] do not exist in Mandarin, but [li] [lʰa] [lʰao] [lʰɛ] [lʰou] [lʰan] [lin] [lʰaŋ] [liŋ] do. Such difference in syllable distribution greatly influences the adaptation of English onset /ɹ/. Among the 25 cases where /ɹ/ is adapted into /l/, nine are due to their frequency while 14 are due to the syllable inventory. It is evident that both reasons have an impact on the perception of English /ɹ/ as Mandarin speakers consider the onset /ʐ/ as a marked onset. So, they choose an approximant /l/ as a preferred substitute to replace English onset /ɹ/. Besides, /l/ and /ɹ/ are both liquids, so they produce a similar airflow without obvious constriction, only differing in the direction of the airflow by the tongue sending it within the mouth before exiting the lips.

#### 4.7 Vowel Adaptations

English has a rich system of height in the front vowels, where there is a five-way distinction with front vowels going from top to bottom: /i/ (bead); /ɪ/ (bid); /e/ (more precisely, [eɪ] (bayed)); /ɛ/ (bed); /æ/ (bad). The phonology of English suggests a system with three basic heights (high, mid, low), on which is superimposed an additional, finer distinction commonly called [tense]. (A synonym for [-tense] is “lax”.) The front vowel can be labelled as high tense vowel /i/, high lax vowel /ɪ/, mid tense vowel /e/, mid lax vowel /ɛ/, and low lax vowel /æ/. For the central vowels, English has mid tense vowel /ʌ/ and mid lax vowel /ə/. For the back vowels, English has high tense vowel /u/, high lax vowel /ʊ/, mid tense vowel /oʊ/, mid lax vowel /ɔ/, and low tense vowel /ɑ/.

**Table 40**

*Phonemic Vowels According to their Tenseness in General American*

Front		Central		Back	
tense	lax	lax	tense	lax	tense

High	i	ɪ			ʊ	u
Mid	eɪ	ɛ	ə	ɜ	ɔ	oʊ
Low		æ		ʌ		ɑ
Diphthongs	aɪ	ɔɪ	aʊ			

*Note.* Adapted from Ladefoged & Maddieson, 1996

The vowels are rearranged according to their articulatory features.

**Table 41**

*Phonemic Vowels According to their Articulatory Features*

	Front Unrounded	Central	Back Unrounded	Back Rounded
High	i ɪ			u ʊ
Mid	eɪ ɛ	ɜ ʌ ɝ		oʊ ɔ ɔɪ
Low	æ aɪ		ɑ	aʊ

*Note.* Adapted from Ladefoged & Maddieson, 1996

Compared to English, Mandarin has a much smaller vowel inventory of only five vowel phonemes. It has been generally agreed that vowel adaptation in Mandarin exhibits a high degree of variation as it is common to adapt the same English vowel to several different vowels (Lin, 2008; Miao, 2006). There have been various analyses of Mandarin vowels and glides and in this thesis, I adopt the system described as follows (cf. Lin, 1989, 2007; Duanmu, 2000). Mandarin has five phonemic vowels, as shown in Table 42, with /ə/ and /a/ unspecified for backness, and the surface vowels are given in Table 43.

**Table 42**

*Phonemic Vowels in Mandarin*

	Front Unrounded	Front Rounded	Central	Back
High	i	y		u
Mid			ə	
Low			a	

*Note.* Adapted from Lin, 1989, 2007; Duanmu, 2000

**Table 43**

*Surface Vowels in Mandarin*

	Front Unrounded	Front Rounded	Central	Back Unrounded	Back Rounded
High	i	y			u
Mid	e ɛ		ə	ɤ	o
Low	a		A		ɑ

*Note.* Adapted from Lin, 1989, 2007; Duanmu, 2000

In order to achieve a mapping from English vowels to Mandarin vowels, English and Mandarin vowels will be compared in terms in height as Mandarin mid and low vowels are unspecified for backness.

High vowels in Mandarin and in English

Mandarin has five vowel phonemes /i, y, u, ə, a/ (e.g., Lin, 1989; Duanmu, 2007; Lin, 2007). Among the five vowels, /i/, /y/, and /u/ are high vowels. /i/ and /u/ are similar to those in English. /y/ is a front, high, rounded vowel. A minimal contrastive triplet is:

[li] ‘force’

[ly] ‘filter’

[lu] ‘road’

English has four high vowels /i, ɪ, u, ʊ/. The vowels /i, ɪ/ are front and unrounded whereas /u, ʊ/ are back and rounded. English lacks the high rounded vowel /y/ in Mandarin. Examples with English high vowels are:

beat [bit]

bit [bɪt]

boot [buːt]

book [bʊk]

When a Mandarin high vowel is in an onset position and is followed by a mid or low vowel, it changes into a glide. The corresponding glides of Mandarin high vowels /i, y, u/ are /j, ɥ, w/, respectively. This phonologic pattern can be summarised as /i, y, u/->/j, ɥ, w// (C)\_V[-high].

Examples of Mandarin glides are:

[jɛ] 'leaf'

[ɥɛ] 'about'

[wo] 'I'

[tjɛ] 'fall'

[lɥɛ] 'omit'

[two] 'many'

#### Mid vowels in Mandarin and in English

The mid vowel /ə/ has several allophones. However, scholars disagree on how to transcribe the variants of this mid vowel (e.g., Chao, 1968; Cheng, 1973; Xu, 1980; Lin, 2007). Mid vowel /ə/ changes its frontness and its rounding in different environments, but not its height. Examples of the allophones of the mid vowel /ə/ are:

Variant	Sample	Environment
[o]	[wo] 'I'	In open syllables, after labials
[ɛ]	[jɛ] 'leaf'	In open syllables, after palatals



[ʋ]	[kʋ] 'song'	In open syllables, not after labials or palatals
[e]	[fei] 'fly'	Before [i]
[ə]	[kəu] 'dog'	Before [u, n, ŋ]
	[mən] 'door'	
	[məŋ] 'dream'	

In English, the mid vowels include /ɛ ə ɜ ʌ ɔ/, among which the front mid vowel is /ɛ/ as in *bet* [bɛt], the mid central vowels /ʌ ə ɜ/ as in *hut* [hʌt], *about* [ə'baʊt], *bird* [bɜd], mid back vowel /ɔ/ as in *oar* [ɔ]. English mid vowels are expected to be mapped into Mandarin mid vowels, English front mid ones mapped to the Mandarin mid vowel allophones, and so on.

#### Low vowels in Mandarin and in English

Mandarin has one low vowel, which also has allophones differing in frontness. But it remains [+low, -round]. Examples of low vowel allophones are:

Variant	Sample	Environment
[A]	[pA] 'eight'	In open syllables
[ɑ]	[t <sup>h</sup> ɑu] 'peach'	In closed syllables, before [u] or [ŋ]
	[t <sup>h</sup> ɑŋ] 'sugar'	
[a]	[k <sup>h</sup> ai] 'open'	In closed syllables, before [n] or [i] and not after palatals
	[san] 'three'	
[ɛ]	[jɛn] 'salt'	In closed syllables, before [n] and after [j] or [ɥ]
	[ɥɛn] 'round'	

English has a front low vowel /æ/ and a back low vowel /ɑ/. English examples are *cat* [kæt], *hot* [hɒt]. It is expected that English low vowels will be mapped to Mandarin low vowel allophones according to their frontness.

#### Diphthongs in Mandarin and in English

Mandarin has four closing diphthongs: /ei, ai, ou, au/ (Lin, 2007). The former two are front vowels and the latter two are back. English has a far richer diphthong inventory. It has five closing diphthongs, viz. /eɪ, aɪ, ɔɪ, aʊ, əʊ/ and three centering diphthongs /ɪə, ʊə, ɛə/ (Collins & Mees, 1996, p. 107). Four diphthongs (/ei, ai, ɪə, ɛə/) are front vowels and four (/ɔɪ, aʊ, əʊ, ʊə/) are back.

#### Retroflex vowel in Mandarin and English

Besides the five vowels /i, u, y, ə, a/, Mandarin also has a so-called retroflex vowel, which is transcribed as [ə̣]. It appears in two cases. First, it is a free morpheme: [ə̣35] 'son', [ə̣214] 'ear', [ə̣51] 'two'. Second, it occurs as a suffix. In English, there is a rhotacised vowel occurring in American English in stressed position in words such as bird [bɜ̄d], which is a mid central unrounded rhotacised or "r-colored".

In the adaptation of English loanwords into Mandarin, the same English vowel is found to be mapped into several different Mandarin vowels (i.e., one-to-many correspondence). The degree of variation is higher in the adaptation of vowels than that of consonants. For example, the English high front vowel /i/ is phonetically and phonologically similar to Mandarin /i/. Thus, the mapping between the English /i/ and the Mandarin /i/ is expected to be perfect. However, as the data shows, the English /i/ can be adapted faithfully to [i] or the less faithful [ei] or [ɛ], as shown below.

*geek* [dʒɪk] > *ji.ke* [tɕi.k<sup>h</sup>ʅ]

*fillet* [fɪlət] > *fei.li* [fei.li]

*cigar* [sɪɡə] > *xue.jia* [ɕɥɛ.tɕja]

This section tries to answer the question about whether the seemingly chaotic variation in Mandarin vowel adaptation is simply arbitrary and random, or instead has general patterns and restrictions.

#### **4.7.1 Prediction of Vowel Mapping**

The predictions of vowel mapping from English to Mandarin will be made based on the PAM-L2 model (Best & Tyler, 2007). The discriminability will also be predicted according to the assimilation pattern. Recall that PAM-L2 model (Best & Tyler, 2007) predicts that accurate perception of non-native sounds depends on how closely each sound maps on to the existing categories of L1. Therefore, a non-native sound can either be assimilated to the existing categories (categorised), perceived as a non-native sound (uncategorised), or perceived as a non-speech sound (non-assimilated). PAM-L2 establishes different predictions about discrimination accuracy depending on the way target sounds assimilate to, or are mapped onto, L1 categories.

The different types of cross-linguistic assimilation patterns can be understood as caused by cross-linguistic phonological similarity/dissimilarity. The core insight of PAM lies in the concept that the perception of foreign contrasts is interfered by the native phonology. When a foreign contrast is perceptually assimilated into a single native category, the difficulty of discriminating the foreign contrast increases; if a foreign pair is assimilated to two native categories, the discrimination is expected to be excellent. These different discrimination patterns of foreign contrast can demonstrate that L1 phonological structure exerts a profound influence on cross-linguistic speech perception.

The perceptual difficulty regarding the vowels in English by Mandarin speakers is described in light of previous research. In contrast to consonants, whose place and manner of articulation can be reasonably determined by self-observation, it is more difficult to determine the tongue positions for vowels, and they can vary considerably across speakers. The English high front vowel pair /i/-/ɪ/ poses perception and production problems for Mandarin speakers since in their L1 there is only one front high unrounded vowel /i/ in the acoustic region. Another front high vowel is the rounded /y/, which is produced with lip protrusion. As Lin (2008) points out, a rounding mismatch rarely occurs


for English unrounded vowels, the rounded /y/ is not perceptually similar to English /i/. Although Mandarin has no vowel length differences, Mandarin speakers might be able to perceive the length difference between /i/ and /ɪ/, but they might not be able to notice the spectral differences as Mandarin does not have a tense-lax distinction in the vowel system. Studies have shown that Mandarin speakers rely heavily on durational cues for the English /i/-/ɪ/ contrast, even though the Mandarin system does not use vowel duration contrastively (Bohn, 1995). English /i/ and Mandarin /i/ are highly comparable acoustically and English /ɪ/'s closest counterpart will also be Mandarin /i/.

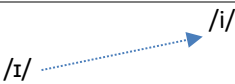
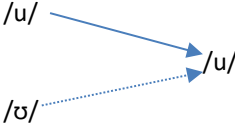
As for the high back vowels, English and Mandarin both have a phoneme /u/ in their respective inventories. According to Chang (2009), the English /u/ and the Mandarin /u/ are different acoustically and the English /u/ is much closer to the Mandarin front rounded vowel /y/. Nevertheless, the two /u/s are phonemically similar as they have the similar positions in the respective vowel inventory as the two /u/s share the same vowel features [+high, +back, +round]. Thus, though the English /u/ is acoustically much more front than the Mandarin /u/, they are phonologically similar. For the English /ʊ/, the closest Mandarin counterpart will also be /u/. The tense-lax pair of English /u/ and /ʊ/ is then expected to be assimilated to Mandarin /u/, with a moderate discrimination level.

Table 44 illustrates the English high vowels predicted assimilation pattern in accordance with PAM-L2 and the expected discrimination level. English tense vowels /i/ and /u/ are predicted to be highly comparable to Mandarin /i/ and /u/. English lax vowels /ɪ/ and /ʊ/ are perceived as a poorer fit of the Mandarin /i/ and /u/.

**Table 44**

*English High Vowel Pairs and Predicted Assimilation Pattern in Accordance with PAM-L2*

English Vowel Pairs	Assimilation Pattern	L2-L1 Prediction	Discrimination Level
/i/-/ɪ/	Category goodness	/i/ 	Moderate to very good

	difference assimilation (CG)		
/u/-/ʊ/	Category goodness difference assimilation (CG)		Moderate to very good

Previous studies have shown that Mandarin speakers have difficulties distinguishing some vowel contrasts, especially non-high vowels. Ho (2010) showed that Mandarin speakers perceived /æ/ better than /e/ and /ɛ/. Tseng (2011) found that mal-perception existed among /e/-/ɛ/-/æ/, with /ɛ/ the hardest and /æ/ the easiest for Taiwan EFL learners to perceive. Lin (2014) proved that mainland Mandarin EFL learners performed worst in /e/-/ɛ/-/æ/ perception, where /e/ was misperceived as /ɛ/, and /æ/ as /e/. Acoustic cues, such as differences of cross-language vowel systems, spectral distance of L2 vowels, and durational cues have been discussed as factors contributing to the difficulty in L2 vowel perception. Studies of cross-language speech systems show that L2 learners are insensitive to certain sounds which are realised as different allophones in L1 but are realised as phonemes in L2. For example, Mandarin EFL learners may mingle English vowel contrast /ɛ/-/æ/ because [ɛ]-[æ] are allophones of phoneme /a/ in the Mandarin vowel system. Such a situation may well be explained by PAM-L2 that Mandarin EFL learners fail to establish a new perceptive category for foreign sounds. Therefore, they tend to have low discriminating rates when distinguishing /ɛ/-/æ/ contrast.

In deciding cross-linguistic phonological similarity relations, phonemic parallelisms between two vowels systems play a primary role. It is labelled as higher-level information by Chang (2015) as opposed to lower-level information (e.g., acoustic properties, allophonic alternations). As for the mapping of English non-high vowels to Mandarin, the smaller set of Mandarin non-high vowels results in the English non-high vowel categories collapsing to one Mandarin vowel. The so called “armchair methods” proposed by Bohn (2002) can be used to help predict the L1-L2 perceptual

similarity. In this method, if an L1 sound and an L2 sound are transcribed with the same symbol in the International Phonetic Alphabet, it is implied that the L2 sound is not “new”, but rather “similar” or “identical” to the L1 sound. If an L1 sound and an L2 sound are transcribed with different symbols, the L2 sound would be described as a “dissimilar” sound and would be considered “uncategorised” following PAM’s classification. It is a heuristic tool because the transcription conventions for a given language are often based on phonemic considerations. Chang (2015) summarised that the comparison between the phonetic symbols can often coincide with the cross-linguistic phonemic analysis. As non-high vowels do not differentiate much in their articulatory and acoustic properties and the first formants of non-high vowels show certain overlapping between non-high vowels (Reetz & Jongman, 2020, p. 299), the non-high vowels are more difficult to distinguish. Based on the articulatory differences, Table 45 summarises the correspondences between Mandarin and English non-high vowels.

**Table 45**

*Correspondences Between Mandarin and English Non-high Vowels*

	Front	Central	Back
English	/ɛ/ /æ/	/ə/ /ʌ/ /ɜ:/	/ɑ/ /ɔ/
Mandarin	[ɛ] [a]	[ɤ][A]	[ɑ]

What will the assimilation patterns of the non-high English vowels be? Based on PAM-L2, an L2 segment will be mapped to the closest L1 segment at the phonological level. A lot of research has provided a demonstration of this perceptual performance (Bohn & Best, 2012; Polka & Bohn, 1996). This performance of relying more on phonological rather than acoustic information is especially obvious in the perception of non-native vowels. When there is a disagreement between acoustic similarity and phonological similarity, the phonemically closest L1 segment is favored over the acoustically closest one for the L2 segment to be assimilated into. PAM L2 proposes that the

interaction between the phonological level and the phonetic level is likely to change over time as the L2 learners gain more phonological knowledge of the L2. Thus, for bilingual speakers, phonemic mapping is more determining than phonetic mapping in the assimilation of non-native segments. Any two phonemes from English mid vowels /ɛ/, /ə/, /ɜ/, /ɔ/, /ʌ/ may form a mid vowel contrast. As Mandarin has only one mid vowel /ə/, it is predicted that the mid vowel contrasts will be assimilated into Mandarin /ə/, forming CG assimilation.

In this assimilation type, the discrimination is expected to range from moderate to very good, depending on the degree of category goodness. It is expected that the front and back contrast will be discriminated better than the front central contrast or central back contrast. The same will apply to low vowels /æ/-/ɑ/, which will be assimilated into Mandarin /a/ and will be discriminated moderately. As Mandarin /ə/ and /a/ have front and back allophones, the adapted English segments will be expected to surface as Mandarin allophones with the corresponding frontness. As for the mid and low vowel pairs, such as /ɛ/-/æ/, since their opposition does not exist in the Mandarin vowel inventory, they are expected to be differentiated by more fine-grained phonetic information. The low vowel /a/ has front allophones which are transcribed differently by different scholars; cf. S. Xu (1980), M. Fu (1956), Chao (1968), Y. Lin (1989). The front allophones in different environments are transcribed in Table 46.

**Table 46**

*Allophones of Front Vowels in Different Environments in Mandarin*

	[j_n]	[ɥ_n]	[_i]/[_n]
S. Xu (1980)	[æ]	[ɒ]	[a]
M. Fu (1956)	[ɛ]	[ɛ]	[a]
Chao (1968)	[ɛ]	[a]	[a]
Y. Lin (1989)	[ɛ]	[a]([ɛ])	[a]

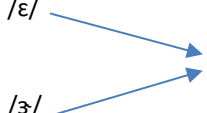
*Note.* The underscore in the top row indicates the location of the low vowel. Adapted from Duanmu, 2007.

From Table 46, we can see that [ɛ] and [æ] are allophones of Mandarin low vowels. Thus, the English mid and low vowel pair /ɛ/-/æ/ is expected to be assimilated to Mandarin /a/ with poor discrimination.

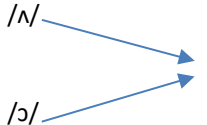
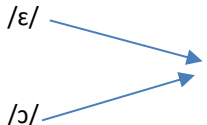

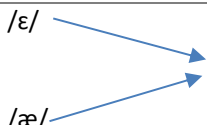

Another mid and low vowel pair is the back vowels /ɔ/-/ɑ/. Though they are allophones of a mid vowel and low vowel respectively, they are not expected to be assimilated to two categories. The reason is that for the Mandarin mid vowel, the back allophones are [o] and [ɤ]. Yet [o] occurs only in open syllables, after labials such as [wo] ‘I’; [ɤ] only occurs in open syllables, not after labials or palatals such as [kɤ] ‘song’. For the Mandarin low vowel, it has only one back allophone [ɑ], which occurs in closed syllables, before [u] or [ŋ] such as [tʰau] ‘peach’ and [tʰaŋ] ‘sugar’. Such distribution patterns of Mandarin [o], [ɤ], and [ɑ] make it extremely difficult to distinguish English /ɔ/ and /ɑ/. When they are in open syllables, they would be perceived as mid vowels; when in closed syllables, they would be more like low vowel [ɑ]. Thus, the assimilation of this contrast will be an Uncategorized-Uncategorised assimilation (UU). Their discrimination level is expected to be poor because their phonetic distance is small.

**Table 47**

*English Non-high Vowel Pairs and Predicted Assimilation Pattern in Accordance with PAM-L2*

English Vowel Pairs	Assimilation Pattern	L2-L1 Prediction	Discrimination Level
/ɛ/-/ɜ/	Category goodness difference assimilation (CG)		from moderate to very good



/ʌ/-/ɔ/	Category goodness difference assimilation (CG)		from moderate to very good
/ɛ/-/ɔ/	Category goodness difference assimilation (CG)		moderate
/æ/-/ɑ/	Category goodness difference assimilation (CG)		from moderate to very good
/ɛ/-/æ/	Single-Category assimilation (SC)		poor
/ɔ/-/ɑ/	Uncategorised-Uncategorised assimilation (UU)		poor

English has five diphthongs /eɪ/, /oʊ/, /ɔɪ/, /aɪ/, /aʊ/; Mandarin has four diphthongs /ei/, /ou/, /ai/, /au/. It is expected that English /eɪ/, /oʊ/, /aɪ/, /aʊ/ will be assimilated to Mandarin /ei/, /ou/, /ai/, /au/ respectively. As for /ɔɪ/ which can be mapped to Mandarin diphthongs, as the [ɔ] sounds more prominent than the [ɪ] sound, it is perceptually more like Mandarin [o] than [i]. Therefore, it is expected to be mapped to Mandarin /ə/, realised as [o].

After the prediction of the assimilation pattern is made, the data obtained from the corpus will be listed and analysed to see if the prediction matches the adaptation of vowels in the corpus. If they don't match, the reasons behind it will further be explored.

#### 4.7.2 Adaptation of High Vowels

In the corpus, the high tense-lax vowel contrasts are found in many cases. Their adaptation generally matches the predicted pattern.

**Table 48***The Adaptation of High Vowels*

	English form sample	Adapted Mandarin form sample
/i/ → [i]	Barbie [baɹbi]	ba.bi [pa.pi] 芭比
/ɪ/ → [i]	bikini [bikini]	bi.ji.ni [pi.tɕi.ni] 比基尼
/i/ → [ei]	wiki fee	wei.ji [wei.tɕi] 维基 fei[fei]
/ɪ/ → [ei]	whiskey film fillet filibuster	wei.shi.ji [wei.ʂ.tɕi] 威士忌 fei.lin [fei.lin] 菲林 fei.li [fei.li] 菲力 fei.li.ba.shi.tuo [fei.li.pA.ʂ.tʰwo] 费力把事拖
/ɪ/ → [ə]	sphinx	si.fen.ke.si [sɪ.fən.kɤ.sɪ] 斯芬克斯
/u/ → [u]	cool [kul]	ku [kʰu] 酷
/u/ → [o]	mousse [mus]	mo.si [mwo.sɪ] 摩丝
/ʊ/ → [A]	bullying [bʊliɪŋ]	ba.ling [pA.lɪŋ] 霸凌 (orthographic influence)

*Note.* Based on the findings in this study

A few deviant cases are found, in which /i/ and /ɪ/ are adapted into sounds other than [i] and is caused by external factors: *carnival* > *jia.nian.hua* [tɕia.nian.xwa] 嘉年华, *cigar* > *xue.jia* [ɕyɛ.tɕia] 雪茄, *tips* > *tie.shi* [tʰjɛ.ʂ] 贴士, *Nazi* > *na.cui* [na.tswei] 纳粹.

Among the deviant cases, three of them, *carnival*, *cigar*, *tips*, might be borrowed from a southern dialect of China, probably Cantonese or Wu. As the character representing the syllable [nian] 年 is [ni] in Cantonese or Wu, this is a faithful match to the English /nɪ/; for [ɕyɛ] 雪 is [si], for [tʰjɛ] 贴 is [ti], all showing the predicted assimilation of English high front vowel. After the words were borrowed into Mandarin, the same characters remained to represent the words, but the

pronunciation of the characters changed to a Mandarin reading, thus causing the seemingly unpredicted assimilation. As for the word *Nazi*, it is not the original adapted form. In the period of the Republic of China (1912-1949), the word *Nazi* was first borrowed into Mandarin as *nan.jian* [nan.tɕjan] 南尖 by a military officer from the *Kuomintang*. As the German pronunciation of <z> is voiceless affricate [ts<sup>h</sup>], it was adapted into Mandarin affricate [tɕ], which could be seen as a faithful match though the aspiration was not preserved. In fact there were some other versions such as *na.qi* [na. tɕ<sup>h</sup>i] 那齐, which is a more faithful phonetic match. Later on, the term was modified into *na.cui* [na.tswei] 纳粹 by that military officer, literally meaning ‘absorb + essence’, as he thought the name might reflect the admiration he had for Hitler’s army.

Besides the four cases where external factors affected the adaptation output, the other cases, in which /i/ and /ɪ/ are adapted into [ei] or [ə], show the influence of the phonotactic rules on loanword adaptation. The Mandarin syllable inventory is quite strict and has a great impact on the loanword adaptation process. Duanmu (2007) pointed out that a puzzling fact about Mandarin is that the majority of expected syllables are missing, the reason for which is the systematic constraints on possible syllable structures:

Glide–Nucleus harmony (GN-harmony)

(a) The prenuclear glide and the nucleus must agree in frontness.

(b) The prenuclear glide and the nucleus must agree in rounding.

According to this constraint, \*[-back][+back], \*[+back][-back], \*[-round][+round], \*[+round] [-round], such kinds of combination of glide and nucleus are illicit syllable parts in Mandarin.

This constraint is accountable for the adaptation of the [+back]+[-back] sequence. The syllable [wi] contains such combination. The glide [w] is the allophone of the back vowel [u]. As it is a [+back]+[-back] sequence, it does not exist in Mandarin. Thus, for the English word *wiki*, the best candidate syllable is *wei.ji* [wei.tɕi] 维基. The same adaptation process is applied to the syllable [vi]

in *vitamin*. As [v] is not a consonant in Mandarin, it is mapped either to the labial dental fricative [f] or to the bilabial glide [w]. In most cases [v] is adapted to [w] in this corpus. *Yippies* case is probably because [jɛ] is corresponded to a Chinese surname while [i] can have many meanings, among which the most frequently used is ‘one’. Therefore, [jɛ], though not the closest adaptation, is preferred due to external factors.

#### 4.7.3 Adaptation of non-high Vowels

As for the non-high vowels, the adaptation pattern is much more complex.

**Table 49**

*The Adaptation of the Mid Vowels /ɛ/ /ə/ /ɐ/ /ʌ/ /ɔ/*

		English Form Sample	Adapted Mandarin Form Sample
/ɛ/ →	[ei]	acapella [ʌkəpɛlə]	a.ka.bei.la [A.k <sup>h</sup> A.pei.lA]
/ɛ/ →	[ai]	celluloid [sɛlʊləɪd]	sai.lu.lu [sai.lu.lu]
/ɛ/ →	[ə]	Ben [bɛn]	ben [pən]
/ɛ/ →	[ɻ]	elnino [ɛlninəu]	e.er.ni.nuo [ɻ.ə.ni.nwo]
/ɛ/ →	[i]	engine [ɛndʒɪn]	yin.qing [in.tɕ <sup>h</sup> ɪŋ]
/ɛ/ →	[ja]	pence [pɛns]	bian.shi [pjan.ʃ]
/ə/ →	[wo]	birdie [bɜːdi]	bo.di [pwo.ti]
/ə/ →	[y]	shirt [ʃɜːt]	xu [ɕy]
/ə/ →	[i]	sirloin [sɜːlɔɪn]	xi.leng [ɕi.ləŋ]
/ə/ →	[wo]	humour [hʊmə]	you.mo [ju.mwo]
/ə/ →	[ɻ]	internet [ɪntənɛt]	yin.te.wang [in.t <sup>h</sup> ɻ.wəŋ]
/ə/ →	[ai]	ether [iθə]	yi.tai [i.t <sup>h</sup> ai]
/ə/ →	[a]	vanilla [vənɪlə]	fan.ni.lan [fan.ni.lan]
/ʌ/ →	[ai]	butter [bʌtə]	bai.ta [pai.t <sup>h</sup> A]
/ʌ/ →	[ə]	bungee [bʌŋdʒi]	beng.ji [pəŋ.tɕi]
/ʌ/ →	[A]	mug [mʌg]	ma.ke [mA.k <sup>h</sup> ɻ]

/ʌ/ →	[ɑ]	ounce [ʌns]	ang.si [ɑŋ.sɿ]
/ʌ/ →	[a]	dumping [dʌmpɪŋ]	tan.ping [tʰan.pʰiŋ]
/ɔ/ →	[wo]	Labrador [labɹədɔ]	la.bu.la.duo [lA.pu.lA.two]
/ɔ/ →	[A]	morphine [mɔfin]	ma.fei [mA.fei]
/ɔ/ →	[au]	Porsche [pɔʃ]	bao.shi.jie [pau. ʃ.tɕjɛ]
/ɔ/ →	[u]	short [ʃɔt]	xiu.dou [ɕju.tou]
/ɔ/ →	[ɑ]	sauna [sɔna]	sang.na [sɑŋ.nA]
/ɔ/ →	[ɤ]	hormone [hɔmoʊn]	he.er.meng [xɤ.ə.məŋ]
/ɔ/ →	[ou]	organza [ɔgænzə]	ou.gen.sha [ou.kən. ʃA]
/ɔ/ →	[ai]	broadway [bɹɔdweɪ]	bai.lao.hui [pai.lau.xwei]

*Note.* Based on the findings in this study

The adaptation of mid vowels shows a lot of variation. Each English mid vowel can be adapted into several Mandarin vowel allophones. Yet some mapping patterns can still be observed. First, front mid vowel /ɛ/ is mostly adapted into front vowels except when it is adapted into mid back [ɤ] as a single syllable because among all the mid vowel allophones, only [ɤ] can appear by itself. Similarly, back mid vowel /ɔ/ is adapted to back mid vowels with only one exception. It means that the [+back] feature is faithfully preserved. The adaptation of /ɛ/ and /ɔ/ shows that English non-central vowels are mostly matched in backness in Mandarin. Second, for the central mid vowels /ə/ /ə/ and /ʌ/, /ə/ and /ə/ are adapted into mid or high vowels while /ʌ/ is adapted into mid or low vowels, which indicate that the match of height between mid and high vowels and the match between mid and low vowels are tolerated to various degrees. And as /ʌ/ is mostly adapted into Mandarin low vowels, its phonetic information might be perceived as a low vowel for Mandarin speakers. As the central vowels are unspecified for front and back, it is reasonable that they are adapted into different allophones regardless of backness.

Next, the adaptation of English low vowels will be analysed.

**Table 50***The Adaptation of the Low Vowels /æ/ and /ɑ/*

	English Form Sample	Adapted Mandarin Form Sample
/æ/ → [ai]	passion	bai.xiang
/æ/ → [a]	bandage	bang.di
/æ/ → [a]	banjo	ban.zhuo
/æ/ → [ɤ]	carat	ke.la
/æ/ → [ə]	fans	fen.si
/æ/ → [A]	gallon	jia.lun
/æ/ → [ei]	hacker	hei.ke
/ɑ/ → [a]	freon	fu.li.ang
/ɑ/ → [au]	Hollywood	hao.lai.wu
/ɑ/ → [A]	coffee	ka.fei
/ɑ/ → [o]	nylon	ni.long
/ɑ/ → [wo]	model	mo.te
/ɑ/ → [ə]	dacron	da.ke.lun
/ɑ/ → [ɤ]	gothic	ge.te
/ɑ/ → [ɥɛ]	shopping	xue.pin

*Note.* Based on the findings in this study

The adaptation of low vowels shows that firstly, Mandarin speakers have difficulty distinguishing this pair. Both members of the pair can be adapted into Mandarin low vowels [a] [A] [ɑ] and mid vowels [ɤ] [ə]. What is noticeable is that the front low vowel /æ/ can be adapted into front diphthongs [ai] and [ei] while back low vowel /ɑ/ cannot. Conversely, back low vowel /ɑ/ can be adapted into back vowel [o] and back diphthong [au] while front low vowel /æ/ cannot. This indicates that Mandarin speakers can perceive the difference of the pair based on their backness. Secondly, as neither of the low vowels are adapted into high vowels, it can be summarised that high and low vowels have a strong tendency to be retained as high and low respectively in Mandarin. In other words, deviation in height is tolerated but minimal: that is, a high-mid or mid-low match is acceptable; but a high-low match is not.

#### 4.7.4 Adaptation of Diphthongs

Last, but not least, the adaptation of diphthongs is discussed.

**Table 51**

*The Adaptation of the Diphthongs /eɪ//oʊ//aɪ//ɔɪ/and /aʊ/*

	English Form Sample	Adapted Mandarin Form Sample
/eɪ/ → [ei]	pace	pei.su
/eɪ/ → [i]	champagne	xiang.bin
/eɪ/ → [ai]	ace	ai.si
/eɪ/ → [a]	angel	an.qi.er
/eɪ/ → [ɤ]	shaping	she.bin
/oʊ/ → [A]	mosaic	ma.sai.ke
/oʊ/ → [wo]	motor	mo.tuo
/oʊ/ → [ou]	ohm	ou.mu
/oʊ/ → [au]	bowling	bao.ling
/oʊ/ → [u]	poker	pu.ke
/oʊ/ → [ɑ]	scone	si.kang
/oʊ/ → [ɤ]	tango	tan.ge
/aɪ/ → [ɑ]	binding	bang.ding
/aɪ/ → [A]	dynamite	da.na.ma.te
/aɪ/ → [ai]	idol	ai.dou
/aɪ/ → [i]	nylon	ni.long (orthographic influence)
/aɪ/ → [ei]	wire	wei.ya
/ɔɪ/ → [ei]	boycott	bei.ge
/aʊ/ → [au]	outlets	ao.te.lai.si
/aʊ/ → [ɑ]	brownie	bu.lang.ning

*Note.* Based on the findings in this study

It is a bit surprising that English diphthongs are not mapped into the corresponding Mandarin diphthongs as expected. Instead, the diphthongs are adapted into both diphthongs and

monophthongs. /oʊ/ shows the most variation: it is not mapped faithfully in terms of height and rounding. /eɪ/ is the diphthongised version of the mid front unrounded tense vowel [e] and /oʊ/ is the diphthongised version of the mid back rounded tense vowel [o], though the movement of the tongue (offglide) at the end of the production is not very substantial. It is probable that they are perceived as monophthongs. As for the “true” diphthongs /ɔɪ/ /aɪ/ and /aʊ/, they can’t be properly categorised into any one single cell in the vowel chart as they involve articulation changes (Reetz & Jongman, 2020). The diphthong /ɔɪ/ does not have a mapping in Mandarin as Mandarin does not have this diphthong. /aɪ/ and /aʊ/ have Mandarin counterparts /ai/ and /au/ and they are more faithfully adapted than /eɪ/ and /oʊ/. (/ɔɪ/ is treated as a special case for the lack of adaptation in this corpus.)

In addition, the comparison among the adaptation of monophthongs and diphthongs in the front vowels and back vowels indicates that the confusion among front vowels or back vowels is very obvious. For example, in the front vowels, /i/ /ɪ/ /eɪ/ /ɛ/ /æ/ and /ai/ can all be adapted into different Mandarin front vowels [i] or [ei] or [ɛ] or [a] or [ai]: /i/ to [i], [ei]; /eɪ/ to [ei], [i], [a], [ai]; /ɛ/ to [ei], [i], [ja], [ai]; /æ/ to [ai], [a], [ei]; /ai/ to [ai], [ei]. No wonder that words containing front vowels such as <main>, <men>, <man>, <mine>, would be very difficult for Mandarin speakers to differentiate. Furthermore, Mandarin’s restricted syllable structure also has an impact on the adaptation of front vowels. As Mandarin has only two licit syllables with the [m]+[-high, front vowel]+[n] structure, including [man] and [mjan], no \*[mein] or \*[main], *main*, *men*, *man*, *mine* will all be adapted to either [man] or [mjan]. How the phonotactics affects the adaptation output will be further analysed, as will the other data regarding the quantity of the occurrence of each pattern. The external factors, such as the orthographic influence, folk etymology, the possibility of dialect reading, etc., will first be filtered out. Then the phonological restrictions and the possible explanations for these variant patterns will be explored. Together with the deviant cases concerning consonant adaptation, the theoretical implications about segment adaptation will also be discussed.



## Chapter Five

### Adaptation Process

This chapter aims to investigate how the onset/coda clusters and illicit codas are dealt with in Mandarin loanwords. Two major differences are found between Mandarin and English: first, while Mandarin allows only a single consonant on the onset position within syllables, English allows bi- or tri-consonantal clusters, either on the onset or coda position. Second, Mandarin allows only [n] or [ŋ] to occupy the coda position, whereas English permits all consonants except /h/ to do so and the rhotic can appear in coda position only in rhotic dialects. Since the syllable structure of Mandarin is more restricted than that of English, when English words are borrowed into Mandarin, a modification in syllable structure becomes necessary. For example, if an English word has the CVC syllable, the coda consonant may undergo either vowel paragoge (i.e., CVC>CV.CV) or deletion (i.e.,

CVC>CV). Hence the output of the adaptation becomes compatible with the CV template of Mandarin. The focal concern of this chapter will fall on how the onset clusters and the illicit codas are repaired or modified when English loanwords are adapted into Mandarin.

Three repair strategies — featural change, epenthesis, and deletion — are generally found to operate on these English loanwords. As consonant clusters in the onset and the coda positions might be perceived differently and modified with different repair strategies, they will be discussed in different sections. Vowel epenthesis is primarily used to resolve onset clusters, while deletion occurs mostly in coda clusters. Some scholars claim that vowel epenthesis is the default strategy, while consonant deletion is far less used (Paradis & LaCharité, 1997; Uffmann, 2001, 2004). In this chapter, the phonotactic adaptation of English syllable structure in Mandarin loanwords will be analysed in detail. The types of repair process, the variations between alternate strategies, and the choice of the epenthetic vowel will be analysed. An OT analysis will be developed to account for the adaptation patterns observed in the corpus.

## **5.1 Adaptations of Complex Onsets**

### ***5.1.1 General Adaptation Pattern of Complex Onsets***

Complex onsets are consonant clusters made up of two or more consonant sounds. Consonant clusters have a tendency to follow patterns such as the Sonority Sequencing Principle (SSP), wherein the closer a consonant in a cluster is to the syllable's vowel, the more sonorous the consonant is. According to Chen (2003), the syllable structure of English can vary from V to CCCVCCCC. Harley (2003) explains that there are three main phonotactic rules regarding which English consonants are able to combine to form two consonant onset clusters. Firstly, the first consonant in a two consonant onset cluster must be an obstruent, specifically a stop or a fricative.

Secondly, if the first consonant is anything other than a /s/, the second consonant must be a liquid or a glide such as /l/ or /w/. Thirdly, if the first consonant is a /s/, the second can be a voiceless stop /p/, an alveolar nasal /n/, a liquid /l/, or a glide /w/. These rules are not absolutely followed as loanwords might disobey the cluster limits set by the borrowing language's phonotactics. For example, the English words *sphere* /'sfɪər/ and *sphinx* /'sfɪŋks/, both of which are Greek loanwords, violate the rule that two fricatives may not appear adjacently word-initially.

As noted by Fleming (2007), stop-liquid clusters are among the most common onset consonant clusters. English contrasts three places of articulation in a stop-liquid cluster before /r/ including bilabial (/p, b/), alveolar (/t, d/), and velar (/k, g/). Before /l/, English contrasts two places of articulation stop-liquid clusters, bilabial (/p, b/), and velar (/k, g/). There is a restriction against coronal stops plus /l/ clusters, such as /dl/ or /tl/. In English, the longest possible initial cluster is three consonants, as in *split* /'splɪt/, *strudel* /'ʃtʁuːdəl/, *strengths* /'stɛŋkθs/, and *squirrel* /'skwɪəl/; all beginning with the /s/ or /ʃ/, containing /p/, /t/, or /k/, and ending with /l/, /ɹ/, or /w/.

In the corpus, no tri-consonantal clusters in the onset are found whereas the di-consonantal clusters are prevalent in the onset position. As for the di-consonantal clusters in English, Mandarin mostly adopts two strategies to modify them: insert vowels to syllabify the consonant(s); or delete consonant(s), as Example (b) illustrates. Onset clusters are generally resolved through vowel epenthesis, as shown by Example (a).

Example (a): *blues* [bluz] > *bu4lu3shi4* [pu.lu.ʃ]

Example (b): *cretinism* ['kɹɛtɪnɪz(ə)m] > *ke4ting1* [k<sup>h</sup>ə.t<sup>h</sup>ɪŋ]

Example (a) shows that the onset clusters in English are parsed faithfully into Mandarin, with the insertion of vowels to satisfy the syllable structure constraint. A vowel is inserted between the members of the cluster in order to conform to the basic CV syllable template that allows only one onset consonant.

In the adaptation of onset clusters, the vowel which is inserted in the onset clusters does not seem to have a unified form. Unlike some languages which always have a central vowel to insert to a consonant cluster, (see C. B. Chang (2009) for Burmese; Dupoux et al. (1999) for Japanese), Mandarin has some vowels which are more central than the other vowels. These vowels are also less salient and, consequently, are used as an epenthetic vowel. Mandarin loanwords have more variations in choosing the inserted vowels, as Table 52 illustrates.

**Table 52**

*Adaptation of Onset Clusters with Different Epenthesised Vowels*

a. <i>brandy</i> [bʁændi] > <i>bai2lan2di4</i> [pai.lan.ti]
b. <i>Broadway</i> [brodweɪ] > <i>bai2lao3hui4</i> [pai.lao.x <sup>w</sup> ei]
c. <i>blues</i> [bluz] > <i>bu4lu3shi4</i> [pu.lu.ʃ]
d. <i>browning</i> [braunɪŋ] > <i>bu4lang3ning2</i> [pu.laŋ.niŋ]
e. <i>blog</i> [blɒɡ] > <i>bu4luo4ge</i> [pu.l <sup>w</sup> o.kə]
f. <i>flannel</i> [flænl] > <i>fa3lan2rong2</i> [fa.lan.rɒŋ]
g. <i>franc</i> [fɹæŋk] > <i>fa3lang2</i> [fa.laŋ]
h. <i>freon</i> [fɹiɔn] > <i>fu.li.aŋ</i> [fu.li.aŋ]
i. <i>grammar</i> [græmə] > <i>ge.lang.ma</i> [kɤ.laŋ.mA]
j. <i>Grammy</i> [græmi] > <i>ge.lai.mei</i> [kɤ.lai.mei]
k. <i>cream</i> [kɹim] > <i>qi.lin</i> [tɕ <sup>h</sup> i.lin]
l. <i>Trojan</i> [tɹɔjən] > <i>te.luo.yi</i> [t <sup>h</sup> ɤ.l <sup>w</sup> o.i]
m. <i>trust</i> [tɹʌst] > <i>te.la.si</i> [t <sup>h</sup> ɤ.la.sɪ]
n. <i>clone</i> [kləʊn] > <i>ke.long</i> [k <sup>h</sup> ɤ.lɒŋ]

*Note.* Based on the findings in this study

As can be seen, vowels /ai/ /u/ /a/ /ɤ/ /i/ are chosen to be inserted between the cluster members.

In most cases, epenthesis is preferred to deletion in the adaptation of onset consonant clusters. Yet some examples reveal that deletion may also be a strategy used to deal with the consonant cluster. Several cases of deletion are found in the corpus with the deletion of the

approximant /ɹ/ in the cluster, which are *cretinism* > *ke.ting* [kʰɿ.tʰiŋ], *acrylic* > *ya.ke.li* [jA.kʰɿ.li], *microphone* > *mai.ke.feng* [mai.kʰɿ.fəŋ], *atropine* > *a.tuo.pin* [a.tʰwɔ.pʰin], *acre* > *ai.ke* [ai.kʰɿ], and *lycra* > *lai.ka* [lai.kʰa]. In the six cases with the deletion of the liquid /ɹ/ in a consonant cluster, five are cluster /kɹ/, only one is cluster /tɹ/. All the clusters with liquid /ɹ/ are followed by a mid or back vowel. The phonetic and phonological environment for the [ɹ] deletion will be further analysed in the next section. A question arises here: Are the strategies of epenthesis and deletion predictable?

### 5.1.2 Adaptation of Onset Clusters ([s]) + [obstruent] + [ɹ]

As has been noted in the discussion of the onset [ɹ] cases in Section 4.6.4.2, most of the onset [ɹ] have been adapted into Mandarin /l/. When [ɹ] appears in an onset cluster following an obstruent, it is either deleted or retained (adapted into Mandarin /l/). For example, *lycra* [laikɹa] > *lai.ka* [lai.kʰa], in which the segment [ɹ] is deleted; *brandy* [bɹændi] > *bai2lan2di4* [pai.lan.ti], in which the segment [ɹ] is retained and adapted into [l]. What causes the two adaptation patterns to happen? These phenomena will first be analysed in terms of phonetic salience and perceptual similarity between the source and the output. Then the prosodic constraint of Mandarin syllables is also considered.

As the data shows, when the English [ɹ]s appear as simplex onsets, they are predominantly adapted into Mandarin [l], even though it phonetically corresponds more closely to Mandarin [ʒ], which is also a permissible onset in Mandarin. In the adaptation of consonant clusters containing [ɹ], it is also adapted into [l] when retained. Thus, in the adaptation of consonant cluster onsets containing [ɹ], three repair strategies — featural change, epenthesis, and deletion — are generally found to operate.

In the following analysis, the strategies of featural change and epenthesis are combined and termed “retention” as opposed to deletion. The discussion will focus on the phonetic and phonological environment needed for retention and deletion to happen and answer the question of

whether retention and deletion of English [ɹ] in the onset consonant clusters is predictable. As the database reveals, the majority of onset clusters in English are faithfully parsed into Mandarin syllables, with a vowel inserted to shun consonant clusters, which accounts for over 85% of all cases.

Besides the cases mentioned with [ɹ] deletion, there are some other cases where both adaptation strategies can be applied, resulting in two outcomes, such as: *Truman*, *Castro*, *Trump*, and *Armstrong*. When they are adapted with the retention of the segment [ɹ], the adapted forms are:

*Truman* [tɹumən] > *du.lu.men* [tu.lu.mən]

*Castro* [kastɹəʊ] > *ka.si.te.luo* [k<sup>h</sup>a.sɿ.t<sup>h</sup>ɿ.luə]

*Trump* [tɹʌmp] > *te.lang.pu* [t<sup>h</sup>ɿ.laŋ.p<sup>h</sup>u]

*Armstrong* [amstɹɔŋ] > *a.mu.si.te.lang* [a.mu. sɿ.t<sup>h</sup>ɿ.laŋ]

The other adapted forms of these words are realised with the consonant clusters “fused” into a single retroflex Mandarin phoneme /tʂ/ or /tʂ<sup>h</sup>/:

*Truman* [tɹumən] > *chu.men* [tʂ<sup>h</sup>u.mən]

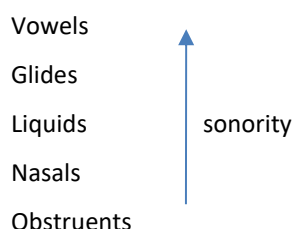
*Castro* [kastɹəʊ] > *ka.si.chu* [k<sup>h</sup>a.sɿ. tʂ<sup>h</sup>u]

*Trump* [tɹʌmp] > *chuan.pu* [tʂ<sup>h</sup>wan.p<sup>h</sup>u]

*Armstrong* [amstɹɔŋ] > *a.mu.si.zhuang* [a.mu. sɿ. tʂwan]

Note that the consonant clusters are all with two consecutive consonants [t] and [ɹ], which share the feature [+coronal]. This feature endows the cluster with a greater tightness in perception and causes them to be fused into one phoneme.

Now, the phonetic and phonological environment for the deletion of the [ɹ] in the onset consonant clusters will be analysed. The first element is the effect of sonority as it influences the adaptation strategy. The sonority of a sound refers to its loudness relative to that of other sounds with the same length, stress, and pitch (Ladefoged, 2001). The sonority scale, in Figure 7, is widely approved by most phoneticians:

**Figure 7***Sonority Scale of Speech Sounds*

*Note.* Adapted from Ladefoged, 2001

The sounds with high sonority are more salient and more perceptible. Thus, it is assumed that in isolation, vowels are the easiest to perceive while obstruents are the hardest, with other sounds ranked in between, as shown below:

Salience hierarchy of sounds in isolation

Vowels > glides > liquids > nasals > obstruents

However, when sounds appear in the context of either “\_V” or “V\_”, the salience hierarchy is reversed. The reason is that the more sonorant the sound is, the more similar it is to the adjacent vowel. In other words, less contrast between the sound and the vowel can be identified. This results in a different salience hierarchy among the sounds, indicating that the perceptual distinctiveness between an obstruent and a vowel is the greatest, while the perceptual distinctiveness between a vowel and another vowel is the weakest, as shown below:

Salience hierarchy in the context of “\_V” or “V\_”

Obstruents > nasals > liquids > glides > vowels

The second element is the place of articulation of the preceding stop. Closer investigation reveals that the preceding stops in the [ɹ] deletion cases are mostly velar stops [k], with the feature [+back]. The similarity of the feature [+back] between the neighbouring stop and [ɹ] contributes to the extent of their confusability. In producing the [+back] velar stop, the tongue root is raised to

make a constriction of the airflow at the velar. In producing the retroflex approximant, the tongue tip is curled back towards the hard palate, whether or not it actually makes contact there (Bickford & Floyd, 2006). A retroflex thus bears a certain similarity to a [+back] stop in that the articulation of both involves the back part of the oral cavity or the backward movement of the tongue. Under this rationale, in the sequence of “stop[+back]+[ɭ]”, the retroflex may in a sense “blend” with the precedent stop, weakening the perceptual distinctiveness of the latter. This effect can partly explain the loanword data, in which the onset stop+[ɭ] are not 100% retained.

The third element that affects the adaptation strategy of the liquid [ɭ] in the onset cluster is the following vowel. When the liquid [ɭ] is followed by a back vowel, the deletion of [ɭ] is more likely to happen. The articulatory similarity of the back vowel and [ɭ] is one aspect. The acoustic similarity is another. In acoustic terms, the backness of vowels is primarily reflected in their second formant frequencies: front vowels have a high F2 and back vowels have a low F2. The F2 of [ɭ] is also rather low, behaving like a [+back] vowel.

**Table 53**

*F2 of [-back] Vowels, [+back] Vowels, and Liquids*

	[-back] Vowels	[+back] Vowels	Liquids
F2	1660-2250Hz	870-1100Hz	1000-1200Hz

*Note.* Based on Ladefoged 2001.

As the [+back] vowels and the liquids have similar F2, the transition of [ɭ] to the following vowel is rather flat. Thus the perception of the liquid is hard for Mandarin listeners, contributing to the adaptation of the sequence “stop[+back]+[ɭ]+vowel[+back]” into “stop[+back] +vowel[+back]”, with the [ɭ] deleted. In contrast, in the adaptation of the sequence “stop[-back]+[ɭ]+vowel[-back]” the liquid is never deleted, because the production dissimilarity of stop[-back]and [ɭ]and vowel[-



back] makes the perception of [ɹ] easier. Acoustically, as the [-back] vowels have a higher F2, the transition from [ɹ] to [-back] vowel would be like a sharp increase, such as from 1000-1200 Hz to 1660-2250Hz, which endows the [ɹ] with more robustness. Therefore, the adaptation strategy of the sequence “stop[-back]+[ɹ]+vowel[-back]” is always epenthesis.

So far, the adaptation of [ɹ] in the onset position has been discussed, as a simplex onset in Section 4.6.4.2, as a second or third segment in complex onsets in Section 5.1.2. The adaptation of liquid [ɹ] as coda will be further discussed in the Section 5.2.1.5. The adaptation strategy of the liquid varies with its position. Syllable onsets enjoy more perceptual privileges compared to syllable codas (Beckman, 1998; Steriade, 2001). The simplex onset liquids are the most prominent perceptually and are 100% retained; the liquids as the second or third segments in an onset are in an intermediate position, with a high rate of retention; in the coda position, liquids are the least prominent therefore most of them are deleted. This salience hierarchy of [ɹ] in different positional contexts can well explain the degree of deletion of [ɹ]. In the coda position, the phonological reason, such as the preference for disyllabic words in Mandarin, will also come into play. The interaction between phonetic salience and the prosody constraint of minimal word constraint will be further discussed in an OT analysis in Section 5.2.1.5.

## **5.2 Adaptation of Codas**

### **5.2.1 Adaptation of Simplex Codas**

As Mandarin allows only two codas [n] and [ŋ] and retroflex coda [ʂ] in limited distribution, all the coda stops are illicit. Kenstowicz (2003) suggests that perceptual salience is the crucial factor underlying the choice of a repair strategy. Recent studies of this question suggest that auditory salience and similarity are critical factors in resolving the choice of which to preserve and which to delete (see Kenstowicz, 2007; Steriade, 2001; Kang, 2003, among others). Kang (2003) also argues

that the output tends to be perceptually similar to the input whether epenthesis or deletion is chosen. The speaker will tend to preserve features whose absence would be most noticeable (Kenstowicz, 2007). Thus, if a coda is of high salience, it is likely to be preserved; if a coda is of low auditory salience, it is likely to be deleted. In English loanwords in Korean for example, they are influenced by the consonantal features of the coda and the quality of the preceding vowel. When the coda is voiced (rather than voiceless) and when it is coronal, it is more likely to be repaired by vowel epenthesis. Vowel epenthesis is more frequent when the coda is voiced than when it is voiceless because the created CV syllable has great perceptual closeness to the intervocalic voicing context in Korean. The higher frequency of vowel epenthesis after coronal stops than after non-coronal stops is because in Korean phonology, coronal-final words are restricted. From these findings, we can see that the choice between vowel epenthesis and consonant is determined by which strategy results in maximal perceptual similarity between the input and the output.

**5.2.1.1 Adaptation of Coda Stops.** Stops are at the least sonorant end of the sonorant hierarchy. Coda stops are expected to be repaired using deletion instead of paragoge.

**Table 54**

*Examples of Epenthesis in the Adaptation of Coda Stops*

Adaptation Pattern	Example
/_p/ > /p <sup>h</sup> v/	<i>jeep</i> > [tɕi. p <sup>h</sup> u] 吉普
/_b/ > /pV/	<i>subway</i> > [sai.pai.wei] 赛百味
/_t/ > /t <sup>h</sup> v/	<i>pint</i> > [p <sup>h</sup> in. t <sup>h</sup> o] 品脱
/_t/ > /tV/	<i>short</i> > [ɕ <sup>l</sup> ou.tou] 秀逗
/_d/ > /t <sup>h</sup> v/	<i>Ford</i> > [fu. t <sup>h</sup> ɤ] 福特
/_d/ > /tV/	<i>Polaroid</i> > [p <sup>h</sup> ai.li.tɤ] 拍立得
/_k/ > /k <sup>h</sup> v/	<i>tank</i> > [t <sup>h</sup> an. k <sup>h</sup> ɤ] 坦克

*Note.* Based on the findings in this study

Generally, the stop codas in English have no audible release (Lisker & Abramson, 1964), and they are also not found in Mandarin coda position, therefore, whether they are voiced or voiceless are hard to distinguish for Mandarin speakers. In the adaptation of /t/ and /d/, both aspirated and unaspirated alveolar stops are attested.

**Table 55**

*Examples of Deletion in the Adaptation of Coda Stops*

Adaptation Pattern	Example
/_p/ > ∅	<i>pump</i> > [pən] 泵
/_b/ > ∅	not found in this corpus
/_t/ > ∅	<i>jacket</i> > [tɕ <sup>l</sup> a. k <sup>h</sup> ɿ] 夹克
/_d/ > ∅	<i>card</i> > [k <sup>h</sup> a] 卡
/_k/ > ∅	<i>logic</i> > [l <sup>w</sup> o.tɕi] 逻辑
/_g/ > ∅	<i>jitterbug</i> > [tɕi.t <sup>h</sup> ɿ.pa] 吉特巴 only one example, not included in the table

*Note.* Based on the findings in this study



**Table 56***Mapping Distribution of Coda Stops from English Loanwords to Mandarin*

	English Coda/_p/		English	English Coda/_t/			English Coda /_d/			English Coda/_k/	
	Coda/_b/										
	/p <sup>h</sup> V/	∅	/pV/	/t <sup>h</sup> V/	/tV/	∅	/t <sup>h</sup> V/	/tV/	∅	/k <sup>h</sup> V/	∅
Times	6	4	2	6	3	31	1	1	12	14	3
Percentage	60	40	100	15	7.5	77.5	7.1	7.1	85.8	82.4	17.6
Cases	<i>pop art</i>	<i>pump</i>	<i>subway</i>	<i>caste</i>	<i>partner</i>	<i>(omitted)</i>	<i>Ford</i>	<i>Polaroid</i>	<i>card</i>	<i>baroque</i>	<i>park</i>
	<i>gypsy</i>	<i>tips</i>	<i>Forbes</i>	<i>karat</i>	<i>short</i>				<i>Polaroid</i>	<i>dictator</i>	<i>shark</i>
	<i>gallop</i>	<i>tittup</i>		<i>karst pint</i>	<i>pest</i>				<i>pound</i>	<i>DINK</i>	<i>Kodak</i>
	<i>gap</i>	<i>Lipton</i>		<i>Kmart</i>					<i>safeguard</i>	<i>funk</i>	
	<i>jeep</i>			<i>bit</i>					<i>salad</i>	<i>geek</i>	
									<i>sandwich</i>	<i>mark</i>	
									<i>Budweiser</i>	<i>mosaic</i>	
									<i>podcast</i>	<i>NASDAQ</i>	
									<i>Broadway</i>	<i>OPEC</i>	
									<i>cupid</i>	<i>punk</i>	
									<i>Garfield</i>	<i>shock</i>	
									<i>Hollywood</i>	<i>Starbucks</i>	
										<i>tank</i>	
										<i>quark</i>	
									<i>Buick</i>		

*Note.* /g/ in coda position not found in the corpus. Based on the findings in this study



When the coda is /t/ and /d/, the cases of deletion outnumber those of epenthesis. One possible reason for deletion as the most common strategy is that the dental coda consonants have a less audible release than labial and velar consonants, so they are the least salient among the coda stops. Therefore, the dental coda stops are the least salient in perception. Deletion is the better strategy for coda /t/ and /d/ to make the input and the output maximally similar.

**5.2.1.2 Adaptation of Coda Fricatives and Affricates.** In the corpus, not many words end with fricatives or affricates. As fricatives and affricates are more sonorant and easier to perceive than the stops, they are expected to not be deleted. Therefore, coda fricatives are mostly repaired by vowel paragoge.

**Table 57**

*Adaptation Pattern of Coda Fricatives*

Adaptation Pattern	Example
/_f/→[fV]	<i>golf</i> > [kau.ə.fu] 高尔夫
/_v/→[fV]	<i>dove</i> > [tʰ.fu] 德芙 only one example, not included in the table
/_θ/→[sV]	<i>myth</i> > [mi.sɿ] 迷思 only one example, not included in the table
/_ð/	not found in this corpus
/_s/→[sV]	<i>lace</i> > [lei.sɿ] 蕾丝
/_s/→[ʃV]	<i>romance</i> > [luo.man.ʃ] 罗曼史 (many cases in which /s/ is first borrowed into Cantonese as [si] with the character ‘士’ often used and then into Mandarin as [ʃ])
/_s/→∅	<i>mongoose</i> > [mənɣ.kv] 蒙哥
/_z/→[sV]	<i>mosaic</i> > [ma.sai.k <sup>h</sup> ɿ] 马赛克
/_z/→[ʃV]	<i>jazz</i> > [tɕɥɛ.ʃ] 爵士

/_z/→[tsV]	<i>AIDS</i> > [ai.tsɿ] 艾滋
/_z/→[tʂ <sup>h</sup> V]	<i>Benz</i> > [pen.tʂɿ] 奔驰
/_ʃ/→[sV]	<i>cashmere</i> > [k <sup>h</sup> a.sɿ.mi] 开司米 only one example, not included in the table
/_ʒ/	not found in this corpus

*Note.* Based on the findings in this study

**Table 58**

*Mapping Distribution of Coda Fricative/f s z/ from English into Mandarin*

	Coda/_f/		Coda/_s/		Coda/_z/			
	[fV]	[sV]	[ʃV]	∅	[tʂ <sup>h</sup> V]	[tsV]	[sV]	[ʃV]
Times	2	16	11	3	1	1	1	5
Percentage	100	53.3	36.7	10				
Cases	<i>golf</i>	<i>aspirin</i>	<i>antisterone</i>	<i>kallipygos</i>	<i>Benz</i>	<i>AIDS</i>	<i>fans</i>	<i>blues</i>
	<i>puff</i>	<i>bass</i>	<i>bus</i>	<i>mongoose</i>		<i>Mazda</i>		<i>hippies</i>
		<i>caste</i>	<i>Disneyland</i>	<i>Starbucks</i>				<i>Beatles</i>
		<i>disco</i>	<i>filibuster</i>					<i>cheese</i>
		<i>Esperanto</i>	<i>gestapo</i>					<i>pampers</i>
		<i>hysteria</i>	<i>Mastercard</i>					
		<i>Islam</i>	<i>pasteurise</i>					
		<i>karst</i>						
		<i>morse</i>						
		<i>mousse</i>						
		<i>muse</i>						
		<i>NASDAQ</i>						
		<i>Oscar</i>						
		<i>outlets</i>						
		<i>pest</i>						
		<i>Haagen-Dazs</i>						

*Note.* Based on the findings in this study

Only four examples with coda affricates are found, in the adaptation of which the coda affricates are all modified by vowel paragoge.



**Table 59***Adaptation Pattern of Coda Affricates*

Adaptation Pattern	Example
/tʃ/→[tʃV]	<i>sandwich</i> > [san.miŋ.tʃ] 三明治 graphically from Cantonese pronounced as [san.miŋ.tʃi] <i>Greenwich</i> > [kʷ.lin.ni. tʃ] 格林尼治
/tʃ/→[tsʰV]	<i>inch</i> > [jiŋ. tsʰwən] 英寸 This is not a pure phonetic loanword. [in] is adapted to [iŋ] instead of [in] to correspond to a Chinese morpheme ‘ying’, meaning “English”, and coda [tʃ] is adapted to a Chinese morpheme meaning “a measurement of length”.
/dʒ/→∅	<i>bandage</i> > [paŋ.ti] 邦迪

*Note.* Based on the findings in this study

It is not surprising that most of the coda fricatives and affricates are mapped to a Mandarin sound rather than deleted; compared to the higher percentage of deletion in coda stops. The reason is that fricatives and affricates have higher sonority than stops. It is also found that the vowel to add to a coda fricative /f v/ is a back vowel /u/, which is the same vowel used in epenthesis for consonant cluster beginning with /f/ in the onset position. While in the cases with other fricatives in the coda position /s z ʃ/ and the affricates /tʃ/, two Mandarin apical vowels /ɿ/, /ʅ/ are added to form a syllable. They can only appear after a sibilant, and they are also described as syllabic consonants /z z/ instead of vowels (Duanmu, 2007). Therefore, the syllable with a dental sibilant /ts, tsʰ, s/ and an apical vowel can form /tsɿ/, /tsʰɿ/, /sɿ/ (also transcribed as /tsz/, /tsʰz/, /sz/); the syllable with a retroflex sibilant and an apical vowel can form /tʂɿ/, /tʂʰɿ/, /ʂɿ/ (also transcribed as /tʂz/, /tʂʰz/, /ʂz/). The apical vowels can be regarded as the surface form of an (underlying) empty nuclear slot /i/

(Chinese kōngyùn, meaning “empty rhyme”) that is, as not containing a vowel phoneme at all. Thus, the adapted sibilants plus a syllabic consonant best approximate the original coda sibilants. As for the various mapping patterns between English sibilants and Mandarin, it is shown that English coda /s/ and /z/ are variously adapted into Mandarin fricatives and affricates. For English coda /s/, the Mandarin outputs are fricatives /s/ and /ʃ/, differing in the place feature; for English coda /z/, the outputs even include affricates /ts/ and /tʃ<sup>h</sup>/. The possible reason might be that since Mandarin has no coda sibilants, the English /s/ and /z/ are difficult for Mandarin speakers to differentiate, especially the non-existent phoneme /z/.

**5.2.1.3 Adaptation of Coda Nasals.** English /m/ and /n/ in the final positions are usually differently adapted into Mandarin loanwords. English /m/ mostly forms an independent syllable by vowel insertion, for example, English *lyme* > Mandarin *lai.mu* [lai.mu]. But syllable final /m/ is also adapted into Mandarin /n/ in some cases, such as English *Islam* > Mandarin *yi.si.lan* [ji.sɿ.lan]. When /n/ is in the final position with another consonant, it is mostly adapted into the coda nasal of the preceding syllable, for example, English *pint* > Mandarin *pin.tuo* [p<sup>h</sup>in.t<sup>w</sup>o]. But when /n/ appears in the syllable final position without a following consonant, it is not always adapted into /n/. For example, English *marathon* > Mandarin *ma.la.song* [ma.la.sɔŋ], *hormone* > *he.er.meng* [xɿ.ə.məŋ]. The adaptation of /ŋ/ is also not as straightforward as expected. For example, English *dumping* is adapted into Mandarin *tan.pin* [t<sup>h</sup>an.p<sup>h</sup>in] instead of *tan.ping* [t<sup>h</sup>an.p<sup>h</sup>ɪŋ].

A limited range of context-free variation is commonly tolerated in the adaptation of coda nasals: for example, a coda nasal can be adapted as either an alveolar or velar nasal in Mandarin. For example, *Johnson* [dʒɔŋsən] is adapted into either *qiang.sheng* [tɕ<sup>h</sup> a ŋ. ʃəŋ] or *qiang.sen* [tɕ<sup>h</sup> a ŋ.sən]. More examples of coda nasal adaptation are listed in Table 60.

**Table 60***Adaptation of Coda Nasal*

Adaptation Pattern	Example
/m/→[n]	<i>Olympic</i> > [au.lin.p <sup>h</sup> i.k <sup>h</sup> ɿ] 奥林匹克
/m/→[mV]	<i>rum</i> > [laŋ.mu] 朗姆
/m/→[ŋ]	<i>totem</i> > [t <sup>h</sup> u.t <sup>h</sup> əŋ] 图腾
/n/→[n]	<i>gallon</i> > [tɕia.lun] 加仑
/n/→[ŋ]	<i>cartoon</i> > [k <sup>h</sup> a.t <sup>h</sup> oŋ] 卡通
/n/→∅	<i>morphine</i> > [ma.feɪ] 吗啡 only example, probably not from English
/ŋ/→[ŋ]	<i>bowling</i> > [pau.liŋ] 保龄
/ŋ/→[n]	<i>tank</i> > [t <sup>h</sup> an.k <sup>h</sup> ɿ] 坦克

*Note.* Based on the findings in this study

**Table 61***Mapping Distribution of Coda Nasals from English Loanwords in Mandarin*

	/m/			/n/			/ŋ/	
Output	[n]	[mV]	[ŋ]	[n]	[ŋ]	∅	[ŋ]	[n]
Times	12	7	15	81	63	1	10	5
Percentage	35.3	20.6	44.1	55.9	43.4	0.7	66.7	33.3
Cases	<i>rumba</i>	<i>lyme</i>	<i>samba</i>	<i>angel</i>	<i>antisterone</i>	<i>morphine</i>	<i>binding</i>	<i>shaping</i>
	<i>film</i>	<i>ohm</i>	<i>euphonium</i>	<i>antisterone</i>	<i>bandage</i>		<i>bing</i>	<i>shopping</i>
	<i>harem</i>	<i>rum</i>	<i>pentium</i>	<i>aspirin</i>	<i>bassoon</i>		<i>bowling</i>	<i>Buckingham</i>
	<i>Islam</i>	<i>Thames</i>	<i>pump</i>	<i>atropine</i>	<i>bungee</i>		<i>bullying</i>	<i>Boeing</i>
	<i>Olympic</i>	<i>Sam</i>	<i>shampoo</i>	<i>bacon</i>	<i>byzantine</i>		<i>darling</i>	<i>tank</i>
	<i>Buckingham</i>	<i>Holmes</i>	<i>totem</i>	<i>banjo</i>	<i>cannon</i>		<i>dengue</i>	<i>dumping</i>
	<i>coulomb</i>	<i>dumdum</i>	<i>ream</i>	<i>Benz</i>	<i>canon</i>		<i>DINK</i>	<i>tango</i>
	<i>dumdum</i>		<i>champagne</i>	<i>Big Ben</i>	<i>cartoon</i>		<i>pingpong</i>	
	<i>ampere</i>		<i>Pampers</i>	<i>brandy</i>	<i>chaconne</i>		<i>pudding</i>	
	<i>ampoule</i>		<i>mammoth</i>	<i>carbine</i>	<i>chanson</i>		<i>punk</i>	
	<i>Columbia</i>		<i>cream</i>	<i>cement</i>	<i>chiffon</i>		<i>shilling</i>	
	<i>hamburger</i>		<i>denim</i>	<i>cent</i>	<i>clone</i>		<i>funk</i>	
			<i>grammar</i>	<i>champagne</i>	<i>cologne</i>		<i>karting</i>	
			<i>paracetamol</i>	<i>cocaine</i>	<i>cretinism</i>		<i>mango</i>	
				<i>caffeine</i>	<i>fashion</i>		<i>pingpong</i>	
				<i>currant</i>	<i>franc</i>		<i>pudding</i>	
				<i>durian</i>	<i>Freon</i>			

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<i>encore</i>	<i>gondola</i>
<i>engine</i>	<i>hormone</i>
<i>Esperanto</i>	<i>inch</i>
<i>Fabian</i>	<i>Internet</i>
<i>fahrenheit</i>	<i>iPhone</i>
<i>fans</i>	<i>kangaroo (old</i>
<i>formalin</i>	<i>borrowing)</i>
<i>gallon</i>	<i>lemon</i>
<i>gasoline</i>	<i>liaison</i>
<i>gene</i>	<i>lumen</i>
<i>gin</i>	<i>marathon</i>
<i>heroin</i>	<i>microphone</i>
<i>index</i>	<i>modern</i>
<i>lesbian</i>	<i>mongoose</i>
<i>lidocaine</i>	<i>montage</i>
<i>lithopone</i>	<i>nicotine</i>
<i>longman</i>	<i>nylon</i>
<i>mandolin</i>	<i>ounce</i>
<i>mince</i>	<i>partner</i>
<i>organza</i>	<i>passion (fruit)</i>
<i>pancake</i>	<i>poncho</i>
<i>Pandora</i>	<i>pound</i>
<i>pence</i>	<i>salon</i>
<i>penicillin</i>	<i>sardine</i>
<i>pentium</i>	<i>saxophone</i>

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<i>pint</i>	<i>scone</i>
<i>romantic</i>	<i>(shut) down</i>
<i>salmon</i>	<i>simmons</i>
<i>sandwich</i>	<i>sirloin</i>
<i>Satan</i>	<i>sphinx</i>
<i>science</i>	<i>sundae</i>
<i>shaman</i>	<i>telephone</i>
<i>syndicate</i>	<i>toucan</i>
<i>ton</i>	<i>typhoon</i>
<i>turbine</i>	<i>vitamin</i>
<i>tween</i>	
<i>vaseline</i>	

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*Note.* Based on the findings in this study

Based on the above table, we can see that the percentage of the adaptation of English coda nasals /n/ and /ŋ/ show the adaptation of coda nasals /n ŋ/ is not so straightforward. Whether /n/ and /ŋ/ is adapted into Mandarin /n/ and /ŋ/ is influenced by how the preceding vowel is adapted.

As both /n/ and /ŋ/ exist in English and Mandarin in the coda position, it is expected that they should be faithfully mapped. But as the data shows, the adaptation of coda nasals /n ŋ/ is not so straightforward. The alveolar nasal /n/ is either adapted into /n/ or the velar nasal /ŋ/. So is the velar nasal /ŋ/. The percentage of adaptation pattern from /n/ to /n/ and /ŋ/ is almost evenly split while the percentage of /ŋ/ to /ŋ/ is twice the percentage of /ŋ/ to /n/. The adaptation of coda nasals /n/ and /ŋ/ is affected, to a great degree, by the preceding vowel. In Mandarin, there is a rule that postulates the combination of the vowel and the coda nasal in a syllable, which is termed as Nucleus–coda harmony (NC-harmony) (Duanmu, 2007), whereby:

- (a) The nucleus and the coda must agree in frontness.
- (b) The nucleus and the coda must agree in rounding.

Since Mandarin has only one mid vowel /ə/ and one low vowel /a/, they are unspecified for [back] or [round]. Wang (1993) also suggests that the mid and the low vowels do not have values for [back] or [round] when they are short but do when they are long. Thus, in the context of nasal codas, the mid and low vowels take a relatively front allophone before the dental nasal /n/ and a relatively back allophone before the velar nasal /ŋ/.

By contrast, English front and back vowels can be freely combined with dental nasals and velar nasals. Therefore, there are four possible combinations composed of a vowel which is either a front vowel or a back vowel and a nasal which is either a dental nasal or a velar nasal.

## Table 62

### *Possible Outcomes of Vowel + Nasal Combinations*

English Non-high Vowel	+ Dental Nasal [n]	+ Velar Nasal [ŋ]
ɛ	[ɛn]	[ɛŋ]
ə	[ən]	[əŋ]
o	[on]	[oŋ] (does not exist in English)
æ	[æn]	[æŋ]
ʌ	[ʌn]	[ʌŋ]
ɔ	[ɑn]	[ɑŋ]

*Note.* Author's own summary

As Mandarin has two high vowels, one of which is front /i/ and other is back /u/, it is only necessary to make a comparison between Mandarin rhymes with non-high vowels + coda nasals and English non-high vowel + nasal coda syllables.

**Table 63**

Mandarin Non-high Vowel + Nasal Coda Combinations

Mandarin Non-high Vowel	+ Dental Nasal [n]	+ Velar Nasal [ŋ]
/ə/	[ɛn] [ən]	[əŋ] [oŋ]
/a/	[an]	[ɑŋ]

*Note.* Author's own summary









In the adaptation of non-high vowel + nasal coda combinations, there will be a conflict between being faithful to the English vowel and being faithful to the coda nasal. As non-high vowels are nonspecific and noncontrastive for [back] in Mandarin, if the phonological adaptation stance is taken, faithfulness to the coda nasal between English and Mandarin would be expected as the coda nasals are the point of similarity at the phonological level. If the coda nasal is not the determining factor, that is, the phonetic match between the English vowel and the Mandarin vowel is perceived to be more salient, the adaptation might turn out to be different. The [back] of the vowel would be



matched to achieve a better overall phonetic match as the coda nasals have a relatively faint distinguishing feature and it has been observed that the nasals [n ɲ] often do not have complete oral closure when they occur in the coda (Xu, 1986; Wang, 1993), especially after the low vowel. That's to say, the coda nasals tend to be neutralised. Based on the phonological coda nasal mapping, the adaptation would be as listed in Table 64.

**Table 64**




*Adaptation Pattern of Vowel + Nasal Combination Based on the Phonological Coda Nasal Mapping*

English Non-high Vowel + Dental Nasal [n]		Mandarin Non-high Vowel + Dental Nasal [n]	
[ɛn] [ən] [on]		[ɛn] [ən]	
[æɪn]		[an]	
[ʌn]			
[ɑn]			
English Non-high Vowel + Velar Nasal [ŋ]		Mandarin Non-high Vowel + Velar Nasal [ŋ]	
[ɛŋ] [əŋ]		[əŋ] [oŋ]	
[æŋ]		[aŋ]	
[ʌŋ]			
[ɑŋ]			

Based on the phonetic vowel mapping, the adaptation would be shown as in Table 65.

**Table 65**

*Adaptation Pattern of Vowel + Nasal Combination Based on the Phonetic Vowel Mapping*

English Non-high Vowel + Dental Nasal [n] / Velar Nasal [ŋ]		Mandarin Non-high Vowel + Dental Nasal [n] / Velar Nasal [ŋ]	
[ɛn] [ɛŋ]		[ɛn]	
[ən] [əŋ]		[ən] [əŋ]	
[on]		[on]	

[æŋ] [æŋ]	→	[an]
[ʌŋ] [ʌŋ] [aŋ] [aŋ]	→	[aŋ]

For the coda nasals following high vowels, Mandarin has coda dental nasals and coda velar nasals following /i/, but no coda nasals following /u/. It is predicted that when it is a [high back vowel] + [coda nasal], it is adapted into Mandarin [oŋ] to make the vowel faithfully adapted. From the corpus, it is shown that most of the cases where dental coda nasals are adapted to velar coda nasals, are syllables with high back vowels. For the high front vowel + coda nasal, it is predicted to be faithfully adapted. But as Mandarin syllable inventory does not have certain consonant + dental nasal combinations, the high front vowel + dental nasal is adapted to high front vowel + velar nasal, for example, \*[tin] \*[t<sup>h</sup>in] \*[fin]. The dentals /t<sup>h</sup>/ and /t/ can be followed by a velar nasal but not a dental nasal. As syllables \*[tin] \*[t<sup>h</sup>in] do not exist in Mandarin, the dental nasals in examples *Byzantine*, *cretinism*, and *nicotine* are adapted into the velar nasal /ŋ/. For the consonant /f/, both [fin] and [fiŋ] do not exist, so *sphinx* is adapted into *si.fen.ke.si* [sɿ.fən.k<sup>h</sup>ʰ.sɿ] with the high vowel changing to a mid vowel. Still, the faithfulness of the nasal mapping is not retained as /fəŋ/ corresponds to a Chinese morpheme meaning “crazy, lunatic”, which is abandoned as it is not an appropriate meaning.

There are a few more cases where the adaptation seems unfaithful to the original sound sequence and the changes are due to semantic consideration. For example, *inch* is adapted into *ying.cun* [jiŋ.ts<sup>w</sup>ən] instead of *yin.cun* [jin.ts<sup>w</sup>ən] because [jiŋ] corresponds to a morpheme meaning ‘English, of English’, so *ying.cun* [jiŋ.tswən] literally means ‘English inch’, indicating a foreign measurement. *Vitamin* is adapted into *wei.ta.ming* instead of *wei.ta.min* as *wei.ta.ming* literally means ‘support + his + life’, semantically associated with the original word.

What happens to the intervocalic nasal? It is well-known that the phonetic effect causes low vowels to be more likely nasalised (Whalen & Beddor, 1989). Moreover, Solé's (1992) and Krakow's (1994) research on vowel nasalisation suggest that non-high vowels in nasal contexts, such as CVN in English, exhibit more nasalisation than high vowels; therefore, inserting a nasal after a stressed non-high vowel produces a better match in phonetic detail. In the loanword adaptation process, the phonetic details of the duration and nasality of the non-high vowel in the English source word might be perceived and an extra nasal consonant might be inserted to better approximate the phonetic details. For example, *anarchy* [ænəki] > *an.na.qi* [an.na.tɕ<sup>h</sup>i], *denim* [ˈdenim] > *dan.ning* [tan.niŋ], *penny* [peni] > *bian.ni* [p<sup>i</sup>ɛn.ni]. Other cases with the insertion of nasal in the intervocalic position in the corpus include: *Athena*, *brownie*, *browning*, *carnation*, *Donald*, *Internationale*, *mammoth*, *penicillin*, *penny*, *sauna*, *sonar*, and *tannin*. Not all intervocalic nasals are adapted with an extra nasal insertion. The examples show that nasal insertion appears (1) when the prenasal stressed vowel in English is a non-high vowel or is a diphthong; (2) when the prenasal vowel is stressed. Therefore, in the loanword adaptation process, Mandarin speakers perceive the phonetic details of the duration and nasality of the vowel in the English source word, and insert an extra nasal consonant to better approximate the phonetic details.

The insertion process can also be explained from the perspective of ambisyllabicity. In the present case, the intervocalic nasal consonants are ambisyllabic in English. Hayes (2009) argues that ambisyllabic consonants are dominated by more than one syllable. The stressed syllable wants to have more segments, while the stressless one wants fewer and meanwhile, all syllables want to have onsets. He further argues that this representation would account for the ambiguous intuition speakers have concerning the syllabification of such words. In the adaptation of intervocalic nasals, when the ambisyllabic consonant is a nasal consonant, syllabification seems to be affected by the degree of vowel nasalisation and/or vowel duration on the prenasal vowel (cf. Hayes, 2009 v. Durvasula, Huang & Merrill, 2013).

Since Mandarin does not allow nasal /m/ in coda position, a coda /m/ in English has to change to /n/ or /ŋ/ in Mandarin loanwords; for example, *Islam* [is'læm] > *yi.si.lan* [i.sɿ.lan], and *samba* > *sang.ba* [saŋ.pa]. Another explanation is that the prenasal vowel becomes nasalised (Heyes, 2009). Thus, it could be said that the nasal /m/ is unchanged but gets deleted in the adaptation process. The ratio between the adaptation of /\_m/ to /\_n/, /\_m/ to /\_ŋ/, and /\_m/ to /mV/ is pretty even: 35%: 44%: 21%. In Mandarin, syllables with coda /n/ and coda /ŋ/ have a different distribution, with overlapping vowels. When the vowels in the adapted output with coda /n/ and coda /ŋ/ are the high front vowel /i/ and /ɪ/, the nucleus + coda [in] is the output of lax vowel /ɪ/ + nasal /m/, as in *Olympic* > *ao.lin.pi.ke* [ao.lin.p<sup>hi</sup>.<sup>hɿ</sup>]; the nucleus + coda [iŋ] is the output of tense vowel /i/ + nasal /m/, as in *ream* > *ling* [liŋ]. One possible reason is that with a tense prenasal vowel, the coda /m/ gets more nasality so it is adapted to /ŋ/. The same adaption pattern is observed with non-high front prenasal vowel + /m/. When the prenasal vowel is unstressed or lax, the coda /m/ is more likely to be adapted into /n/, for example, *Islam*, *Buckingham*, and *dumdum*. When the prenasal vowel is in a stressed syllable, the coda /m/ is more likely to be adapted into /ŋ/, as in *samba*, *shampoo*, *champagne*, *Pampers*, *mammoth*, and *grammar*.

When the coda /m/ is adapted by a vowel paragoge, the vowel /u/ is chosen to form a syllable with /m/. /u/ and /ɔ/ have two articulatory gestures — one is a lip gesture, the other is a dorsal gesture — but only one lingual gesture, the dorsal gesture. Therefore, the back vowels show a pattern of “lingual simplification” (Gick et al., 2004). Due to the advantages of similarity of feature [labial] with syllable-final /m/ and the simpler manner of pronunciation, /u/ and /ɔ/ are chosen to modify syllable-final /m/.

**5.2.1.4 Adaptation of Alveolar Coda Approximant /l/. What strategies do Mandarin speakers use to modify or approximate English syllable-final /l/?** First, some studies have found that Mandarin speakers had difficulties in producing /l/ correctly in the syllable final position (He, 2014).

Hansen (2001) conducted another study which pointed out that the syllable-final /l/ in the word final was one of the most difficult consonants for Mandarin speakers. He found that the /l/ was absent in 23% of their production and that 8% of their production involved feature change. It is argued that the syllable final /l/ is different from the syllable initial /l/ in the articulation. The phoneme /l/ has two articulatory gestures: consonantal apical gesture and vocalic dorsal gesture. In producing the initial /l/, it was found that the apical gesture occurs slightly before the vocalic gesture; while in producing the syllable final /l/, the dorsal gesture occurs much earlier than the apical gesture. The end of the dorsal gesture is almost synchronous with the beginning of the apical gesture (Browman & Goldstein, 1995). What's more, in terms of loudness, the vocalic dorsal gesture is stronger than the consonantal apical gesture in the final position (Sproat & Fujimura, 1993, p. 305).

Due to the fact that the English coda /l/ has an obvious loudness and Mandarin has the CodaCon constraint, it is predicted that the perception of the coda /l/ may be influenced by the CV syllable pattern in Mandarin. The stronger vocalic gesture in the syllable final position would be more perceivable to Mandarin speakers while the consonantal apical gesture would be more likely to be ignored. Thus, it is predicted that the coda /l/ will be adapted into a vowel. The cases in the corpus also match the prediction with only a few /l/ deletion cases.

**Table 66**

*Different Adaptation Strategies for the Adaptation of Coda /l/*

Vocalisation: _C/l/ > _/CV/	Retroflexion: _V/l/ > _/ə/	Deletion: _/l/ > Ø
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<i>waffle</i> [wɒfl] > <i>hua.fu</i> [xwa.fu]	<i>bel</i> [bɛl] > <i>bei.er</i> [pei.ə]	<i>cool</i> [ku] > <i>ku</i> [k <sup>h</sup> u]
<i>title</i> [taɪtl] > <i>tai.tou</i> [t <sup>h</sup> ai.t <sup>h</sup> ou]	<i>waltz</i> [wɒlts] > <i>hua.er.zi</i> [xwa.ə.tsɪ]	<i>volt</i> [vɒlt] > <i>fu.te</i> [fu.t <sup>h</sup> ɤ]
<i>rifle</i> [ˌɹɪfl] > <i>lai.fu</i> [lai.fu]	<i>polka</i> [pɒlka] > <i>bo.er.ka</i> [pwo.ə.k <sup>h</sup> a]	<i>polka</i> [pɒlka] > <i>bo.ka</i>
<i>idol</i> [aɪdl] > <i>ai.dou</i> [ai.tou]	<i>modal</i> [modal] > <i>mo.dai.er</i> [mwo.tai.ə]	[pwo.k <sup>h</sup> a]
<i>bagel</i> [bægl] > <i>bei.gwo</i> [pei.kwo]	<i>mile</i> [maɪl] > <i>mai.er</i> [mai.ə]	
<i>barbital</i> [bɑːbɪtl] > <i>ba.bi.tuo</i> [pa.pi.t <sup>h</sup> wo]	<i>joule</i> [dʒul] > <i>jiao.er</i> [tɕ'ao.ə]	
<i>carnival</i> [kɑːnɪvl] > <i>jia.nian.hua</i>	<i>golf</i> [gɒlf] > <i>gao.er.fu</i> [kao.ə.fu]	
[tɕja.njɛn.xwa]	<i>Email</i> [ɪmeɪl] > <i>yi.mei.er</i> [i.mei.ə]	
<i>model</i> [mɒdl] > <i>mo.te</i> [mwo.t <sup>h</sup> ɤ]	<i>angel</i> [eɪndʒəl] > <i>an.qi.er</i> [an.tɕ <sup>h</sup> i.ə]	
<i>TOEFL</i> [təʊfl] > <i>tuo.fu</i> [t <sup>h</sup> wo.fu]	<i>Wall (Street)</i> [wɒl] > <i>hua.er</i> [xwa.ə]	
<i>beatles</i> [bɪtlz] > <i>pi.tou.shi</i> [p <sup>h</sup> i.təʊ.ʃɪ]	<i>internationale</i> [ɪntə'næʃnal] >	
	<i>ying.te.nai.xiong.na.er</i> [ɪŋ.t <sup>h</sup> ɤ.nai. ɕjɔŋ.na.ə]	
	<i>Nobel</i> [nəʊbəl] > <i>nuo.bei.er</i> [nwo.pei.ə]	
	<i>alpha</i> [alfə] > <i>a.er.fɑ</i> [a.ə.fɑ]	
	<i>Elnino</i> [ɛl.ni.nəʊ] > <i>e.er.ni.nuo</i> [ɤ.ə.ni.nwo]	

*Note.* Based on the findings in this study

For the above cases with coda /l/, Mandarin speakers used three strategies to modify the syllable final /l/: vocalisation, retroflexion, and deletion.

Vocalisation means a vowel is substituted for the syllable final /l/ because the /l/ is perceived as a vowel with the apical gesture lost and the dorsal gesture maintained. That is, coda /l/ has articulatory manners which make it possible for /l/ itself to be vocalised rather than being attached to a vowel. As a result, the vocalised /l/ is heard as a back vowel such as /u/ or /o/ or /ɤ/. The reason why the vowels /u/ /o/ /ɤ/ (and sometimes their diphthong /ou/) are selected to be the substitutes for syllable-final /l/ is because of the shared articulation gestures they have with the syllable final /l/. The vowels /u/ /o/ /ɤ/ share the features of [+back], which means that /u/ /o/ /ɤ/ have the same articulation gestures, a dorsal gesture. Thus, when the strategy of vocalisation is adopted, the vowels /u/ /o/ /ɤ/ keep the vocalic dorsal gesture by retracting the tongue. The dorsal gesture of the syllable final /l/ is perceived and retained and the apical gesture of syllable-final /l/ is lost.

The second way to adapt the syllable final /l/ is to replace it with the Mandarin retroflex back unrounded vowel /ɤ/. Mandarin /ɤ/ is also categorised as a rhotic vowel, written as “er” in pinyin, representing a “rhotacized final” or “a retroflex central vowel” (Norman, 1988, p. 144; Ramsey, 1987, p. 45). This adaptation strategy is called “retroflexion”. Mandarin /ɤ/ can appear as an isolate syllable and has a common feature [-rounded] with the syllable final /l/. They differ in that Mandarin /ɤ/ is produced by retroflexing the tip of the tongue while the syllable final /l/ is produced by extending the tongue to the alveolar ridge. By replacing /l/ with /ɤ/, the dorsal gesture is also retained, and the apical gesture is also lost. This is not a unique way of modifying syllable-final /l/. In African American English, a similar central vowel /ə/ is used to substitute for the syllable-final /l/, as in *bea* [beə] for ‘bell’ and *pia* [piə] for ‘pill’ (Green, 2002, p. 120). It is also observed that when the syllable final /l/ is followed by another consonant, it is replaced by /ɤ/, such as *hua.er.zi* [x<sup>w</sup>a.ɤ.tsɿ] for *waltz*, *bo.er.ka* [pwo.ɤ.k<sup>h</sup>a] for *polka*, *gao.er.fu* [kao.ɤ.fu] for *golf*, and *a.er.fa* [a.ɤ.fa] for *alpha*.

The third way to adapt the syllable final /l/ is to delete it, such as the example of *cool* [kul] > *ku* [k<sup>h</sup>u] in the corpus. It is the least used strategy. It is predicted that the preceding vowels /u/ and /o/ promote deletion of the syllable final /l/ because of the perceptual difficulty of hearing syllable final /l/ when it occurs after back vowels as they share the feature [dorsal]. It is possible that as the dorsum of the tongue is already retracted in the back vowel /u/, the dorsal apical gesture of the syllable final /l/ is harder for Mandarin speakers to perceive than it is after front vowels. Yet, for the final /l/ following a back vowel, two adaptation strategies, retroflexion and deletion, are found to co-exist. For example, *polka* is borrowed both as *bo.er.ka* [pwo.ɤ.k<sup>h</sup>a] and *bo.ka* [pwo.k<sup>h</sup>a].

**5.2.1.5 Adaptation of Retroflex Coda Approximant /ɹ/.** If the source of the loanword is from North American English or Irish English, in words such as *start*, many speakers have r-colouring in the coda of the vowel. Such vowels are called an r-coloured or rhotic vowel (also called a “retroflex

vowel”, “vocalic *r*”, or “a rhotacised vowel”). In North American English, they are found in words such as *butter*, *nurse* and, for some speakers, *start*.

In Mandarin, especially in the north of China, there is also a rhotacised ending attached to some words, which is the prime way to distinguish speakers of standard northern Mandarin (Beijing Mandarin) and southwestern Mandarin from speakers of other forms of Mandarin in China.

Mandarin speakers call this phenomenon *erhua*, meaning “adding *er*”. For example, when saying *mei.men* [mei.mən], lit. ‘no door’, meaning “No way”, northern Mandarin speakers will say [mei.mə̃] while southern Mandarin speakers will just say [mei.mən]. In many words, the *-r* suffix occurs as a diminutive marker of nouns. For example, *hua.er* [xwa.ə̃], lit. ‘flower little’, meaning “little flower”.

Beside the suffix *-r*, Mandarin also has a separate syllable /ə̃/, which is phonetically a retroflex back unrounded vowel, usually written with the IPA form /ɤ̃/, also termed “rhotacized final” or “a retroflex central vowel” (Norman, 1988; Ramsey, 1987). When [ə̃] appears as a separate syllable, it is sometimes pronounced as a diphthong [aə̃]. In Mandarin, the separate syllable [ə̃] only occurs in four cases: *er*2 [ə̃ 2] ‘son’; *er*3 [ə̃ 3] ‘ear’; *er*3 [ə̃ 3] ‘you’; *er*4 [ə̃ 4] ‘two’. One important difference between the suffix *-r* /ə̃/ and the syllable *er* /ə̃/ is that the suffix *-r* is pronounced with a neutral tone and a short duration while the syllable /ə̃/ can bear tones and is produced much longer.

Since English and Mandarin have very similar rhotic coda, coda /ə̃/ is expected to be perceived and retained in Mandarin and be changed to a Mandarin isolate syllable /ə̃/. Note that the coda /l/ and /ə̃/ are not repaired by the strategy of vowel epenthesis, which indicates that they are phonetically perceived not as a consonant, but as a vowel by Mandarin speakers.

## Table 67

*Different Adaptation Strategies for the Adaptation of Coda [ə̃]*



Rhotic Coda Adapted into Isolate /ə/	Rhotic Coda Adapted to Ø
<i>Darwin</i> ['daəwɪn] > <i>da.er.wen</i> [ta.ə.wən]	<i>car</i> [kaə] > <i>ka</i> [k <sup>h</sup> a]
<i>hormone</i> ['hɔəmon] > <i>he.er.meng</i> [xɤ.ə.məŋ]	<i>card</i> [kaəd] > <i>ka</i> [k <sup>h</sup> a]
<i>bourgeois</i> [buə'ʒwa] > <i>bu.er.qiao.ya</i> [pu.ə.tɕ <sup>h</sup> jaʊ.ja]	<i>carbine</i> [kaəbɪn] > <i>ka.bin</i> [k <sup>h</sup> a.pɪn]
<i>formalin</i> [fɔəmalɪn] > <i>fu.er.ma.lin</i> [fu.ə.ma.lɪn]	<i>carnation</i> [kaəneɪʃən] > <i>kang.nai.xin</i> [k <sup>h</sup> aŋ.nai.ɕɪn]
<i>Morse</i> [mɔəs] > <i>mo.er.si</i> [mwo.ə.sɪ]	<i>cartoon</i> [kaə tun] > <i>ka.tong</i> [k <sup>h</sup> a.t <sup>h</sup> oŋ]
	<i>birdie</i> [bɜdi] > <i>bo.di</i> [pwo.ti]
	<i>encore</i> [aŋ.kɔə] > <i>an.ke</i> [an.k <sup>h</sup> ɤ]
	<i>mark</i> [maə k] > <i>ma.ke</i> [ma.k <sup>h</sup> ɤ]
	<i>morphine</i> [mɔə.fin] > <i>ma.fei</i> [ma.fei]
	<i>motor</i> [məʊ.tə] > <i>mo.tuo</i> [mwo.t <sup>h</sup> wo]
	<i>martini</i> [maə.ti.ni] > <i>ma.ti.ni</i> [ma.t <sup>h</sup> i.ni]
	<i>park</i> [paək] > <i>pa</i> [p <sup>h</sup> a]
	<i>parkour</i> [paəkoə] > <i>pao.ku</i> [p <sup>h</sup> au.k <sup>h</sup> u]
	<i>partner</i> [paətnə] > <i>pai.dang</i> [p <sup>h</sup> ai.taŋ]
	<i>party</i> [paəti] > <i>pa.ti</i> [p <sup>h</sup> a.t <sup>h</sup> i]
	<i>shark</i> [ʃaək] > <i>sha</i> [tʃa]
	<i>shirt</i> [ʃɜt] > <i>xu</i> [ɕɤ]
	<i>smart</i> [smaət] > <i>shi.mao</i> [ʃɿ.mau]
	<i>tart</i> [taət] > <i>ta</i> [t <sup>h</sup> a]
	<i>tyre</i> [taiə] > <i>tai</i> [t <sup>h</sup> ai]
	<i>wafer</i> [weɪfə] > <i>hua.fu</i> [xwa.fu]
	<i>yogurt</i> [jəʊgət] > <i>you.ge</i> [jou.kɤ]

*Note.* Based on the findings in this study

As can be seen from the data, the rate of deletion of coda [ə] is higher than the retainment of the coda [ə], which may result from Mandarin speakers' experience with different English varieties. British English was the dominant English variety taught in China up to the early 1990s. But after that, American English takes a more dominant role in the English teaching syllabus in China. As coda [ə] is not pronounced in British English, there is no need to discuss the adaptation strategy of the rhoticised [ə]. If it is pronounced in American English, a similar adaptation strategy is found compared to coda /l/, that is, deletion is rare while maintaining is dominant. The difference is that

when /l/ is after an obstruent consonant in a complex coda, for example, *Beatles* > pi.tou.shi [p<sup>h</sup>i.təʊ.ʃ], it is adapted to a back vowel. After being vocalised, the CL pattern becomes CV, which conforms to the universally least-marked syllable structure (Yavas, 1994). But for coda [ə], it is always adapted to the Mandarin retroflex syllable [ə].

### 5.3 An OT Analysis on the Variable Adaptation Phenomena in Mandarin Loanwords

#### 5.3.1 An Introduction of Optimality Theory (OT)

Optimality Theory (Prince & Smolensky, 1993; Archangeli & Langendoen, 1997) is a general model of how grammars are structured. In the theory, the grammar of languages consists of a set of ranked violable well-formedness constraints. The surface forms of language reflect resolutions of conflicts between competing constraints. While the constraints are universal, the ranking of constraints is language-specific. In its classical form, the grammar is composed of three components: Gen (Generator); Eval (Evaluation); and Con (Constraint) (Prince & Smolensky, 1993). OT mainly deals with the correspondence between input and output. Given an input, the Gen function will generate a set of possible candidates, based on the universal well-formedness constraints. Then this candidate set is submitted to another the Eval function. Eval, composed of a language-specific ranking of constraints, evaluates all the possible candidates generated by Gen in parallel and selects one which best satisfies or minimally violates the ranking as the optimal output. Assume that the ranking of constraints consists of the constraints C1, C2, and C3, which are in the order of C1>>C2>>C3. If Candidate 1 and Candidate 2 violates top-ranked C1 while Candidate 3 does not violate it, then Candidate 3 is optimal. If, conversely, Candidate 3 violates C1, then Candidate 3 is out of the running. The optimal output will be between Candidate 1 and Candidate 2 and the winner will be the one that does not violate C2. The constraints are arranged in strict-domination hierarchies. The violation of higher-ranking constraints is more fatal than the violation of lower-ranking constraints.

The lower-ranked constraint can be violated to satisfy a dominant constraint to avoid the fatal violation.

The notion of minimal violation or best satisfaction needs to be defined in terms of this ranking. The following two tableaux have the following convention: (1) The domination order of constraints is shown in left-to-right order; (2) Violation of a constraint is marked by \* while satisfaction is indicated by a blank cell; (3) The sign ! signifies a fatal violation, the one that is responsible for a candidate's non-optimality, whereas the symbol  $\mathbb{P}$  indicates the optimal output; (4) Shading emphasises the irrelevance of the constraint to the fate of the non-optimal candidate.

Tableau 1 represents one situation of minimal violation.

**Tableau 1**

Input	Constraint 1	Constraint 2	Constraint 3
$\mathbb{P}$ Candidate 1			*
Candidate 2		*!	
Candidate 3	*!		

As Tableau 1 shows, Constraint 1 is ranked higher than Constraint 2, followed by Constraint 3. The violation of higher-ranked constraints is fatal. Thus, though all the candidates violate only one constraint respectively, Candidates 2 and 3 are eliminated since they violate higher-ranked constraints. Candidate 1 violates the lower-ranked constraint thus, with the minimal penalty, is selected as the optimal output. This illustrates a key characteristic of OT: A simple violation of a constraint is never in itself fatal. While constraints are in conflict, if the higher-ranked constraint is violated, it is fatal; if a lower-ranked constraint is violated, the candidate may satisfy a dominant constraint and avoid the fatal violation.

There is another situation of minimal violation. If Candidates 1 and 2 both violate Constraint 1 equally, and if they violate Constraint 1 less than Candidate 3 does, then Candidate 3 is out of the running and the choice between Candidate 1 and Candidate 2 goes to Constraint 2.

**Tableau 2**

Input	Constraint 1	Constraint 2	Constraint 3
Candidate 1	*		*
Candidate 2	*	*	
Candidate 3	**		

This illustrates another feature of OT: “Violation is only fatal while there are other competing candidates that pass the constraint” (McCarthy & Prince, 1993, p. 7).

In sum, no specific rules are needed within the framework of OT since “the candidate analyses, evaluated by the constraint hierarchy, are admitted by very general considerations of structural well formedness” (McCarthy & Price, 1993, p. 5). No derivational processes are proposed since the best satisfaction of the candidate set is computed in parallel.

The forces or constraints can be divided into two basic groups: Markedness and Faithfulness. Markedness constraints state that unmarked structures are universally favoured over marked structures. For example, an open syllable is favoured over a closed syllable (No-CODA); only some types of consonants can serve as the coda in many languages (Coda CONDITION); a voiceless obstruent is favoured over a voiced obstruent (Voiced Obstruent PROHIBITION (VOP)), and so on. Each faithfulness constraint states that the output must preserve the properties of the input, which can be defined in terms of features, segments, or prosodic structures. For example, the output segment must have the same value for the feature [voice] as the input segment (IDENT-IO (voice)); segments in the output must have correspondents in the input (Dep-IO); and the output must have the same linear order of the segments as the input (Linearity-IO). Faithfulness to the input can be understood as pressure to preserve lexical contrasts.

OT analysis has advantages over a rule-based theory. In a standard, traditional theory concerning loanword adaptation, several rules of insertion and deletion are framed to account for

how the English syllable initial or syllable final consonant clusters are modified to comply with Mandarin syllable structures, such as inserting [i] between syllable initial [s] and stops or nasals, [o] or [i] between a consonant + liquid, and deleting postvocalic [ɹ] or word final consonants (Chang, 1996, p. 18).

The first problem this rule-based analysis encounters is: Where do the rules of epenthesis and deletion originate? In terms of Standard Theory, these rules should exist in Mandarin or be imported from English. However, native Mandarin forms provide no evidence for underlying representations with consonant clusters and illicit codas, so there are no alternations providing evidence for a rule to epenthesise vowels after each consonant of consonant clusters or illicit codas. These so-called rules do not originate from Mandarin and English, and thus there is room for doubt about the status of these rules. It can be seen from the constraints active in Mandarin native phonology that there are no constraints concerning consonant clusters or illicit codas. The constraints active in Mandarin phonology are:

- a) USE-LISTED-SYLLABLE: a syllable in the adapted loanword must have a precedent in the native inventory.
- b) DEP-coda: no insertions of coda.
- c) IDENT-cont: the manner feature [continuancy] of an output segment is identical to that of the input.
- d) IDENT-lab: the place feature [labial] of an output segment is identical to that of the input.
- e) IDENT-lat: the place feature [lateral] of an output segment is identical to that of the input.
- f) IDENT-asp: the aspiration of an output segment is identical to that of the input.
- g) IDENT-nas: the manner feature [nasal] of an output segment is identical to that of the input.
- h) IDENT-voicing: the voicing of an output segment is identical to that of the input.
- i) IDENT-Vft: the frontness of the input vowel is identical to that of the output vowel.

The second problem is that some rules cannot apply to all the members of identical context in the database. As Mandarin can have only nasal [n] and [ŋ] in the syllable final position, the rule for the syllable final [l] in English would be the deletion of [l] or to repair the illicit coda by epenthesis. In the rule-based perspective, a rule of the syllable final [l] deletion or epenthesis would be proposed. This rule, however, fails to explain why in some other cases, the syllable final [l] can be deleted or can be changed into a retroflex [ʈ].

### ***5.3.2 A Constraint-based Analysis of Mandarin Loanword Phonology***

OT analysis of language mainly focuses on the surface or output structure. The focus on surface forms or outputs makes OT well suited to the description of loanword phonology. The loan language (Mandarin) may introduce underlying representations that are not motivated by itself. But since all the underlying representations will ultimately be forced to conform to the surface constraints in the loan language, the foreign underlying forms (English) will come out looking like the surface forms of the loan language (Mandarin). By means of inspecting the loanword outputs, the constraints and their dominancy or ranking in Mandarin can be worked out.

This section will form the set of constraints that are active and arrange the constraints in the hierarchy in Mandarin loanword phonology. By applying this constraint hierarchy to loanword adaptation phenomena, the seemingly chaotic outputs can reflect a predictable pattern.

**5.3.2.1 On the Licit Consonants.** Licit consonants refer to the consonants which have the same phonological counterpart in Mandarin, and which appear in a licit position according to Mandarin phonology. We will first look at the onset approximant [ɹ].

A licit consonant may get adapted because the syllable where it occurs simply cannot surface. Consider the examples where English onset [ɹ] surfaces as [l] or [ʈ]. As discussed in Section 4.5.1.2, the *r* sound in Mandarin is a controversial issue, and the mainstream view treats it as a

fricative rather than an approximant. In this thesis, the /ɹ/ sound is supposed to be represented by two allophones [ʐ] and [ɻ] and is perceptually similar to English approximant /ɹ/.

We find that English [ɹ] is followed by [eɪ], [ɛ], [ʌ], [aɪ], [i], [əʊ] as in *radar*, *reggae*, *rum*, *rifle*, and *romantic* in the corpus. If we further assume that the acoustic signals of these vowels most closely approximate Mandarin [ei], [ɛ], [a], [ai], [i], [əʊ] respectively, the syllables in question will be represented as [ɹei], [ɹɛ], [ɹa], [ɹai], [ɹi], [ɹəʊ]. Because syllables [ɹɛ], [ɹa], [ɹai], [ɹi] cannot surface, the easiest way for Mandarin to fix them seems to be to turn the onset [ɹ] into [l], meaning that only the value for [lateral] changes. Thus, a constraint of the Mandarin phonology is proposed:

USE-LISTED-SYLLABLE: a syllable in the adapted loanword must have a precedent in the native inventory.

This constraint should be in a higher rank than IDENT-IO, which will allow the featural change of the licit consonants to be adapted. The example of the adaptation of *rally* is represented in Tableau 3.

**Tableau 3**

ɹæli	MAX-IO	USE-LISTED-SYLLABLE	IDENT-IO
a. ɹa.li		*ɹ	
b. la.li			*

Syllables [ɹei] and [ɹəʊ] can surface in Mandarin. But we still find the onset [ɹ] changed into Mandarin [l] in the adaptation of *radar* and *romantic*. I argue that for *radar*, it is because the syllable [ɹei] in Mandarin corresponds to characters that are in much less frequent use than the character corresponding [lei]. Besides the character 雷 [lei] has the meaning “thunder”. It is possible that when *radar* was borrowed, it referred to the radar used for weather forecasting. Therefore, the syllable [lei] has a semantic connection with the original word. As for the case of *romantic*, it is borrowed as *luo.man.ti.ke* [lwo.man.ti.kɤ] 罗曼蒂克 instead of *rou.man.ti.ke* [ɹou.man.ti.kɤ] 柔曼蒂克. I argue that *romantic* has the same root with *romance* and *Rome* and its adaptation is influenced

by the adaptation of *Rome*, which is *luo.ma* [lwo.ma] 罗马 in Mandarin. The adaptation of place names and person names are guided by the transliteration regulation, in which the pronunciations are based on its original language. The *r* sound in romance language is a trill and more similar to Mandarin [l].

In this corpus, there are some other cases where the licit consonants are adapted with some feature changes. The main principle in loanword adaptation is to keep the output as close to the input as possible. Therefore, it seems unnecessary to change the licit consonants in the adaptation. It is observed that there are only a few types of feature change, which are listed in Table 68.

**Table 68**

*Adaptation Containing Feature Changes*

Type	Example
coronal → dorsal (nasals)	<i>salon</i> [səlan] > <i>sa.long</i> [sa.loŋ]
dorsal → coronal (nasals)	<i>dumping</i> [dʌmpɪŋ] > <i>tan.pin</i> [tʰan.pʰin]
[-retroflex] → [+retroflex]	<i>sardine</i> [sadin] > <i>sha.ding</i> [ʂa.tiŋ]
[+spread gl] → [-spread gl]	<i>pest</i> [pʰest] > <i>bai.si.du</i> [pai.sɿ.tu]
[-lateral] → [+lateral]	<i>rally</i> [ɹæli] > <i>la.li</i> [la.li]

*Note.* Based on the findings in this study

There seems to be a limit in terms of how different the output can be from the input. A question about why only these types of feature changes are tolerated might be raised. Given that loanword adaptation is minimal, it seems like some types of feature changes make more difference in perception than others. For example, we never find feature changes such as [-continuant] <-> [-continuant] occurring. In this thesis, it is argued that the deviant cases occur mainly because the faithfully adapted syllable has no surface in Mandarin syllable inventory. Therefore, one feature has to be changed to achieve a syllable which can surface.



**5.3.2.2 On the Illicit Consonants.** As opposed to the licit consonants, the illicit consonants refer to consonants which cannot find a counterpart in Mandarin, and which can cause ill-formed syllables in Mandarin. For example, English /θ/ is an illicit consonant as Mandarin does not have an interdental fricative. For such consonants, the native Mandarin phonological constraints IDENT will evaluate the output.

Take the adaptation of onset /θ/ as example. /θ/ has the following features: [+consonantal], [+coronal], [+anterior], and [+continuant]. Under the IDENT constraints, the more the features are obtained, the better the candidate. It is also possible that more than one candidate consonant can be the winner of the adaptation process as the features may be ranked in the same level. Thus, violating the same number of the IDENT constraints can bring about the equally optimal candidate. [t] only violates the feature [+continuant]; [f] only violates the feature [+coronal] but has an additional feature [+strident]; [s] does not violate any feature but also has an additional feature [+strident]. In this corpus, though the cases with onset /θ/ are not many, the majority of them are adapted to dental stops. It might indicate that the constraint IDENT-CONTINUANT is ranked low compared to other IDENT constraints. As [t] does not have any additional features, it might mean that the constraint DEP should rank higher than or parallel to the IDENT constraints. Take the adaptation of *ether* as an example, as shown in Tableau 4:

**Tableau 4**

iθə	MAX(F)	USE-LISTED-SYLLABLE	DEP(F)	IDENT-cont
a. i.tai				*
b. i.tə		*		*
c. i.sə		*	*	
d. i.fə	*!	*	*	

Test the constraint ranking:

MAX(F)>> USE-LISTED-SYLLABLE>> DEP(F)

MAX(F)>> USE-LISTED-SYLLABLE>> IDENT-stri, IDENT-voicing, IDENT-cont in the adaptation of onset consonant /ʃ/:

**Tableau 5**

ʃəʊ	MAX(F)	USE-LISTED-SYLLABLE	DEP(F)	IDEN(F)
a. ʃjəʊ				
b. ɕəʊ		*		
c. səʊ	*		*	*
d. ʒəʊ			*	*

The winning candidate conforms to the loanword output: *show* [ʃəʊ] is adapted to *xiu* [ɕjəʊ] in Mandarin.

**5.3.2.3 On the Illicit Syllable Structures.** The “Basic Syllable Structure Constraints”, as proposed by Prince and Smolensky (1993, pp. 85-88), describe the universally unmarked characteristics of syllable structures. The CV-combination is the most unmarked syllable structure. Based on the CV structure, Prince and Smolensky set constraints for a preferred unmarked syllable structure universally:

- a. ONSET: Syllables must have onsets.
- b. NOCODA: Syllables must not have a coda.
- c. Nuc (nucleus): Syllables must have nuclei.
- d. \*COMPLEX (no complex): No consonant cluster is allowed within a syllable.

Since Mandarin does allow codas but the codas are highly restricted to be [ŋ] or [ŋ], the constraint NOCODA may be refined as CODACON:

CODACON: Syllables must have no coda, except an alveolar or velar nasal

Furthermore, the basis of OT is consistency, that is, there must exist a one-to-one correspondence between the input and output (McCarthy & Prince, 1995b). Any mismatch between the input and output will violate MAX-IO or DEP-IO, which are referred to as a FAITHFULNESS constraint family:

- a. MAX-IO (maximum-input/output, first version): Every segment in the input must have a correspondent in the output.
- b. DEP-IO (dependent-input/output): Every segment in the output must have a correspondent in the input.

DEP-IO requires no insertion since any inserted segment in the output cannot have a correspondent in the input; MAX-IO, on the other hand, craves no deletion since any deleted segment in the output will lead to some segments in the input having no correspondent in the output.

In general, the markedness constraints dominate the faithfulness constraints ( $M \gg F$ ), resulting in changes to the marked structure in the input. For example, it is worse to have a syllable with a consonant cluster than it is to insert a new segment into the output, which leads to the winning output candidate having epenthesis rather than the candidate having deletion. That is, to satisfy the constraint \*COMPLEX, DEP-IO rather than MAX-IO will be violated in Mandarin. This means that \*COMPLEX is ranked higher than MAX-IO followed by DEP-IO (\*COMPLEX  $\gg$  MAX-IO  $\gg$  DEP-IO). If DEP-IO is ranked higher than MAX-IO, deletion of segments will be prevalent, which contradicts the facts found in Mandarin loanwords. One example with onset consonant cluster is demonstrated in Tableau 6.

**Tableau 6**

srukə	*CC	MAX-IO	DEP-IO
a. sruk <sup>h</sup>	*!		
b. ru.k <sup>h</sup>		*	

英 C. sɪ.nu.k <sup>h</sup> ʅ			*
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The ranking among CODACON, MAX-IO, and DEP-IO is also crucial. To shun the illicit coda except liquid codas, the strategy of insertion is also preferred, implying that CODACON is more dominant than MAX-IO, followed by DEP-IO (CODACON >> MAX-IO >> DEP-IO). The interaction among these constraints is demonstrated in Tableau 7.

**Tableau 7**

ɤŋk	CODACON	MAX-IO	DEP-IO
a. ɤŋk	*!		
b. ɤŋ		*	
英 C. ɤŋ.kʅ			*

The ranking between \*COMPLEX and CODACON is not crucial in determining the optimal candidate. It means that there is no interaction between these two constraints here. The ranking can be sketched in the following schema:

\*COMPLEX, CODACON >> MAX-IO >> DEP-IO

The ONSET constraint has a much lower status than the discussed constraints as there are abundant forms with no onsets in Mandarin native forms. Mandarin vowels /i/, /y/, /u/, /ə/ and /A/ can be syllable onsets in Mandarin native words. The words are limited to [i], [u], [ʏ], [A], [in], [in], [yn], [un], [ən], [an], [aŋ], and [ə-]. To maintain faithfulness, the constraint ONSET can be violated as it is ranked below MAX-IO and DEP-IO (MAX-IO >> DEP-IO >> ONSET).

Most of the loanwords with no onset are faithfully adapted to onsetless Mandarin words; the counterpart examples are extremely rare, for which cases, ONSET is more dominant than DEP-IO. The example in Tableaux 8 and 9 shows that the constraint ONSET can be either obeyed or violated in the adaptation of a loanword with no onset: the adaptation of *Acrylic* [ə.kɪ.lɪk] to both *a.ke.li* [a.k<sup>h</sup>ʅ.li] and *ya.ke.li* [ja.k<sup>h</sup>ʅ.li].

Tableau 8

ə.kʊi.lɪk	MAX-IO	DEP-IO	ONSET
a. a.k <sup>h</sup> ʏ.li			*
b. ja.k <sup>h</sup> ʏ.li		*	

Tableau 9

ə.kʊi.lɪk	MAX-IO	ONSET	DEP-IO
a. a.k <sup>h</sup> ʏ.li		*	
b. ja.k <sup>h</sup> ʏ.li			*

Similarly, the Greek God's name *Athena* is adapted as both *a.xi.na* and *ya.dian.na*. Among the two versions, *ya.dian.na* is the more established version. In the corpus, the two cases (*Acrylic* and *Athena*) are the only cases where two versions of adaptation outcomes are found. The majority of cases with no onset obey the faithfulness ranking: DEP-IO >> ONSET. Therefore, it is reasonable to say that the ranking of DEP-IO is generally more dominant than ONSET in Mandarin native forms and loanwords but the interfering factors would cause some constraint ranking "to be in flux" in loanword phonology (Broselow et al., 1997, p. 23) Thus, although counterpart examples to MAX-IO >> DEP-IO >> ONSET exist, the general constraint ranking can be summarised as:

\*COMPLEX, CODACON >> MAX-IO >> DEP-IO >> ONSET

The onset clusters and the coda clusters are generally adapted by epenthesis and the epenthetic vowels can be variant. Lin (1992) observes the following three types of epenthetic vowels in Mandarin loanword adaptation: the apical vowel [ɿ]; the rounded vowel [u]; and the mid back vowel [ɤ]. Which vowel to be inserted is dependent on the preceding consonant. According to Lin (1992), the epenthetic nucleus is realised as [ɿ] through coronal assimilation if preceded by a coronal sibilant, as [u] through labial assimilation if preceded by a labial consonant, and as [ɤ] by a default rule if preceded by another non-labial consonant.

Another markedness constraint that conflicts with the faithfulness constraints is called the “Nucleus-coda harmony”, which is an important phonological rule in Mandarin native words:

(a) The nucleus and the coda must agree in frontness.

(b) The nucleus and the coda must agree in rounding. (Duanmu, 2007)

This constraint is accountable for the adaptation of vowel + nasal codas. For example:

**Tableau 10**

kləun	*COMPLEX	Nucleus-coda Harmony	DEP
a. kləun	*!		
b. kə.lon		*	*
c. kə.lɔŋ			*

Words with back vowel + alveolar nasal are generally adapted to back vowel + velar nasal as the nucleus and the coda must agree in frontness. Words with front vowel + velar nasal are generally adapted to front vowel + alveolar nasal.

As the data shows, vowel epenthesis is preferred to consonant deletion as a strategy to repair ill-formed syllable structures. So far, the constraint ranking can be summarised as:

\*COMPLEX, CODACON >> Nucleus-coda Harmony >> MAX-IO >> DEP-IO >> ONSET

The interaction explains most cases about how the English consonant clusters and codas are modified or repaired in Mandarin. Yet the adaptation of liquids is still left unsolved, as its adaptation violates the ranking in some cases, which will be dealt in the next section.

**5.3.2.4 On the Coda Liquids.** Liquids, if any, are obligatorily adjacent to the nuclear vowel, either prevocalic or postvocalic, under the principle of the Sonority Sequence Principle (SSP). In English, liquids appear as a simplex onset (e.g., *lay* [leɪ], *ray* [ɹeɪ]), as the second onset (e.g., *play* [p<sup>h</sup>leɪ], *pray* [p<sup>h</sup>ɹeɪ]), or as the third onset (e.g., *splash* [splæʃ], *spray* [sp<sup>h</sup>ɹeɪ]). In the coda position, the liquid can be a simplex coda (e.g., *call* [kəl], *car* [kɑɹ]), or the first consonant in a complex coda

(e.g., *cult* [kʌlt], *cart* [kʌt]). English /l/ can also follow an obstruent and act as a syllabic nucleus (e.g., *model* [mɒdɫ]). In Mandarin, the /l/ and /ɹ/ sounds can only appear in the onset. They can be a simplex onset (e.g., *lan* [lan], *ran* [ɹan]), or they can be followed by a labial glide [w] (e.g., *luan* [lwan], *ruan* [ɹwan]). In addition, the retroflex /ʂ/ can be a simple coda after a vowel, only with limited distribution.

The adaptation of coda liquids shows a different pattern from most of the words in the data. For example, the liquid /l/ and /ɹ/ as a simplex coda is repaired by either deletion, or is changed to Mandarin retroflex /ʂ/, or is changed to a vowel (only applied to /l/), but not by epenthesis. (Such cases are very rare, such as *Paul* [pɔl] > *bao.luo* [pau.lwo], *Yule* [jul] > *yo.li* [jou.li]. As they are person's names, they are not included in this corpus.)

**Table 69**

*Different Adaptation Patterns of Coda Liquid /l/*

	Deletion	Adapted to Retroflex Syllable [ʂ]	Adapted to a Vowel
One syllable	<i>cool</i> [kul] >	<i>bel</i> [bɛl] > <i>bei.er</i> [pei.ə]	
word with	<i>ku</i> [k <sup>h</sup> u]	<i>mile</i> [mail] > <i>mai.er</i> [mai.ə]	
simplex coda /l/		<i>joule</i> [dʒul] > <i>jiao.er</i> [tɕjao.ə]	
		<i>Wall (Street)</i> [wɔl] > <i>hua.er</i> [xwa.ə]	
One syllable	<i>volt</i> [vɒlt] >	<i>golf</i> [gɒlf] > <i>gao.er.fu</i> [kao.ə.fu]	
word with	<i>fu.te</i> [fu.t <sup>h</sup> ɥ]	<i>waltz</i> [wɒlts] > <i>hua.er.zi</i> [xwa.ə.tsɿ]	
complex coda [l]			
+ consonant			
Two (or more)		<i>polka</i> [pɒlka] > <i>bo.er.ka</i> [pwo.ə.k <sup>h</sup> ə]	
syllable word		<i>modal</i> [mɒdal] > <i>mo.dai.er</i> [mwo.tai.ə]	
with /l/ as		<i>Email</i> [imeil] > <i>yi.mei.er</i> [i.mei.ə]	
simplex coda		<i>angel</i> [eindʒəl] > <i>an.qi.er</i> [an.tɕ <sup>h</sup> i.ə]	

	<i>Nobel</i> [nəʊbəl] > <i>nuo.bei.er</i> [nwo.pei.ə] <i>alpha</i> [alfa] > <i>a.er.fa</i> [a.ə.fa] <i>internationale</i> [intə'næʃnal] > <i>ying.te.nai.xiong.na.er</i> [jiŋ.t <sup>h</sup> ɣ.nai. ɕjoŋ.na.ə]
Two (or more)	<i>waffle</i> [wɒfl] > <i>hua.fu</i> [xwa.fu]
syllable word	<i>title</i> [taɪtl] > <i>tai.tou</i> [t <sup>h</sup> ai.t <sup>h</sup> ou]
with complex	<i>rifle</i> [ɹaɪfl] > <i>lai.fu</i> [lai.fu]
coda consonant	<i>idol</i> [aɪdl] > <i>ai.dou</i> [ai.tou]
+ [l]	<i>bagel</i> [bægl] > <i>bei.guo</i> [pei.kwo] <i>barbital</i> [bəbitl] > <i>ba.bi.tuo</i> [pa.pi.t <sup>h</sup> wo] <i>TOEFL</i> [təʊfl] > <i>tuo.fu</i> [t <sup>h</sup> wo.fu]

*Note.* Based on the findings in this study

The adaptation pattern for the liquid /l/ can be summarised as below. First, in most of the cases, the illicit liquid coda is not deleted. Second, when the liquid appears as a simplex coda, it is almost always adapted into the retroflex syllable [ə]. Third, when the liquid appears as the first element in a complex coda consonant +/l/, it is adapted into a vowel and becomes a nucleus and forms a new syllable with the precedent consonant.

**Table 70**

*Different Adaptation Patterns of Coda Liquid /l/*

	Deletion	Adapted to Retroflex Syllable [ə]
One syllable	<i>car</i> [kɑə] > <i>ka</i> [k <sup>h</sup> ɑ]	
word with	<i>tyre</i> [taɪə] > <i>tai</i> [t <sup>h</sup> ai]	
simplex coda		
/l/		
One syllable	<i>card</i> [kɑəd] > <i>ka</i> [k <sup>h</sup> ɑ]	<i>morse</i> [mɔəs] > <i>mo.er.si</i> [mwo.ə.sɪ]
word with	<i>shark</i> [ʃɑək] > <i>sha</i> [tʃɑ]	
complex coda	<i>tart</i> [tɑət] > <i>ta</i> [t <sup>h</sup> ɑ]	
[ɹ] +	<i>mark</i> [mɑək] > <i>ma.ke</i> [ma.k <sup>h</sup> ɣ]	
consonant	<i>park</i> [pɑək] > <i>pa</i> [p <sup>h</sup> ɑ]	



	<i>shirt</i> [ʃət] > <i>xu</i> [ɕy]	
	<i>smart</i> [smaət] > <i>shi.mao</i> [ʃ].mau]	
Two (or more)	<i>encore</i> [aŋ.kə] > <i>an.ke</i> [an.k <sup>h</sup> ɿ]	<i>Darwin</i> [ˈdaəwin] > <i>da.er.wen</i> [ta.ə.wən]
syllable word	<i>wafer</i> [weifə] > <i>hua.fu</i> [xwa.fu]	<i>hormone</i> [ˈhɔəmon] > <i>he.er.meng</i> [xɿ.ə.məŋ]
with /ɹ/ as	<i>carbine</i> [kaəbin] > <i>ka.bin</i> [k <sup>h</sup> a.pin]	<i>bourgeois</i> [buəˈʒwa] > <i>bu.er.qiao.ya</i> [pu.ə.tɕ <sup>h</sup> jaɯ.ja]
simplex coda	<i>carnation</i> [kaəneɪʃən] > <i>kang.nai.xin</i> [k <sup>h</sup> aŋ.nai.ɕin]	<i>formalin</i> [fɔəmaɪlɪn] > <i>fu.er.ma.lin</i> [fu.ə.ma.lin]
	<i>morphine</i> [mɔə.ɸin] > <i>ma.fei</i> [ma.fei]	
	<i>motor</i> [məʊ.tə] > <i>mo.tuo</i> [mwo.t <sup>h</sup> wo]	
	<i>martini</i> [maə.ti.ni] > <i>ma.ti.ni</i> [ma.t <sup>h</sup> i.ni]	
	<i>parkour</i> [paəkoə] > <i>pao.ku</i> [p <sup>h</sup> au.k <sup>h</sup> u]	
	<i>partner</i> [paətənə] > <i>pai.dang</i> [p <sup>h</sup> ai.taŋ]	
	<i>party</i> [paəti] > <i>pa.ti</i> [p <sup>h</sup> a.t <sup>h</sup> i]	
Two (or more)	<i>yogurt</i> [jəʊgət] > <i>you.ge</i> [jou.kɿ]	
syllable word		
with complex		
coda [ɹ]		
+consonant		

*Note.* Based on the findings in this study

If the constraint ranking above (\*COMPLEX, CODACON >> Nucleus-coda Harmony >> MAX-IO >> DEP-IO >> ONSET) is used in the adaptation of liquid coda, coda /l/ would be predicted to be preserved and vowel epenthesis will be adopted to obey the highest ranked constraint. Yet, in the database, the majority of coda /l/ is either changed to a vowel or to retroflex vowel [ɻ], which indicates that rather than epenthesis, feature changes can also be employed to repair the illicit forms. As liquid codas are vowel-like, their distinctive features are similar to those of vowels. Liquid codas prefer feature changes to epenthesis in the adaptation. Thus, another constraint IDENT (F) (feature identity) (where the distinctive features of two corresponding segments must be identical) is violated to satisfy the higher ranked faithfulness constraints.

IDENT(F) should be placed at a lower rank than DEP-IO. Candidates that use epenthesis will violate DEP-IO and not be the winner, as Tableau 11 shows.

#### Tableau 11

Input: mail	CODACON	MAX-IO	DEP-IO	IDENT(F)
a. mail	*			
b. mai.ly			*	
c. mai		*		
d. mai.ə				*

In the adaptation of coda approximant [l], featural change and epenthesis are both employed to repair the illicit syllable structure. While in the adaptation of liquid [ɹ], deletion is the preferred strategy. The constraint ranking proposed as \*COMPLEX, CODACON >> Nucleus-coda Harmony >>MAX-IO>> DEP-IO >> ONSET predicts that liquid coda would be parsed everywhere. It is argued that the deletion of coda [ɹ] may be due to its lack of salience. The study sides with Yip to regard that the unsalient segments would be “faintly visible, and thus may be overlooked” (1993, p. 278) by MAX-IO constraint. A final statement of MAX-IO is given, with slight modification:

MAX-IO: every salient segment of the input has a correspondent in the output.

Under this revised MAX-IO constraint, the unsalient segments tend to be overlooked and deleted, but would sometimes be parsed. Just as Table 70 shows the adaptation of coda liquid [ɹ], it is deleted most of the time. It is regarded as unsalient though it is an approximant. It is very possible that the original form is from a variety of English without the rhotic sound.

When the coda liquid is converted into [ə], it violates another constraint IDENT(F). Featural changes cause the violation of IDENT(F) but not the violation of DEP-IO, suggesting that DEP-IO is more dominant than IDENT(F), as illustrated in Tableau 12.

**Tableau 12**

Input: imetl	CODACON	MAX-IO	DEP-IO	IDENT(F)
a. i.mei.ə				*
b. i.meil	*!			
c. i.mei.ly			*!	
d. i.mei		*!		

**5.3.2.5 On One Syllable Words.** If the original word is a monosyllabic word with no coda, it will be adapted to a one syllable word in Mandarin as it does not violate any phonotactic constraints, for example, *fee* [fi] > *fei* [fei]. But if the original word has a coda, whether the coda is simplex or complex, it is observed that even if the coda is unsalient obstruents (which is considered to be unsalient segments), it is modified by epenthesis. For example, *jeep* [dʒip] > *ji.pu* [tʃi.p<sup>h</sup>u]. What is the motivation for parsing the unsalient segment? A universal constraint can answer this question.

MINWD: A lexical word must be disyllabic minimally.

It is the effect of MINWD that triggers the unsalient segments to be parsed, implying that MINWD dominates MAX-IO. Such adaptation can be found in *mug*, *shock*, *short*, etc. The adaptation of *jeep* will be used to illustrate the ranking of MAX-IO and MINWD in Tableau 13.

**Tableau 13**

dʒip	CODACON	MINWD	MAX-IO	DEP-IO
a. ji.pu				*
b. jip	*!	*		
c. ji		*!	*	

Up to now, the ranking of constraints in loanword adaptation will be listed as:

\*COMPLEX, CODACON >> Nucleus-coda Harmony, MINWD >> MAX-IO >> DEP-IO >> IDENT(F),  
ONSET

It will indicate that the constraint MINWD exists in Mandarin and is ranked higher than MAX-IO and DEP-IO. However, native Mandarin does allow monosyllabic lexical words. So, this ranking can be contradictive to native Mandarin words. To solve this dilemma caused by the effect of MINWD, this study adopts the constraint FAITHFULNESS proposed by YIP (1993). By FAITHFULNESS, Yip means that the underlying forms should not be altered. Yip argues that MAX-IO and DEP-IO should

be separated from FAITHFULNESS. FAITHFULNESS pays attention to all underlying segments, while MAX-IO only cares about salient segments. And it would be paradoxical to combine MAX-IO and DEP-IO with FAITHFULNESS.

By applying this constraint, the native Mandarin word with one underlying syllable will not surface as a disyllabic word. Tableau 14 illustrates the word *lan* “blue” in Mandarin.

**Tableau 14**

lan	CODACON	FAITHFULNESS	MINWD	MAX-IO	DEP-IO
a. lan			*		
b. la.nɿ		*!			*

We will apply this ranking of constraints on the adaptation of *jeep* again to see whether the winning candidate will change.

**Tableau 15**

dʒip	CODACON	FAITHFULNESS	MINWD	MAX-IO	DEP-IO
a. ji.pu		*			*
b. jip	*!	*	*		
c. ji		*	*!	*	

From this tableau, we can see that the optimal output for [dʒip] does not change. Thus, based on Mandarin native forms and loanwords the constraint ranking in Mandarin can be modified as:

- a. MAX(F)>> USE-LISTED-SYLLABLE>> DEP(F)
- b. \*COMPLEX, CODACON, FAITHFULNESS >> Nucleus-coda Harmony, MINWD >>MAX-IO>> DEP-IO >> IDENT(F), ONSET

Recall that in the model proposed by Boersma & Hamann (2009a), the cue and structural constraints function in the process of perception. The constraint rankings proposed above can be understood as the cue and structural constraints respectively. The repair strategies — epenthesis,

deletion, and featural changes — are motivated by higher-ranked well-formedness constraints in Mandarin, such as \*COMPLEX and CODACON. The theoretical framework of OT provides a reasonable explanation about why some constraints only bring out their effects in loanword phonology but fail to do so in native phonology. As this study is based on established loanwords, some extra-phonological factors may interfere with the results. The OT framework can serve as a filter to find the deviant cases. Online adaptation will be a better tool to establish the constraint ranking in Mandarin based on a specific group of bilinguals or monolinguals to test whether they use different grammar in their adaptation.

## **Chapter Six**

### **Conclusion**

#### **6.1 General Conclusions of the Study**

The aim of the study is to investigate how English loanwords are integrated into Mandarin. In the area of English loanwords, historical research concludes that Mandarin does not prefer phonetic loans, and semantic transparency in loanwords is abundant and popular in Mandarin. In the study, the general assumption about the preference for semantic borrowing is challenged and the real factors that decide the result of borrowings are explored. One important fact about the result is that it does not align with previous work that claims Mandarin uses calquing and phono-semantic matching on a large scale. In the corpus, there is not a great number of confirmed examples of such camouflaged borrowing. As a study on English loanwords in Mandarin, the dissertation contains discussions focusing on two major topics. The first is a general discussion about English borrowings in Mandarin and includes not only the background of language contact between English and Mandarin, but also the classification of English borrowings in Mandarin. With the focus on the mechanism of borrowing, the study divides English loanwords into overt borrowing, camouflaged borrowing, and covert borrowing. It raises the research question of the much-debated controversy between semantic borrowing and phonetic borrowing.

The second main topic, which is to service the first one, i.e. the classification of English loanwords in Mandarin, is the phonological adaptation of English loanwords in Mandarin. It contains a comparative study of English phonology and Mandarin phonology, the analysis of the adaptation of English consonants and vowels in Mandarin, and the phonotactic adaptation of illicit sound sequences. These analyses show that the majority of English loanwords are phonetically faithfully matched into their corresponding segments in Mandarin and, in the cases where there are deviant mappings or asymmetry between English inputs and variant Mandarin outputs, possible perceptual similarities are caused by syllable frequency in Mandarin rather than the factor of semantics. Phonotactic adaptation is analysed in the framework of Optimality Theory, which shows that Mandarin loanword adaptation is influenced by both perception and phonology. On the one hand, the perception of English input by Mandarin speakers is influenced by native phonotactic constraints.

On the other hand, phonetic approximation rather than phonological categorical matching is at work in some cases. It can be concluded that perception is influenced by both the phonotactic knowledge of native language and the phonetic details of the stimuli. Many loanwords in this study reveal that only a phonetic-phonology approach can explain the variant loanword adaptation processes.

The process of loanword adaptation has played an important role in understanding the role of native grammar. The adaptation process presents a rich empirical ground for studies of language learning theories. Native and loanword grammar can be clearly captured in the adaptation process of loanwords. At the same time, the adaptation process is directly influenced by some extra grammatical factors such as orthography and the source and context of borrowing. In the case of Mandarin, loanwords are mostly adjusted according to the native grammar. However, sometimes seemingly unnecessary repairing strategies are adopted by Mandarin speakers in the adaptation process and the loanword grammar of Mandarin does not equal the syllable inventory of Mandarin. If the writing system is not involved in the adaptation process, the loanword can display syllables richer than the native syllables, that is, the loanword grammar is less restrictive compared to the native grammar. It reveals that native Mandarin Chinese speakers have strong intuitions not only about what the existing words are in their language, but also about which novel forms are phonologically possible or impossible. In other words, their phonotactic knowledge is a gradient and intricate system.

## **6.2 Two Tasks of the Thesis**

The abundance of English loanwords in Mandarin Chinese deserves a systematic, comprehensive, phonological analysis. The current study of English loanwords in Mandarin has two major tasks. One is to solve the debate on the scope and classification of loanwords in Mandarin. The main issues related to the debate are which words are semantically borrowed words, and which are phonetically and semantically borrowed simultaneously. The other main task is the phonological

process in adapting English loanwords, which helps us understand the interaction between phonology and phonetics and explains many variations existing in Mandarin loanword adaptation. The phonological adaptation also further serves as the foundation for a comprehensive picture of the distribution of different types of loanwords in Mandarin. It will also enhance our understanding of Mandarin phonology. With these two tasks of the study on the integration of loanwords addressed, it will clarify the influence of the writing system which is believed to have been an obstacle for large-scale borrowings into Mandarin.

### ***6.2.1 On Achieving a Comprehensive Classification***

First, the thesis reviews the problems that exist in the studies of Mandarin loanwords. The prominent problem lies in the lack of a coherent classification system and the consistent debate on the scope of Mandarin loanwords, which calls for a comprehensive taxonomy in Mandarin borrowings. The problem with different classification systems is that they involve various terms to identify the outcomes of borrowing from a foreign language to Mandarin, such as graphic loans, symbolic loans, wholesale loans, transliteration, and so on. The definitions of these terms by different scholars are not uniform, causing chaos, confusion, and misunderstandings. In this study, no matter what subtypes there are in a classification system, they can be put in the unified taxonomy proposed here based on the transfer of form/meaning unit, or the transfer of meaning. This study shows that the main way of integrating English loanword into Mandarin is through phonetic assimilation. It provides a comprehensive classification system which turns the seemingly messy various borrowing results into types according to their borrowing procedure. Moreover, the semantic part of the loanwords is also properly dealt with, which is always an obstacle in the consideration of camouflaged borrowings.

After reviewing the literature on borrowing and language contact between English and Mandarin, the thesis discusses the peculiarities in the integration of English words into Mandarin,



emphasising the impact of the phonological system and the writing system/Chinese morpheme. In Mandarin Chinese, there are only about 420 morphemes if the tonal variation created by the four-tone system is ignored. The phonological and morphological constraints impose many limitations on phonetically transcribing foreign words into Chinese, especially from languages like English, which allows for many consonant clusters and coda consonants. Another factor that restricts the adaptation of loanwords is the fact that each character represents one morpheme and already contains some intrinsic meaning. This often results in a transliterated output that compromises the full capacity for phonetic fidelity in favour of conveying a more appealing written meaning, even if that meaning is not relevant to the original input word. The process of phonetic borrowing is believed to pose too many obstacles to constitute an efficient means of word borrowing into Mandarin, whereas free translation enables the core significance of a word to be borrowed in a way that better conforms to the morphological patterns of Mandarin Chinese and to the ingrained reading habits of literate Chinese speakers as informed by the several-thousand-year-old cultural history of their orthography.

Based on the morphosyllabic feature of Mandarin, it is believed that semantically borrowed words are preferred over phonetically borrowed words (e.g., Chen, 1999; Zuckermann, 2003; Chan & Kwok, 1990; Norman, 1988). Semantically borrowed words refer to the words that are made up of the combination of Chinese characters that, while not corresponding to the sounds of the input English words, mostly convey the intended meaning of the original word. Based on the corpus, the thesis demonstrates that unless the morphosyntactic model can be found in the source language, the semantically borrowed word should not be considered a borrowing, that is, loan translation/calque with etymological information can be seen as borrowing, while free translation should not.

Not many loan translations are included in the corpus, the reason being that the etymological knowledge is missing from many loan translations. In other words, some so-called loan

translations are not really borrowed as loan translations. For example, *miyue* 蜜月 lit. ‘honey + moon’ is thought to be a loan translation of the English word *honeymoon*. But it is actually borrowed from Japanese *mitsugetsu* written with the same characters 蜜月. For some other foreign concepts, the meaning is rendered in Mandarin by using native Mandarin morphemes to describe the most prominent characteristic of the word. For example, *buffet* is borrowed as *zizhucan* 自助餐 lit. ‘self + help + meal’. In this type of borrowing, there is not a morpheme-to-morpheme translation between the original word and the borrowed word. It can be seen as loan creation by the Mandarin borrowers, while it is also termed as “free translation” or “holistic calque” in Chinese language literature (Cook, 2018). Therefore, without etymological information, it is hard to decide whether a complex word in Mandarin is borrowed or not.

Such language-contact induced change is also termed “pattern replication” that is, “the reshaping of language-internal structures... the patterns of distribution, of grammatical and semantic meaning, and of formal-syntactic arrangement at various levels (discourse, clause, phrase, or word) that are modelled on an external source” (Matras & Sakel, 2007, pp. 820-830). Compared to matter replication, pattern replication is “more controversial” as it does not involve replication of forms, but is manifested rather through a shift in meaning, distribution, or organisation of inherited material. Therefore, this kind of contact-induced change is different from borrowing in that it is seen as the export of constructions from a model language to the replica language.

It is not reasonable to compare the diachronically different borrowed forms to make a statement about whether semantics is preferred in loanword integration. The phenomenon that the phonetic loans such as *demokelaxi* 德莫克拉西 ‘democracy’ is replaced by a free translation *minzhu* 民主 lit. ‘people + master’ cannot demonstrate that semantic transfer is preferred. There is also an abundance of cases where phonetic loans replace loan translation, such as the borrowing of the English word *humour* by Lin Yutang (林语堂), which was borrowed phonologically as *youmo* 幽默 lit.

‘remote + silent’ rather than borrowed by using the Mandarin morphemes to retain the essential meaning. There was a feeling that Mandarin loan translation and free translation with native morphemes could not best render the meaning of the foreign word. The two types of borrowings can exist during the same period, sharing the same function or diverging to two usages in two different sociolinguistic contexts. The oscillation between the two types of borrowings is not only a reflection of the different political attitude towards the western world, but also a change in linguistic competence in Mandarin borrowers. In addition, the phonetic loan and the translated form may have different connotations and be used in quite different environments. In such cases, they should not be compared even though they are two borrowed forms of the same English word.

The thesis argues that it is almost impossible to transfer the meaning and the sound of a foreign word at the same time as it is nearly impossible to have an existing word or a possible combination in characters that has the same meaning and the same (or similar) sound as an English word. Thus, camouflaged borrowing is rarely found in the corpus. The thesis also finds that as the written form of the Chinese language is basically ideographic and each character has a meaning, a phonetic loan, written in Chinese characters, is either meaningful or meaningless. Observing the phenomenon that phono-semantic matching occurs generally in brand names, the thesis argues that the borrowing of brand names is different to common words as they aim to promote market performance instead of achieving approximation to the original sounds. A brand name, before it enters the Chinese market, usually involves an intentional choosing of morphemes to give it a good association. Such an operation is more suitably called “name coinage” instead of phonetic adaptation.

Some cases which are listed as phono-semantic matching are only those with different associations rather than having semantic matchings with the original words (Wang, 2004). For example, *yasi* 雅思 < IELTS (acronym for “International English Language Testing System”) and *tuofu*

托福 < *TOEFL* (acronym for “Test of English as a Foreign Language”). *Yasi* and *tuofu* roughly indicate the pronunciations of the two original terms, but the meanings of the loan words have nothing to do with the meanings of the acronyms *IELTS* and *TOEFL*. *Yasi* is a new combination of two Chinese characters, *ya* ‘elegant’ and *si* ‘think’, and means ‘an elegant style of thinking’. *Tuofu* is a Chinese word meaning ‘(to be) with the help of your concern’, and it just happens to sound like *TOEFL*. The semantics of the so-called phono-semantic borrowing and the original word do not really match. The relation between the loanword and the original word is considered to be “artificial” by Novotná (1967). The semantic is only “suggestive” (Hansell, 2003) or “broadly construed” (Hsieh, 2007).

The increase of English level/ bilingualism in the Chinese population has an impact on the borrowing strategy. Mandarin speakers are becoming more receptive to phonologically adapted loan words with meanings that are extraneous to the word-for-word, literal meanings of the characters used to transcribe them. In other words, it is very likely that their academic backgrounds equip them with a stronger ability to block out the semantic interference that occurs for those less familiar with the English language when they are presented with the semantic disarray conveyed by the Chinese written forms of transliterated words. For example, it is difficult for Chinese speakers not familiar with the English word ‘fans’ to disassociate its transcription 粉丝 *fěnsī* from the word for ‘rice noodle’, which is written with the same characters.

### **6.2.2 Phonological Adaptation**

By analysing the phonological adaptation process of 600 English loanwords in Mandarin, it is clear that although a sound/meaning unit in English is not retained in Mandarin as Mandarin syllables carry meanings represented by characters, the characters are not chosen because they can match the original meaning; they are chosen generally because they are characters with high use

frequency. By and large, the adaptation process is based on perception and the integration of sound sequence in English words.

On the phonological adaptation analysis, the following findings have been observed:

1. Consonants are more faithfully mapped into the corresponding Mandarin consonants than vowels.
2. When native phonotactic requirements make it impossible to maintain both vocalic and consonantal features of the English source words, the vocalic feature is maintained at the expense of change in consonantal quality, that is, vocalic features are more salient than consonantal features in loanword adaptation.
3. The one-to-many mapping pattern of consonants is influenced by the following vowel quality.
4. Salient segments or segments in a perceptually salient position are less likely to be deleted than unsalient segments or segments in a perceptually unsalient position.
5. Phonetic faithfulness to the source is not respected due to the phonotactic constraints or the interference of the semantics.
6. When the adapted segmental combinations cannot be represented by Chinese characters, the combinations should be modified to fit into a character.
7. Some specific properties of the English inputs are used for adaptation matches. For example, in the adaptation of nasals, the input nasality is retained but the place features are not always retained.

The function of perception and phonology are both significant in Mandarin loanword adaptation.

The tendency for the preservation of fricative coda and the tendency for the deletion of stop coda show that the borrower's perception plays a role in the adaptation process. In addition, Mandarin listeners are likely to hear different illusory vowels in different phonological contexts, which could explain the use of different epenthetic vowels in the adaptation of consonant clusters. On the other

hand, the mapping between sound sequence of [alveolar, velar]+[high front vowel] into Mandarin [palatal]+[apical vowel] is not because of the Mandarin listener's misperception, but rather the phonology of the Mandarin syllable.

The phonetics-phonology approach, which emphasises the perceptual similarity between input and out, determines and explains the complicated loanword adaptations. It could be illustrated in the adaptation of English coda [ɹ]. English coda [ɹ] is preserved and turned into a syllable if the preceding vowel is [i] or [e] but deleted if the preceding vowel is [o]/[ɔ] or [ɑ]. Given that in loanword adaptation the output is made as close to the input as possible, a perceptually minimal modification would be preferred over a perceptually non-minimal one. The English coda [ɹ] in [iɹ] and [eɹ] is preserved because this modification causes a perceptually smaller change than deleting it, and that the [ɹ] in [oɹ]/[ɔɹ] and [ɑɹ] is deleted because this modification also causes a perceptually smaller change than preserving it.

### ***6.2.3 The Variation of Adaptation***

The data in the study shows that there is some degree of variation in the adaptation outcomes, that is, one English word can be adapted into more than one Mandarin loanword. The reasons for the variation can be classified as degree of bilingualism, the source of input, the preference for certain characters to achieve foreignness, and so on.

The degree of bilingualism affects the outcome of loanword integration as balanced bilinguals have developed both RL and SL grammars, unbalanced bilinguals have developed an interlanguage perception grammar, and monolinguals have no knowledge of the source language phonology. Balanced bilinguals have access to the underlying representations of the source language, so phoneme-to-phoneme or phoneme-to-phone mapping is more likely to be possible, while monolinguals can only rely on the phonetic input of the speech signal without phonological structure.

Haugen (1950) classified three types of bilingual communities. The speech community in mainland China can be described as pre-bilingual up to the 1980s. Since the Opening-up Policy, the level of bilingualism has become predominantly adult bilingualism due to the spread of education, telecommunication, trade, and so on. Moreover, bilinguals in mainland China have a higher competence in reading and writing compared to listening and speaking. Many people can only read English words the way they learned English at school.

Therefore, the different levels of English proficiency of native Mandarin speakers might be a factor that causes the variation in loanword adaptation. Some examples can be found in the early loanwords. *Greenwich* [gɹɪnɪtʃ] is first borrowed as *ge.lin.wei.zhi* 格林威治. The silent <w> in the word is mistakenly pronounced by the borrower. But after the real pronunciation became the input of the adaptation, the phonetic loan for *Greenwich* has been corrected as *ge.lin.ni.zhi* 格林尼治. *Pint* is borrowed as *pin.tuo* 品脱, the possible reason being that the pronunciation of *pint* is mistaken as [pint] by Chinese borrowers.

Another factor that may lead to the variation in loanword adaptation is the source of the input. If the words are borrowed through writing instead of speech, there is going to be heavy influence from orthographic representations. The borrower might also get input through an intermediate language (e.g., schoolteachers with strong accents) instead of the source language directly. There are likely to be details of the input that differ from what would be present in a native source. In the case of Mandarin, it is very likely that the loanword is borrowed through writing and the real acoustic input is absent for the borrowers. Paradis and LaCharité (2011, p. 765) point out that though loanwords are mainly borrowed orally, it is possible that loanwords enter L1 through writing, especially when bilingualism is relatively low. When a loanword enters Taiwanese Mandarin or Cantonese, the adaptation is usually based on auditory input; while in the case of standard Mandarin, the written form/orthography plays a major role in the adaption process, especially for

place names and personal names. Smith (2006) argues that the existence of different adaptation strategies on one word is due to different input types. When adapting an illicit coda, if the input type is auditory, the coda is deleted since it is not perceived by the borrower; whereas when the input type is orthographic, the coda is preserved via vowel epenthesis as the borrower assumes that there is a perceivable coda consonant in the source.

As a matter of fact, this has become a conduct that in the transliteration of foreign place and personal names, the prescriptive norms by the Xinhua News Agency (Xinhuashe 新华社) be strictly followed. As the norms are practised so frequently, they have become a more accepted version. Huang (2011) gives an example: the basketball player Kobe Bryant has a standard transliteration of [k<sup>h</sup>ɿ.pi] *ke.bi* 科比 lit. ‘a branch, a subject + compare’ and also has an internet nickname of [k<sup>h</sup>ou.pi] *kou.bi* 抠比 lit. ‘dig out something with a finger + compare’. Although the informal form has a higher phonetic similarity to its English source than its official form, it is not widely accepted.

It could be argued that the variation of the adaptation outcome is determined by the preference for one Chinese character over another. It has been confirmed in several corpus-based studies that only a limited set of Chinese characters is preferentially used in phonological loans or in transliteration (Hanzell, 2003; Lou, 1992). This indicates that so long as the matches are phonetically/phonologically similar, a limited range of variation is tolerated.

### 6.3 A Note on Letter Words/Alphabetic Words

A phenomenon worth noting in recent years is that the writing of the source words tends to be accepted by Mandarin borrowers now. For instance, when borrowing English acronyms such as *APP*, *PPT*, *DVD*, and *MP3*, Mandarin borrowers simply adopt the graphemes into their native lexicon, only pronouncing them in a Mandarin way. Mandarin borrowers don’t worry about the way the acronyms are spoken in English. They just pronounce them letter by letter, the way that they



pronounce Chinese characters. For example, *APP* is borrowed as *ei.pi.pi*; *PPT* is borrowed as *pi.pi.ti*, though their native pronunciations are [æp] and [pauə.pɔɪnt] respectively. This method shows that, in contrast to the earlier situation where people feel uncomfortable with exotic writing mixing with Chinese characters, people are quite used to seeing the letter words appearing everywhere. In this way, a huge amount of so-called “letter words” have come into Mandarin. This adaptation strategy is posited by Vendelin and Peperkamp (2006) as “reading adaptations”. Actually, the mechanism is very similar to the “reading adaptation from dialects” such as from Cantonese. The borrowers just read the graphemes of the source form. The difference is that the “reading adaptation from dialects” strategy can be done by a Mandarin monolingual, while “reading adaptations from English” should be performed by people who at least know how to pronounce the English letters. If they don’t know English letters, they would pronounce the letters as in the pinyin alphabet. This increased rate of borrowing alphabetic words conforms to the claim by McMahon that “lexical borrowing requires only very restricted bilingualism” (1994, p. 204). For native speakers of a recipient language, to be the agents of this particular kind of change (borrowing), they must have some kind of knowledge of the source language, either learnt through formal education or acquired in an actual encounter with the foreign language group.

In recent years, English words have even entered Mandarin in their fully-spelled form, such as *wifi*, *low*, *hold*, *man*, *base*, and so on. It should be noted that these full-spelled words are not always used in Mandarin with their original meanings or morphological forms. Take *low* as an example: it is usually used with the meaning “below other people or things in importance or status, not elegant, not fashionable, of bad quality”, as in 这件衣服看起来很 *low*, ‘This shirt looks very unfashionable.’ Other cases of full-spelled letter words either display change in meaning or morphological form in use.

Besides the borrowing of letter words, a surprising borrowing of the English progressive tense marker *-ing* into Mandarin is reported (Jing-Schmidt & Hsieh, 2019). Though it appears

generally in Internet language, it was described by a 2007 article in the *China Daily* as the most “ingenious” lexical innovation. The borrowing of *-ing* is said to have put an end to the absence of inflection in Chinese. The Chinese Internet language is regarded as “a totally different language”, full of hybridised forms that mix characters with alphabetic signs and other visual graphemes. Therefore, whether the integration of *-ing* in Mandarin lexicon can be regarded as borrowing is still open to discussion. Besides *-ing*, the past tense marker *-ed* is also reported to have been borrowed into Mandarin based on data collected from Chinese webpages (Wang, 2008). Recalling the hierarchy of borrowability (Whitney, 1881; Muysken, 1981, quoted in Van Hout & Muysken, 1994, p. 41 and Winford, 2003, p. 51), there is a linguistic (i.e., structural) constraint determining the degree of borrowability. Whitney defined a scale of the various lexical categories according to the freedom with which they were borrowed:

By universal consent, what is most easily transferred from one tongue to another is a noun; the name of a thing is language-material in its most exportable form. Even an adjective, an attributive word, has a more marked tinge of formal character, and is less manageable; and a verb, a predicative word, still more .... Next to the verb, among parts of speech, would come the adverb, with the yet more formal prepositions and conjunctions, and the pronouns; and, not far from these, the formative elements proper, the prefixes and suffixes, first of derivation and then of inflection; and last of all, the fundamental features of grammatical distinction. (Whitney 1881, pp. 19-20)

It has been argued that bound morphology, especially inflectional morphology, is more resistant to being borrowed (van Hoot & Myusken, 1994; Field, 2002). This kind of borrowing between two languages with different morphological structures is a rare phenomenon in language contact situations. The borrowing of *-ing* and *-ed* may be explained by the user-oriented theory of borrowing (Matras, 2009), which states that the “bilingual speaker’s motivation... [is] to blur the

demarcation boundaries between different portions of their overall repertoire of linguistic structures...”(Matras, 2015, p 47).

It is in accordance with the borrowing hierarchy that in the letter words, the first ones that appear in Mandarin lexicon are nouns, while the later ones include adjectives, adverbs, verbs, and even inflectional suffixes. As Haugen notes, “all linguistic features can be borrowed, but they are distributed along a SCALE OF ADOPTABILITY which somehow is correlated to the structural organization” (1950, p. 224). McMahon adds a further, extra-lexical dimension in the scale of borrowability, maintaining that “the lexicon is most easily and radically affected, followed by the phonology, morphology and finally the syntax” (1994, p. 209), a position endorsed by Thomason & Kaufman too, who strongly believe that the depth of borrowing is linked to the depth of contact (1988, p. 73). Given that the language contact between English and Mandarin has been greatly increased, the conspicuous novelty characteristic of Internet letter words exhibits the trend of engaging letters in Mandarin speaking environments.

The integration of letter words (no matter whether they are borrowings or Mandarin pinyin) has been a favourite focus in recent decades in Chinese linguistics. The dramatic increase in the popularity of letter words has raised interest as well as concern. Among the problems in the use of alphabetic words, one of the most heated debates is whether they should be called borrowings. The other is the standardisation of the usage of the new words. Whether they should be considered established loanwords should be based on whether they have attained a sufficient degree of popularity, frequency of use, demographic spread, and genre coverage. If so, they should be qualified as established neologisms, as opposed to isolated examples of ad hoc usage. Matras (2009, p. 111) considers a variety of diagnostic features to determine an item as a borrowing or as a codeswitching, one of which is the degree of speaker bilingualism (monolingual vs. bilingual). In this respect, the full-spelled letter words and inflectional morphemes are not borrowings since the monolingual Mandarin speakers do not use them. As for the standardisation of letter words, the

study argues that the morphological phonological integration into Mandarin makes the letter words loanwords, and “the survival of the fittest” gives the most appropriate explanation for the phenomenon of many alphabetic words in Chinese. They can fulfill communication purposes even for monolingual Mandarin speakers who have only a basic idea of English letters. They remember those letter words as they do characters, that is, not necessarily be able to pronounce them, but might be able to recognise them and thus know their meaning, for example, *taxi*. The thesis argues that although letter words are abundant, they are still not the default form. Since the thesis focuses on the interplay between phonology and semantics of loanwords, letter words are not discussed as they are devoid of “semantic contamination” of Chinese morphemes.

#### 6.4 Limitations of the Study

There are some limitations of the study. The study focuses on the adaptation of onset consonants, coda consonants, vowels, and consonant clusters. Whether stress affects the adaptation pattern of English consonants and vowels is not explored, nor are the ways that English inputs are adapted into Mandarin tones analysed. The function of suprasegmental features in loanword adaptation awaits future research. Furthermore, the thesis does not include many proper names in the database as they are more strictly borrowed by the standard of prescriptive norms of transliteration illustrated in the *English-Chinese transliteration table* (英汉音译表) issued by Xinhua Agency; there exists proper names which are not borrowed according the table. Together with borrowings in other semantic fields, Mandarin loanword adaptation can be explored in a broader perspective and more features might be discovered. Lastly, it should be noted that dialectal influence has been evident in Chinese history and English loanwords have been borrowed through southern dialects, such as Cantonese, Wu, and Min. While these dialects share some similarities, they certainly show much difference too. Without detailed etymological information, it is difficult to

determine from which dialect a borrowing might have entered. Thus, the influences might not have been entirely avoided.

### **6.5 Contribution of the Study**

Through the analysis of a corpus of 600 established English loanwords in Mandarin, the thesis supports the hypothesis that semantic consideration is not involved in the loanword adaptation process because there is no semantic relation between the borrowed words and the characters used to record them. The thesis demonstrates that the semantic resource of the Chinese writing system is not used, as it has been said, on loanwords and it is not an impediment to large-scale borrowing. Borrowing between languages with different writing systems is not much different to borrowing between languages with the same writing system or without a writing system at all.

The study looks at the borrowing of English words from a diachronic perspective and considers the history of language contact between English and Mandarin. The preferences for different borrowing strategies in different historical periods are compared and the tendency of a future borrowing strategy is predicted on the basis of the contact situation and the ever-changing bilingualism in China. As borrowing is sensitive to extra linguistic factors, the study takes into account some factors such as orthographic influence, language attitude, and so on.

It has been observed that, different to the strategy adopted 50 years ago, rare or obsolete characters are now discouraged. In the past, low-frequency Chinese characters were intentionally used in loanword adaptation as low-frequency words sounded more exotic, thus achieving the style of “foreignness”. In recent years, high-frequency characters are preferred as they can be more readable for ordinary people. The characters are “emptied” of their meaning in the sense that it is the intention for the reader to ignore a character’s usual meaning and read it only for its sound.

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### Appendix: English loanwords in Mandarin

English words	Chinese characters	Chinese literal meaning
(baking) powder	泡打 (粉)	bubble+beat+(powder)
acapella	阿卡贝拉	a form of appellation+block+shell+pull
ace	爱司 (球)	love+manage, operate+(ball)
acre	爱克	love+overcome
acrylic	亚克力	second+overcome+strength
AIDS	艾滋 (病)	a plant,end +grow+(sickness)
alpha ray	阿尔法	a form of appellation+you+law
Alpha Go	阿尔法狗	a form of appellation+you+law+dog
amen	阿门	a form of appellation+door
amoeba	阿米巴	a form of appellation+rice+long for
anarchy	安那期	calm, safe+that+period

angel	安琪儿	calm, safe+jade+retroflexion suffix
antisterone	安体舒通	calm, safe+body+comfort+refreshed
aspirin	阿司匹林	a form of appellation+manage, operate+match+forest
Athena	雅典娜	elegant, gentle+classici+female name
atropine	阿托品	a form of appellation+support+object
babesia	巴贝（虫）	long for+shell+(worm)
bacon	培根	cultivate+root
bagel	培果	cultivate+fruit
ballet	芭蕾（舞）	a plant+flower bud+(dance)
bandage	邦迪	nation+enlighten
banjo	班卓	class+excellence
bar	（酒）吧	(wine)+an auxiliary
Barbie	芭比	a fragrant plant+compete
barbital	巴比妥	long for+compete+ready
baroque	巴洛克	long for+a place name+overcome
bass	贝司，贝斯	shell+manage, operate
bassoon	巴颂（管）	long for+praise+(tube, pipe)
Beatles	披头士	drape+head+person
beeper	BP 机	BP+machine
beer	啤（酒）	beer+(wine)
bel	贝耳	shell+ear
Benz	奔驰	run quickly+gallop
beret	贝雷（帽）	shell+thunder+(hat)
Big Ben	大笨（钟）	big+stupid+(clock)
bikini	比基尼	compete+base+Buddist nun
binding	绑定	tie, bind+fix
Bing	必应	definitely+respond
birdie	伯蒂	uncle+the base of a flower or fruit
blues	布鲁士	cloth+stupid, rude, rough+person

Bobo	波波（族）	wave+wave+(people)
Boeing	波音	wave+sound
bogey	博基	abundant+base
boogie	不羁	not+inhibited
bourgeois	布尔乔亚	cloth+you+a surname+second
bowling	保龄（球）	preserve+age+(ball)
boycott	杯葛	cup+a surname
brandy	白兰地	white+orchid+land
Broadway	百老汇	hundred+old+collection
brownie	布朗宁	cloth+a surname+quiet
browning	白朗宁	white+a surname+quiet
bullying	霸凌	dominate, control+invade, insult
bungee jumping	蹦极	jump+extreme
bus	巴士	long for+person
butter	白塔（油）	white+tower+(oil)
buy	败	defeat, fail, make the family reduced to poverty
bye-bye	拜拜	originally a form of greeting by women in history, bow to show respect
Byzantine	拜占庭	a form of greeting by women in history+occupy+courtyard
cacao	可可	approve, can+approve, can
calcium	钙	calcium
calorie	卡路里	block+road+inside
camera	开卖拉	open+sell+pull
cannon	加农（炮）	add+agriculture+(cannon)
canon	卡农	block+farmer
cappuccino	卡布其诺	block+cloth+a surname+promise
car	卡车	block+vehicle
carat	克拉	overcome+pull
carbine	卡宾（枪）	block+guest+(gun)



card	卡（片）	block+(piece,slice)
carnation	康乃馨	healthy+therefore,hence+fragrance
carnival	嘉年华	good+year+magnificent
Carrefour	家乐福	family+happy+luck
cartoon	卡通	block+through
cashmere	开司米	open+manage, operate+rice
caste	喀斯特	a noise+a surname+a surname
CD	CD	CD
celluloid	赛璐璐	match, game+jade+jade
cement	水门汀	water+door+spit of land
cent	仙股	a surname+stock
CEO	CEO	CEO
cha-cha	恰恰	proper+proper
chaconne	恰空	proper+air,empty
champagne	香槟	fragrant+a kind of apple
chanson	香颂	fragrant+ode
cheddar	车打	vehicle+beat
cheese	起司	stand up+manage, operate
cherry	车厘子	vehicle+a unit of weight+small
cheetah	赤獭	red+otter
chiffon	雪纺	snow+cloth
chiffon	威风	a surname+wind
chocolate	巧克力	artful+overcome+strength
cigar	雪茄	snow+a surname
Clean & Clear	可伶可俐	approve, can +smart, bright+approve, can +light, handy
clone	克隆	overcome+a surname
Coca-Cola	可口可乐	delicious+pleasant
cocaine	可卡因	approve, can +block+factor
coffee	咖啡	coffee

caffeine	咖啡因	coffee+factor
cologne	古龙	a surname+a surname+fragrant
cool	酷	cool
coolie	苦力	bitter+laborer
copy	拷贝	beat+shell
cracker	克力架	overcome+strength+frame
cretinism	克汀（病）	overcome+spit of land+sickness
Cupid	丘比特	a surname+compete+a surname
currant	加仑	a surname+logic
curry	咖喱	curry
cutex	蔻丹	simile of teenage girls and their beauty+red
cyclamen	仙客来	fairy+guest+come
dacron	的确良	for sure+good
Dadaism	达达主义	eminent+eminent+doctrine
darling	达令	arrive+order
DDT	滴滴涕	drop+drop+tear
decibel	分贝	portion, fraction+shell
dengue fever	登革热	ascend, mount+leather+heat, fever
denim	丹宁	red+quiet
derby	德比	virtue+competition
Dettol	滴露	drop+dew
dictator	迪克推多	enlighten+overcome+push+many
DINK	丁克	person, small dice+overcome
disco	迪斯科	enlighten+this+section
Disney	迪斯尼	enlighten+this+nun
DIY	DIY	DIY
DNA	DNA	DNA
domino	多米诺	many+rice+promise
Donald Duck	唐老鸭	a surname +old+duck
dozen	打	beat, hit

dumping	探拼	explore+put together
durian	榴莲	pomegranate+lotus
dynamite	达纳马特	arrive+accept+horse+special
Elnino	厄尔尼诺	disaster+you+nun+promise
Email	伊妹儿	he or she+little sister+suffix
Emmy Awards	艾美奖	a plant, end+pretty+award
Emotional Quotient	EQ	EQ
emu	鸸鹋	emu
encore	安可	safe+approve, can
engine	引擎	lead+hold up
Esperanto	爱思不难读	love+think+not+hard+read
ether	以太	take, use+most, extreme
eucalyptus	尤加利（树）	outstanding+add+benefit+(tree)
euphonium	悠风宁（号）	outstanding+wind+tranquil+(trumpet, horn)
Fabian Society	费边社	a surname+edge+society
Fahrenheit	华伦海脱	surname hua2+temperature
fair play	费厄泼赖	fee, expense+disaster+splash+bad
fans	粉丝	bean powder+a threadlike thing
Fascist	法西斯	law+western+this
fee	费	fee, expense, wasteful
filibuster	费力把事拖	spend, waste+strength+make+thing+postpone
fillet	菲力	fragrant+strength
film	菲林	fragrance+forest
flannel	法兰绒	related to France+orchid+fine cloth
formalin	福尔马林	luck+you+horse+forest
franc	法郎	law, of France+form of address to some people
freon	氟利昂	fluorine+benefit+raise
fuge	赋格（曲）	compose+style+(song)
funk	放克，疯克	release+overcome, crazy+overcome
gallon	加仑	add+logical sequence

gamma ray	伽玛射线	gamma+shoot+line
Garden of Eden	伊甸园	he or she+pasture+garden
Garfield	加菲 (猫)	add+fragrant+(cat)
gasoline	格士林	square+peoson+forest
GDP	GDP	GDP
geek	极客	extreme+guest
gene	基因	base+cause
georgette	乔其 (纱)	a surname+oneself+(veil)
Gestapo	盖世太保	cover+world+most, extreme+protect
gin	金 (酒)	gold+(wine)
golf	高尔夫	high+you+husband
gondola	贡多拉	tribute+many+pull
Gothic	哥特	brother+special
grammar	葛朗玛	a vine+bright+a kind of mineral
Grammy	格莱美	square+weed+beautiful
guitar	吉他	auspicious+he
Gypsy	吉普赛	auspicious+common+match, game
hacker	黑客	black, secret, illegal, evil +guest
hallelujah	哈里路亚	breathe out+inside+road+second
hamburger	汉堡	man, Chinese language+castle
harem	哈伦 (裤)	breathe out+ethics, order+(trousers, pants)
hello	哈喽	breathe out+auxiliary word after a verb to indicate the completion of an envisaged action
heroin	海洛因	sea+a place name+cause
hi	嗨	onomatopoeia
high	嗨	onomatopoeia
hip hop	嘻哈	giggle, laugh, not serious+laugh, breathe out
Hippies	嬉皮士	play+naughty+person
HIV	HIV	HIV
Hollywood	好莱坞	good+weed+castle, dock

hormone	荷尔蒙	lotus+you+cover
humor	幽默	secret+silent
hysteria	歇斯底里	rest, cease+you+bottom+inside
ice cream	冰淇淋, 冰激凌	ice+the name of a river+sprinkle
idol	爱豆	love+bean
IKEA	宜家	suitable+home
inch	英寸	British+ a unit of length
index	引得	lead+get, obtain
Information Technology	IT	IT
Intelligent Quotient	IQ	IQ
Internationale	英特耐雄纳尔	hero+special+endurance+powerful+accept+you
Internet	英特网	hero+special+net
iphone	爱疯	love+crazy
Islam	伊斯兰	he or she+this+orchid
jacket	夹克	press+overcome
jazz	爵士 (乐)	rank of nobility+person+(music)
jeep	吉普	auspicious+general
jelly	啫喱	jelly
Jews	犹太人	just as, like+most, extreme+(person)
jitterbug	吉特巴 (舞)	auspicious+special+long for+(dance)
joule	焦耳	worried+ear
Judas	犹大	just as, like+big
Jurassic	侏罗	a surname, dwarf+net
kallipygos	佳丽屁股	beauty, beautiful woman+buttocks
kangaroo	更格卢	change, replace+square+a surname
karat	开	open
karst	喀斯特	noise made in coughing or vomiting+this+special
karting	卡丁 (车)	block+small dice+(car, vehicle)
khaki	卡叽 (布)	khaki+(cloth)

kiwi	几维（鸟）	a few+dimension+(bird)
kiwi	奇异（果）	strange+unusual+(fruit)
koala	考拉	examination+pull
labrador	拉布拉多（狗）	pull+cloth+pull+many+(dog)
lace	蕾丝	bud+silk
Lafayette	老佛爷	old+Budda+grandpa
laser	镭射	radium+shoot
lemon	柠檬	lemon
lesbian	蕾丝边	bud+silk +edge
liaison	联播	join+read aloud
lidocaine	利多卡因	benefit+many+block+cause
lithopone	立德粉	stand+virtue+powder
logic	逻辑	patrol+edit
LOHA(acronym for "Lifestyles Of Health and Sustainability")	乐活（族）	happy+living+(people)
lolita	洛丽塔	a place name+pretty+tower
Longman	朗文	clear, luminous+language, writing
loser	庐舍族	cottage, hut+house, hut+people
lottery	乐透	happy+completely
lumen	流明	flowing+brightness, light
lycra	莱卡	weed+block
lyme	莱姆（病）	weed+housemaid+(sickness)
macaroon	马卡龙	horse+block+dragon
mammoth	猛犸	mammoth
mandolin	曼陀林	graceful+low hill+forest
mango	芒果	Chinese silvergrass+fruit
Marathon	马拉松	horse+pull+pine
mark	马克	horse+overcome
marker pen	马克笔	horse+overcome+pen
Marlboro	万宝路	ten thousand+treasure+road

martini	马提尼	horse+lift+nun
Marxism	马克思主义	horse+overcome+think+doctrine
Master	万事达	ten thousand+things+done, finish, reach
Matthew effect	马太效应	horse+extreme, most+effect
Mazda	马自达	horse+self+arrive
MBA	MBA	MBA
media	媒体	intermediary+substance
Messiah	弥赛亚	full, cover+match, game+second
metre	米	metre
Michelin	米其林	rice+this+forest
Mickey Mouse	米奇鼠	rice+mouse
microphone	麦克风	wheat+overcome+wind
mile	迈尔	stride+you
mince	免治	avoid+cure
mini	迷你	fascinating+you
missa	弥撒	full, cover+sprinkle, scatter
mocha	摩卡	stroke, rub+block
modal	莫代尔	none, nothing+generation+you
model	模特	mode, pattern+special
modern	摩登	stroke, rub+mount
mohair	马海毛	horse+sea+hair
Mojito	魔吉拖	magic+auspicious+pull,drag
Mojito	莫吉托	none, nothing+auspicious+support
mongoose	蒙哥	cover+brother
montage	蒙太奇	cover+most, extreme+peculiar, strange
morphine	吗啡	morphine
Morse Code	摩尔斯电码	stroke, rub+you+this+electric+code
mosaic	马赛克	horse+match, game+overcome
motor	马达	horse+arrive
motor	摩托	stroke, rub+support

mousse	摩丝	stroke, rub+silk
mousse	慕斯	admire+this
MP3	MP3	MP3
mug	马克（杯）	horse+overcome+(cup)
Muse	缪斯	pretend, cheat+this
myth	迷思	confusion+thinking
nanometre	纳米	accept+metre
NASDAQ	纳斯达克	accept+this+arrive+overcome
Nazi	纳粹	accept+essence
NBA	NBA	NBA
neon	霓虹	secondary rainbow+rainbow
NG	NG	NG
nicotine	尼古丁	nun+ancient+small dice
Nike	耐克	endure+can, overcome
Noah's Ark	诺亚方舟	Noah+rectangle+boat
Nobel	诺贝尔	promise+shell+you
number one	拿摩温	take+stroke, rub+warm
nylon	尼龙	nun+dragon
ohm	欧姆	Europe+housemaid
OK	OK	OK
Olympics	奥林匹克	profound+forest+be equal to+overcome
OPEC	欧佩克	Europe+wear, admire+overcome
opium	鸦片	crow+piece,slice
organza	欧根纱	Europe+root+yarn
Oscar	奥斯卡	profound+this+block
ounce	盎司	quiet+this, vigorous+manage, operate
outlets	奥特莱斯	profound+special+weed+this
own goal	乌龙	dark+dragon
pace	配速	allocate+speed
Pampers	帮宝适	help+baby+comfortable



pancake	班戟	class+halberd
Pandora	潘多拉	a surname+many+pull
papaw	八婆（果）	eight+granny+fruit
Paracetamol	扑热息痛	wipe out+heat+quiet down+pain
park	泊（车）	park+(car)
parkour	跑酷	run+cool
partner	拍档	pat+schedule
party	派对	group+correct
passion fruit	百香果	hundred+fragrant+fruit
pence	便士	convenience+person
penicillin	盘尼西林	plate+nun+west+forest
penny	便尼	convenience+nun
Pentium	奔腾	run+rise, soar
Pepsi-cola	百事可乐	hundred+thing+approve, can+happy
personal computer	PC	PC
pest	百斯笃	hundred+this+sincere
pharaoh	法老	law+old
photoshop	PS	PS
pickup	皮卡	leather+block
pie	派	pie
pingpong	乒乓（球）	the sound of pingpong+(ball)
pint	品脱	quality+take off
pizza	披萨	drape+a surname
Pizza Hut	必胜客	sure+win+guest
PK	PK	PK
PM2.5	PM2.5	PM2.5
poker	扑克	throw, pounce+overcome
Polaroid	拍立得	take+immediately+get
polka	波尔卡	wave+you+block
poncho	蓬却	fluffy+but

pop art	波普艺术	wave+common+art
Porsche	保时捷	maintain+time+quick
port	波打（酒）	earthen bowl+(wine)
pound	磅	scale, weight
pound	镑	pound
president	伯里玺	uncle+inside+royal seal
Producer Price Index	PPI	PPI
proletariat	普罗大众	common+collect+broad+the masses
pudding	布丁	cloth+person, small dice
puff	泡芙	bubble+lotus
pump	泵	pump
punk	朋克	friend+overcome
Quaker	贵格（会）	expensive+square+(meeting, society)
radar	雷达	thunder+arrive
rally	拉力	pull+power
reggae	雷鬼	thunder+ghost
rifle	来复（枪）	come+again, repeatedly+(gun)
robustness	鲁棒性	stupid, rude, rough +stick, strong+character, quality
rococo	洛可可	a place name+approve, can+approve, can
romantic	罗曼蒂克	romantic
rum	朗姆（酒）	bright+housemaid+(wine)
rumba	伦巴（舞）	ethics+long for+(dance)
Safeguard	舒肤佳	comfort+skin+good
salad	色拉	color+pull
salami	色拉米	color+pull+rice
salmon	三文鱼	three+language, writing+fish
salon	沙龙	sand+dragon
samba	桑巴（舞）	mulberry+long for+(dance)
sandwich	三明治	three+bright+rule

sardine	沙丁（鱼）	sand+man+(fish)
sari	纱丽	yarn+beautiful
Satan	撒旦	sprinkle+day
sauce	沙司	sand+manage, operate
sauna	桑拿	mulberry+take
saxophone	萨克斯风	a surname+overcome+this+wind
science	赛因斯	match, game+cause+this
scone	司康	manage, operate+healthy
shaman	萨满	a surname+full
shampoo	香波	fragrant+wave
shaping	舍宾	house+guest
share	晒	dry in the sun
shark	鲨鱼	shark+fish
sherry	雪利（酒）	snow+benefit+wine
shilling	先令	first+order
shimmy	西迷（舞）	west+charming+dance
shirt	恤（衫）	anxiety, pity, sympathize+unlined upper garment
shock	休克	rest, cease+overcome, restrain, capture
shopping	血拼	blood+fight
short	秀逗	beautiful+tease
show	秀	beautiful
(shut) down	宕（机）	delay+(machine)
simmons	席梦思	mattress+dream+think
sirloin	西冷	western+cool, elegant
smart	时髦	time+man of talent or superior character
snooker	斯诺克	this+promise+overcome
soda	苏打	revive+beat
sofa	沙发	sand+send out
sonar	声纳	sound+receive

sphinx	斯芬克斯	this+fragrance+overcome+this
Starbucks	星巴克	star+long for+overcome
Subway	赛百味	match, game+hundred+taste
sundae	圣代	saint+generation
syndicate	辛迪加	hot, pungent+inspiration+add
taboo	答布	answer+cloth
talk show	脱口秀	cast+mouth+show
tango	探戈	explore+dagger+axe
tank	坦克	smooth+overcome
tannin	丹宁	red+quiet
tanta- as in "tantalize"	忐忑	single character has no meaning
tart	蛋挞	egg+whip
taxi	的士	taxi
telephone	德律风	virtue+discipline+wind
Thames	泰晤士(河)	peaceful+interview+person+(river)
tips	贴士	stick+person
title	抬头	raise+head
tittup	踢踏(舞)	kick+tread+(dance)
toast	吐司	spit+manage, operate
TOEFL	托福	entrust+luck
TOEIC	托业	entrust+profession
toffee	太妃(糖)	most, extreme+imperial concubine+(candy)
ton	吨	ton
topology	拓扑(学)	expand+pounce on+(a branch of science)
Tory Party	托利党	support+benefit+party
totem	图腾	picture+rise
toucan	鷓鴣	toucan
Trojan horse	特洛伊木马	special+a place name+he or she+wooden+horse
trust	托拉斯	support+pull+this

T-shirt	T 恤	T+anxiety, pity, sympathize
turbine	透平（机）	penetrate+level+(machine)
tween	吞（世代）	swallow+(world+generation)
twitter	推特	push, spread+ special
typhoon	台风	deck, platform+wind
tyre	（车）胎	(car)+tyre
UFO	UFO	UFO
UFO	幽浮	quiet+float
Uncle Sam	山姆大叔	mountain+housemaid+big+uncle
USB flash disk	U 盘	U+disk
Utopia	乌托邦	dark, without+support, hope+country
vanilla	梵尼兰	Sanskrit, Buddhist+nun+orchid
Vaseline	凡士林	ordinary+person+forest
VCD	VCD	VCD
Viagra	万艾可	ten thousand+a plant, end+approve, can
Viagra	威而刚	power+and+rigid, hard
Viagra	伟哥	big, mighty+brother
VIP	VIP	VIP
vitamin	维他命	sustain+he+life
V-neck	V 领	V +collar
volt	伏特	bend over+special
voodoo	巫毒	witch, wizard+poison
wafer	威化	powerful+change
waffle	华夫（饼干）	magnificent+husband+cookie
Wall Street	华尔街	magnificent+you+street
waltz	华尔兹	magnificent+you+this
Waterloo	滑铁卢	slip+iron+a surname
watt	瓦特	tile+special
whiskey	威士忌	powerful+person+envy, fear
wiki	维客	dimention+guest

wiki	维基	tie up, hold together+foundation, ground work
wire	威亚	powerful+second
witkey	威客	powerful+guest
world wide web	万维网	ten thousand+dimension+web
WTO	WTO	WTO
X-ray	艾克斯光	a plant, end+overcome+this+light
yahoo	雅虎	elegant+tiger
yeah	耶，吔，	yeah
yippies	叶皮士	leave+leather+person
yoga	瑜伽	jade+a Korean instrument
yoghourt	优格	good+square
yoyo	悠悠（球）	swing+swing+(ball)
yuppies	雅皮士	elegant+skin, leather+person