Loanword Adaptation in Mandarin Chinese: Perceptual,

Phonological and Sociolinguistic Factors

A Dissertation Presented

by

Ruiqin Miao

to

The Graduate School

in Partial Fulfillment of the

Requirements

for the Degree of

Doctor of Philosophy

in

Linguistics

Stony Brook University

December 2005

Stony Brook University

The Graduate School

Ruiqin Miao

We, the dissertation committee for the above candidate for the

Doctor of Philosophy degree,

hereby recommend acceptance of this dissertation.

Co-Advisor: Ellen Broselow, Professor, Department of Linguistics

---
Co-Advisor: Lori Repetti, Associate Professor, Department of Linguistics

---
Marie K. Huffman, Associate Professor, Department of Linguistics

---
Alice C. Harris, Professor, Department of Linguistics

Agnes Weiyun He, Assistant Professor, Department of Asian and Asian
American Studies, Stony Brook University

This dissertation is accepted by the Graduate School

Dean of the Graduate School

Abstract of the Dissertation

Loanword Adaptation in Mandarin Chinese: Perceptual,

Phonological and Sociolinguistic Factors

by

Ruiqin Miao

Doctor of Philosophy

in

Linguistics

Stony Brook University

2005

This dissertation is a study of Mandarin Chinese loanword phonology, with focus on phoneme substitution patterns for consonants and processes used in resolving foreign syllable structures which are illicit in Mandarin. The data serving as the basis for analysis are loans borrowed into modern Mandarin from three Indo-European languages, namely English, German and Italian. I investigate the perceptual and phonological factors that regulate the variability of loanword adaptation in Mandarin. In addition, I discuss the influence of sociolinguistic factors on the phonological processes observed in the data.

Based on the adaptation patterns in Mandarin, I argue that the recipient language speakers' perceptual knowledge plays a crucial role in loanword phonology and that loanword processes function to create an adapted form that is perceived as sufficiently similar to the source word. I propose a constraint ranking analysis within the Optimality

Theoretic framework (Prince & Smolensky 1993, McCarthy & Prince 1993, McCarthy & Prince 1995). Following Steriade's (2002) P-map hypothesis, I conjecture that rankings of various correspondence constraints are projected by the perceptual similarity between the source form and the adapted form. Furthermore, this analysis is tested by data from online loan perception and adaptation experiments, the results of which corroborate the hypothesis that perceptual similarity plays an important role in loanword adaptation.

This research supports cross-linguistic findings about the preference for faithfulness of manner over faithfulness of other features such as voicing and place (e.g. Broselow 1999, Steriade 2002) and the preference for segment preservation over deletion in loan adaptation (e.g. Paradis & LaCharité 1997, Uffmann 2001, 2004). It enriches our understanding of the role of perceptual similarity and perceptual salience in phonology and their relationship to constraint ranking.

Table of Contents

List of Figures and Tables

Figure

Tables

List of Symbols and Abbreviations

◊   superscript "◊," indicating a foreign term adapted with
                              semantic associations

ø   Mandarin syllable that is not an independent morpheme

>   adapted into

<   adapted from

[ ] in Pinyin   boundaries of a bi- or multi-syllabic native Mandarin word,
                              or boundaries of monosyllabic word as the semantic part of
                              a hybrid loan

AUX   auxiliary

MC   Mandarin Chinese

MEAS   Mandarin syllable standing for a measure word

Numerals in Pinyin   Mandarin tones (1= first tone, 2 = second tone, 3 = third
                              tone, 4 = fourth tone; 0 = neutral tone; e.g. "mu3" stands
                              for a syllable "mu" with a third tone)

POSS   Mandarin syllable standing for a possessive marker

PREF   prefix

Q   Mandarin syllable standing for a question marker

RIVER   Mandarin syllable standing for a river name

SL   source language

SF   source form

/ /   boundaries of IPA symbols

SUF   suffix

SUR   Mandarin syllable standing for a surname

WF   Mandarin written form

Acknowledgments

I am grateful to many people who have accompanied me along the journey of working on this dissertation. First and foremost, I would like to thank my advisors, Ellen Broselow and Lori Repetti, who were the center of the most memorable and stimulating stage during my student career at Stony Brook University. Prof. Broselow guided me through this research from its crude start as a term paper to its further development into a qualifying paper, and now happily to its completion as a doctoral dissertation. I have learned from her not only linguistics, but also devotion to academics and dedication to students. Prof. Repetti is an excellent advisor and warm supporter, who is ready to offer suggestions and discussions with enthusiasm and patience at any time. Her insightful comments on various aspects of the drafts, and especially on the work involving the Italian data, contributed significantly to this research.

I am deeply indebted to my other committee members, Marie K. Huffman, Alice C. Harris and Agnes Weiyun He. Prof. Huffman has shouldered many roles in my study with admirable zest: an academic mentor, a teacher, an experiment expert, the chair of the dissertation, and many more ... To have her in my doctoral life was a most enjoyable and enriching experience. Prof. Harris has given me warm encouragement and helpful suggestions, always with a kind smile, from the very beginning and throughout. I benefited greatly from her expertise on historical linguistics as well as her comments on the dissertation proper. Prof. He has offered me enormous assistance and support with passion not only as a member of the dissertation committee and an expert on Chinese linguistics, but also as a friend with an understanding heart. She gave me constant inspiration and confidence in whatever research topic I decided to pursue.

To all faculty, staff and fellow students in the Department of Linguistics, I owe the joy, excitement and fun of learning at Stony Brook. Special thanks go to Christina C. Bethin, who introduced me into the realm of phonology. It was from her Phonology I class that the seed of my interest in Mandarin Chinese loanword phonology was planted. She contributed advice, comments and corrections to the growth of this interest with delicacy and professionalism, when I worked on the same topic for a qualifying paper and afterwards for this dissertation. I wish to acknowledge the encouragement from the following faculty at various stages of my study: Frank Anshen, Robert D. Hoberman, S.N. Sridhar and Kamal K. Sridhar. I thank Sandra Brennan and Susan Mitchell for taking impeccable care of every administrative need, and in particular, Sandra, who has never failed to give the right answer to any question I could think of.

Writing this dissertation would not have been as smooth as it had been if without the company of my fellow students in the Department of Linguistics. Thanks are due to the following: Jonathan MacDonald, for help with the English data and the experiments; Diane Abraham, Marianne Borroff and Carlos de Cuba, for discussions about English pronunciation; Michael Helten, for help with the German data; Andrei Antonenko, for discussions about Russian; Franc Marušič, for technology support and entertaining conversations across the office corridor; Yiya Chen, for many suggestions on how to conduct and complete a dissertation research; Yunju Suh, Tomoko Kawamura and Yukiko Asano, for their friendship and mental support.

I wish to thank many non-linguist friends at Stony Brook and elsewhere in the United States: the volunteer participants in the experiments for this research, who generously

Chapter 1
Loanword Adaptation and Phonological Theories

1.1 Introduction

In the research on loanword phonology, it is observed that the original foreign pronunciation of borrowed words tends to undergo systematic adaptation or nativization. The resultant loan form frequently both conforms to the native phonology of the recipient language and bears as much similarity to the source form as possible. Loanword adaptation may involve phonological structures on various levels, ranging from segmental features to phonotactic rules and prosodic patterns (e.g. Weinreich 1968, Hock & Joseph 1996, Campbell 1998). Investigations into these issues have been carried out in a large array of languages, including Cantonese (Silverman 1992, Yip 1993), Japanese (Itô & Mester 1995, Shinohara 2000), Fula (Paradis & LaCharité 1997), Huave (Davidson & Noyer 1997), Selayarese (Broselow 1999), Fijian (Kenstowicz 2003a), Fon (Kenstowicz 2003b), and Korean (Kang 2003), to name just a few.

Findings from various languages show that the output of loanword processes is generally a native form that demonstrates minimal changes from its foreign origin. On the segmental level, the principle of minimal modification functions through phoneme substitution, by which foreign sounds are replaced by their closest match available in the native inventory (Hock and Joseph 1996). Phonotactic adjustments aim to adapt foreign syllable structures that are incompatible with the native phonology. Lastly, nativization with respect to prosodic (or suprasegmental) patterns may involve mapping of stress or tone from the donor language to the borrower language (e.g. Silverman 1992, Davidson & Noyer 1997, Broselow 1999, 2005, Shinohara 2000, Kenstowicz 2003a).

Phonological modifications on these different levels are illustrated in (1) by Cantonese adaptation of English words. On the segmental level, English consonants are replaced by their closest correspondents in Cantonese, as in the replacement of English /b/ by Cantonese /p/. On the phonotactic level, consonant clusters within the syllable, which are licit in English but impermissible in Cantonese, undergo simplification through vowel epenthesis, as in "**fl**uke" > /f**u** luk/. On the prosodic level, English stress is mapped to Cantonese tones. A stressed syllable is assigned a high [H] tone, and a non-final unstressed syllable receives a middle [M] tone, as in "buffet" > /pow[M] fey[H]/. An epenthetic syllable in non-final positions receives a low [L] tone, as in "fluke" > /fu[L] luk[H]/. In word-final positions, unstressed syllables and derived epenthetic ones surface with a contour tone MH, as in "body" > /pɔ[H] ti[MH]/, and "film" > /fey [H] lɐm[MH]/. Thus, adaptations on different levels in collaboration enable the adapted form to satisfy

the dual requirement of obeying native language restrictions and maintaining similarity with the source pronunciation.

(1) English   Cantonese
     buffet   /bəˈfeɪ/   /pow[M] fey[H]/
     body   /ˈbɑdi/   /pɔ[H] ti[MH]/
     fluke   /fluk/   /fu[L] luk[H]/
     film   /fɪlm/   /fey [H] lɐm[MH]/
                                 (Source: Silverman 1992)

The loanword phonology of Mandarin Chinese (also known as "Mandarin," "Modern Standard Chinese" or "Pǔtōnghuà") demonstrates great variability both in phoneme substitution patterns and in strategies used to accommodate foreign syllable structures. Phoneme mapping from a lending language to Mandarin is flexible in that the same foreign sound can have alternative substitutes in Mandarin. Generally, a foreign phoneme is mapped to its phonologically/phonetically closest correspondent in Mandarin. The result of this mapping will be referred to as the *faithful* output. Sometimes a substitute which differs from the expected faithful match in certain ways is chosen. This will be referred to as a *deviant* output. A less similar substitute often arises for semantic reasons in that Mandarin speakers tend to choose a particular Chinese character (and thereby a morpheme) which can convey desirable meaning associations between the source word and the adapted form, although there are also cases in which a deviant output does not bring about any special semantic effects.

Variant phoneme substitutions are illustrated in (2) by the mapping of consonants from English to Mandarin. In the faithful adaptation of plosives, an English voiceless plosive is replaced by a Mandarin aspirated plosive (at the same place of articulation), and an English voiced plosive by a Mandarin unaspirated one (at the same place of articulation). The alveolar nasal, which is a licit coda in both English and Mandarin, is expected to undergo no modification.

(2) Variant phoneme substitutions

	English	MC Pinyin	IPA	Gloss
a)	Puma◊	piao1-ma3	/pʰiɑu-ma/	to soar-horse
	Portland	bo1-te4-lan2	/puɔ-tʰɤ-lan/	wave-special-orchid
b)	Tylenol◊	tai4-nuo4	/tʰai-nuɔ/	health-to promise
	Texaco	de2-shi4-gu3	/tɤ-ʂɻ-ku/	virtue-gentleman-ancient
c)	Mead	mi3-de2	/mi-tɤ/	rice-virtue
	Tide◊	tai4-zi4	/tʰai-tsz̩/	to eliminate-stain
d)	Enron	an1-ran2	/an-ɻan/	safe-such
	Avon◊	ya3-fang1	/ia-faŋ/	elegance-fragrance

The words in (2) show variable adaptations of English plosives and nasal codas. In each pair of words, the first item exemplifies a faithful mapping, and the second one

shows a deviant substitution. (Hereafter, the symbol "◊" labels a term whose Mandarin form conveys simultaneously both phonemic similarity and semantic associations with the source form.) The examples in (2a) and (2b) involve plosive onsets. In (2a), English /p/ in word-initial positions is alternatively adapted into Mandarin as an aspirated labial stop /pʰ/ (i.e. in "**P**uma" > "**p**iao1-ma3" /**p**ʰiɑu-ma/ *to soar-horse*) or an unaspirated /p/ (i.e. in **P**ortland" > "**b**o1-te4-lan2" /**p**uɔ- tʰɤ-lan/ *wave-special-orchid*). In (2b), English /t/ is replaced by Mandarin /tʰ/ in one case (i.e. "**T**ylenol" < "**t**ai4-nuo4" /**t**ʰai-nuɔ/ *health-to promise*) and /t/ in the other (i.e. "**T**exaco" < "**d**e2-shi4-gu3" /**t**ɤ-ʂʅ-ku/ *virtue-gentleman-ancient*). In both pairs of words, the faithful adaptation of the onset consonant creates meaning links between the source word and the Mandarin output. The adapted form of "Puma" presents an image of "soaring with high speed" for the particular brand of sport shoes, and that of "Tylenol" conveys the function of this medicine to "promise health." The deviant realization of an English voiceless plosive as a Mandarin unaspirated plosive in the adaptation of "Portland" and "Texaco" does not contribute to any special semantic associations between the source and the output.

The data in (2c) and (2d) illustrate variant mappings for coda consonants. In (2c), English coda /d/ is adapted as Mandarin unaspirated /t/ (along with vowel epenthesis) in "Mea**d**" > "mi3-**de**3" /mi-**tɤ**/ *rice-virtue*, but as /ts/ in "Ti**d**e" > "tai4-**z**i4" /tʰai-**ts**z̩/ *to eliminate-stain*. The deviant mapping of /t/ to /ts/ in the latter enables the Mandarin form to suggest that the detergent "Tide" has the desirable function of "eliminating stains." In (2d), the nasal coda /n/ is faithfully replaced by Mandarin /n/ in "Enro**n**" > "an1-ra**n**2" /an-ɻan/ *safe-so*), but by /ŋ/ in "Avo**n**" > "ya3-fa**ng**1" /ia-fa**ŋ**/ *elegance-fragrance*. The Mandarin form of "Enron" does not convey any semantic effect, but that for "Avon" creates a good image for the referent as cosmetic products that can bring "elegance and fragrance" to consumers.

In addition, Mandarin adaptation of foreign words displays variations between alternative phonotactic strategies in resolving foreign syllable structures that are incompatible with Mandarin phonology. From the English loans in (3) and (4), it can be seen that an English coda consonant can either be preserved through vowel epenthesis, as in (3), or simply deleted, as in (4).

(3)   Vowel epenthesis in adaptation of final codas

English	MC Pinyin	IPA	Gloss
Ga**p**	jia1-**pu**3	/tɕia-**p**ʰu/	to add-popular
Modo**c**	mo4-duo1-**ke**4	/muɔ-tuɔ-**k**ʰɤ/	silence-much-gram
Dalla**s**	da2-la4-**si**1	/ta-la-**s**z̩/	to arrive-to pull-this

(4)   Consonant deletion in adaptation of final codas

English	MC Pinyin	IPA	Gloss
Celpi**p**◊	si1-pei2 < >	/sz̩-pʰei/	thinking-to cultivate
Compa**q**	kang1-bai3 < >	/kɑŋ-pai /	health-cypress
Cheeto**s**◊	qi2-duo1 < >	/tɕʰi-tuɔ/	wonder-many

For example, in "Ga**p**" > "jia1-**pu**3" /tɕia-**pʰu**/ *to add-popular*, the English stop /p/ undergoes resyllabification through /u/ insertion, whereas the /p/ coda is deleted in "Celpi**p**" > "si1-pei2 < >" /sẓ-pʰei/ *thinking-to cultivate*.

Variable segmental and phonotactic processes in Mandarin loanword phonology lead to interesting questions about loanword adaptation in general. First, what are the constraints on phoneme substitutions so that the adapted form can maintain adequate (although not always maximal) phonological/phonetic similarity with the foreign source form? Second, what are the phonological factors that condition the variation between processes targeted towards ill-formed syllable structures?

Although a number of studies have shown that the variations in loanword adaptations correlate systematically with such factors as phoneme categories (e.g. obstruents vs. sonorants) and/or phonotactic contexts (e.g. onset vs. coda) (e.g. Silverman 1992, Kenstowicz 2003a, Kang 2003), the variability demonstrated in Mandarin loanword adaptations has not received full investigation. Previous works on foreign loans in Mandarin as well as in the Chinese language in general focus on etymological or sociolinguistic descriptions (e.g. Liu 1986, Masini 1993), rather than constructing theoretical explanations for the adaptation processes. Even purely phonemic loans, in which no semantic factors are at play, have not been adequately studied.

The goal of this dissertation is to present a comprehensive analysis of Mandarin loanword phonology, by focusing on phoneme substitution patterns for consonants and on adaptation of foreign syllable structures. The data for this research are a corpus of existing loans borrowed into modern Mandarin since the 1950s from three Indo-European languages, namely English, German and Italian. By analyzing the corpus data, the study will propose formal phonological analyses for Mandarin nativization of foreign consonants and syllable structures. It will also examine the influence of socio-linguistic and socio-cultural factors on the phonological adaptations. Furthermore, to test the hypotheses proposed on the basis of existing loans, online loan perception and adaptation experiments were conducted. This study contributes to both the research on loanword phonology and the development of phonological theories in general.

The rest of the chapter sets the background for this research. Section §1.2 surveys the major theories of loanword phonology advanced in the literature and introduces recent proposals about perceptual similarity as a promising direction for loanword research. §1.3 reviews briefly the state of research on loanword adaptation into Chinese, including Mandarin and other Chinese dialects. The specific research goals of the study are presented in §1.4, and the data corpus that serves as the basis of analysis is introduced in §1.5. Lastly, §1.6 outlines the organization of this dissertation.

1.2 Theories of loanword adaptation: Literature review

One central issue in loanword phonology concerns what linguistic mechanism governs the adaptation of foreign pronunciation. In particular, questions to be answered are whether loan adaptation is a function of perception or of production, and whether

adaptation processes are phonological in nature or sensitive to phonetic details of the source language.

Regarding this issue, various adaptation theories have been proposed in the literature. In this section, I will review the major proposals and introduce recent studies that integrate perceptual similarity and perceptual salience into the production grammar as a promising direction of loanword research.

1.2.1 The perception-only approach

It has been proposed in some studies of loanword adaptation that loan processes are solely determined by perception (e.g. Dupoux & Peperkamp 2002, Peperkamp 2002, 2003, and Peperkamp & Dupoux 2003). Proponents of this view assume that speakers of the recipient language have no access to the source language phonology and that adaptation is the result of the borrower's misperception of the foreign source word. For instance, it is assumed that when a Japanese speaker listens to an English word "hit," what he really hears is /hit:o/, rather than the English pronunciation /hɪt/. Thus, the adaptation of "hit" into /hit:o/ is fulfilled in perception, while phonology does not play any function.

While acknowledging the role of phonetic information in loan adaptation, the radical perception (or misperception) theory as proposed by Peperkamp (2003) and Peperkamp & Dupoux (2003) has its drawbacks. First, the assumption that the input to adaptation consists of simply acoustic signals without phonological information may not be applicable to all borrowing situations. Since language borrowing is commonly done by competent bilinguals (Haugen 1950, Grosjean 1982, Poplack, Sankoff & Miller 1988, Paradis & LaCharité 1997), it is doubtful that the borrower has no knowledge of the donor language phonology. Second, there are studies showing that perception is not the only factor functioning in loan processes, although it is indeed an important factor (e.g. Takagi & Mann 1994, Smith 2004). In view of these observations, the validity of a phonetics-oriented model awaits further investigation.

1.2.2 The production-only approach

Unlike Peperkamp (2003) and Peperkamp & Dupoux (2003), who argue for a perception-only approach, other scholars advocate a production-only approach, positing that loan adaptation is phonological in nature and is solely a function of the production grammar (e.g. Paradis 1996, Paradis & LaCharité 1997, Itô & Mester 1995, Davidson & Noyer 1997, Jacobs & Gussenhoven 2000). Paradis (1996) and Paradis & LaCharité (1997) propose the Theory of Constraints and Repair Strategies (TCRS), in which they argue that the variation between segment preservation and consonant deletion is constrained by how costly a repair strategy will be. The threshold of modifications is set at two steps. Once preservation of a segment exceeds the threshold, deletion will occur, as in the case of a segment that is absent in the native inventory and meanwhile stands in an illicit phonotactic position. For example, in "avocat" /avɔka/ (French) > /awɔka/ (Fula), the preservation of /v/ by /v/ > /w/ mapping involves a one-step repair, i.e. insertion of a [+son] feature. In contrast, deletion is adopted in "voyage" /vwajaʒ/ (French) > /< > waja:s/, */**wu**waja:s/ (Fula) because preservation would involve three steps, namely, insertion of a nucleus node, spreading of the glide /w/ to the nucleus position, and adaptation of non-native /v/ into native /w/.

Some other studies propose production-oriented analyses of loan adaptation from a constraint-ranking Optimality Theoretic (OT) perspective. Itô & Mester (1995) argue that re-ranking of the same set of faithfulness constraints accounts for the different strata of the Japanese lexicon, ranging from the core (native or fully nativized vocabulary) to the periphery (less nativized vocabulary). Davidson & Noyer (1997) advance a similar analysis of stress assignment in Hauve adaptation of Spanish loans by re-ranking the faithfulness constraint that requires matching of stress between the foreign input and the adapted form. Both studies assume that loanword adaptations are determined by the production grammar defined in terms of phonological constraints and their rankings. More explicit arguments for a production-only approach are presented by Jacobs & Gussenhoven (2000), who argue that the concept of perception (and misperception) should be dispensed with and that loan phonology can be solely accounted for by a constraint-based production grammar. For instance, the adaptation of front rounded vowels (e.g. /y/) from French into Mauritian Creole, a language that lacks such vowels, is accounted for by a hierarchy of structural constraints against the association of vowel place to a certain articulator (e.g. labial and dorsal) and faithfulnesss constraints that demand parsing of features and filling of place nodes (see details in Jacobs & Gussenhoven 2000: 201-203).

Similar to the perception-oriented approach (Peperkamp 2003, Peperkamp & Dupoux 2003), which fails to reflect the diversity of language borrowing situations, the production-oriented proposals as introduced above cannot explain all the patterns of loan adaptation. For instance, Brasington (1997) observes that TCRS fails to account for Marshallese adaptations of English words, where the choice between vowel epenthesis and consonant deletion in resolving English consonant clusters depends on position as well as cluster type. Vowel insertion is the primary strategy for onset clusters, whereas deletion is common for coda clusters. In the adaptation of English final nasal-obstruent clusters, a post-nasal stop is more likely to be deleted than a post-nasal sibilant. The TCRS theory, which mechanically calculates the number of steps involved in consonant deletion and vowel insertion, cannot explain the differential preference for different repair strategies in various phonological/phonetic contexts. Brasington (1997) contends that the loan data of Paradis & LaCharité (1997), which involve French either as a recipient language or as a donor language, are not representative of the range of loan adaptation patterns.

Similarly, Ulrich (1997) investigates Lama loan phonology, showing that a variety of processes in Lama adaptations of English and French words disprove the TCRS theory (see details in 1997: 452-459). He points out that TCRS leads to incorrect predictions for segmental adaptations as well as phonotactic adjustments. For example, the Threshold Principle of Paradis & LaCharité (1997), which predicts that deletion will occur if preservation requires more than two steps of repair, is not substantiated in that Lama speakers adapt some ill-formed structures (e.g. Fench /-ʒ/ codas) through vowel insertion even though this process is a three-step repair. (See Rose 1999a for other arguments against the Threshold Principle).

1.2.3 The approach with separate perception and production levels

A third type of approach to account for loanword adaptation takes both perception and production into consideration but treats them as separate levels governed by different grammars (Silverman 1992, Yip 1993, Kenstowicz 2003b, Broselow 2005). What is shared by these researchers is that the recipient language speakers have no access to the original foreign pronunciation. The input to processes on the production level is the output of the perception level, and hence a form modified from the source pronunciation.

Silverman (1992) proposes a multiple-scansion model, based on loan adaptation in Cantonese. His model consists of two distinct "scansions" or levels, namely the Perceptual Level (Scansion One) and the Operative Level (Scansion Two). At Scansion One, the borrower perceives the foreign source form as simply a string of acoustic signals constrained by native segmental and prosodic (e.g. tonal) inventories. For example, the unaspirated allophone of an English voiceless stop (e.g. /t/ in "s**t**ick") will be perceived as an unaspirated stop in Cantonese. At Scansion Two, native phonotactic constraints come into play, and the perceived sound sequence (i.e. output of Scansion One) is adjusted to fit native syllable structures. For instance, English "stick" is perceived as /s tik[H]/ on the Perceptual Level, and adapted as /si[L] tik[H]/ on the Operative Level by vowel epenthesis after /s/ to simplify the complex onset and by assignment of a low (L) tone to the epenthetic syllable. To account for the variation between preservation and deletion, Silverman introduces the notion of phonetic or perceptual salience. Nonsalient segments (e.g. word-final obstruents), are not perceived on the Perceptual Level and thus not realized in the adapted form, as in "ban**d**" (English) > /pɛn< >/ (Cantonese). Salient sounds (e.g. fricatives) are easily perceived and thus preserved, as in "bu**s**" (English) > /pa **s**i/.

Yip (1993) adopts Silverman's (1992) concept of separate perception and adaptation levels. She adheres to Silverman's hypothesis that the recipient language speaker's perception of the foreign word is filtered through their native phonetics and phonology. For the Operative Level, however, Yip employs a formal framework different from Silverman's. In the rule-based analysis of Silverman, processes on the Operative Level stand as "peculiar" to loan adaptation and separate from the native/core phonology (1992: 301). Yip analyzes this level from an OT perspective, which enables her to use the same grammar to account for both loan phonology (at the Operative Level) and the native phonology (also see comments in Jacobs & Gussenhoven 2000: 196-198).

Kenstowicz (2003b) argues that in Fon adaptation of French loans, the perception grammar and the production grammar consist of different constraint hierarchies (cf. Yip 1993, in which only production is analyzed in terms of constraint ranking). In the perception grammar, the constraint against vowel insertion (i.e. Dep-V) has higher priority than that against consonant deletion (i.e. Max-C), which makes it possible for consonants to be deleted at the perception level (e.g. "pos**t**e" /post/ → /pos < >/). In the production grammar, however, Max-C dominates Dep-V, which motivates the preference for vowel insertion to consonant deletion at the production level (e.g. /po**s**/ → /po**su**/).

Based on stress assignment patterns in the loan phonology of Huave and Fijian, Broselow (2005) argues that a bi-level hypothesis with separate perception and production grammars provides a more tenable approach to stress adaptation than the production-oriented accounts proposed by Davidson & Noyer (1997) (for Huave) and by Kenstowicz (2003a) (for Fijian). She observes that since the borrower's native language

provides no evidence for the ranking of the crucial faithfulness constraint that mandates faithful match of the stress position (Match Stress or Max-Stress), the analyses of Davidson & Noyer and Kenstowicz are faced with a learnability problem. Broselow posits that the borrower's perception of foreign stress is regulated by the perception grammar of the native language. Hence, she eliminates the need for loanword-unique constraints and accounts for stress adaptation by the respective constraint-rankings in the native production and perception grammars.

Separation of perception and production brings both advantages and drawbacks to adaptation theories introduced above. On the one hand, it provides a formal mechanism that can generate variation in transformation strategies (e.g. vowel insertion and consonant deletion). Segments that are not perceived will not be realized in the adapted form, while those that are perceived and survive the perception level will be preserved at the production level (e.g. through vowel insertion). Whether a segment will be perceived or not may be either due to the degree of its phonetic salience (Silverman 1992, and Yip 1993) or to the ranking of phonological constraints (Kenstowicz 2003b). On the other hand, the assumption about separate perception and production levels is faced with the same problem as the perception-only approach (Peperkamp 2003, Peperkamp & Dupoux (2003). The hypothesis that the borrower has no access to the source language phonology (Silverman 1992, Yip 1993) may not be appropriate for communities where language borrowing is done by competent bilinguals.

1.2.4 The perceptual-similarity approach

A recent direction in general phonology is to integrate perceptual similarity into the production grammar (e.g. Steriade 2002, Fleischhacker 2001, 2002, Walker 2003), and loanword studies that adopt this approach propose that loan processes tend to maximize the perceptual similarity between the adapted form and the foreign input (Kang 2003, Kenstowicz 2003a, Adler 2004). Kenstowicz (2003a) argues that auditory salience and similarity play a crucial role in Fijian adaptation of English words. Salient segments or structures tend to be preserved in adaptation processes (e.g. stress assignment), and when repairs are needed, modifications will be kept as unobtrusive as possible. For instance, he attributes the dominance of /i/ as the epenthetic vowel to resolve illicit codas (e.g. in "bus" > /basi/) to the fact that /i/ as a high vowel is phonetically short and hence helps create a loan form that is minimally different from the source pronunciation (see Kenstowicz 2003b, for a similar view on vowel insertion in Fon).

Kang (2003) studies Korean adaptations of English post-vocalic word-final stops, contending that considerations of perceptual similarity underlie the variations between vowel insertion and consonant deletion. She finds that the frequencies of vowel insertion correlate with both phonetic and phonological contexts. Vowel insertion is preferred to consonant deletion when the preceding vowel is tense (vs. lax) and when the coda stop is voiced (vs. voiceless). Kang posits that vowel insertion serves as a better strategy in these contexts because it maximizes the perceptual similarity between the English input and the adapted form. For instance, for the higher frequency of vowel epenthesis in relation to vowel quality, she argues that final stops are more likely to be released when following a tense vowel, and thus vowel insertion produces an adapted form of maximal perceptual

similarity with the English pronunciation (e.g. in "pea**k**" > /pʰi**kʰɨ**/, */pʰi**k**/; cf. "comi**c**" > /kʰomi**k**/, */kʰomi**kʰɨ**).

Based on analysis of English loans elicited from Hawaiian speakers, Adler (2004) proposes that loanword adaptation is governed by perceptual as well as articulatory similarity. For example, in segmental adaptation, modifications of voice and place are allowed, but those of sonority and nasality are banned (e.g. /b/ > /p/, */m/; and /t/ > /k/, */n/, * /l/). To account for such patterns, she claims that changes in sonority and nasality are more perceptible than changes in voice and place, which motivates higher priority of preserving the former than the latter in phoneme mappings.

A perceptual-similarity approach to loan phonology has unique advantages over other types of approach. First, integration of perception and production makes it feasible for a single grammar to account for both phonological factors (e.g. mapping between phoneme classes) and non-contrastive phonetic factors (e.g. stop release) in loan adaptation. Second, by building perceptual similarity into the production grammar, a similarity approach avoids the redundancy of having separate perception and production levels as posited in Silverman (1992) and others.

In this section, I introduced the major theories of loanword phonology. Review of these various proposals shows that the recent approach, which integrates perceptual similarity into the production grammar of phonology, stands as a promising direction for loanword research.

The purpose of this dissertation is to analyze the loanword adaptation patterns in Mandarin Chinese from the perspective of perceptual similarity. Following Kang (2003) and others, I propose that loanword phonology optimally produces an adapted form that is perceived by the recipient language speakers as most similar to the foreign source pronunciation. Furthermore, I will argue that when deviations from the expected optimal output occur due to various factors (e.g. socio-cultural and semantic considerations), the extent of deviation is constrained by phonology so that adequate (although not the greatest) perceptual similarity can be attained.

In this research, I assume that foreign words are introduced into Mandarin Chinese by bilinguals, based on the sociolinguistic context of language borrowing in Mainland China. Although contacts between Mandarin and foreign languages, especially English, have been increasing in Mainland China since the late 1970s when China initiated its opening policy, the contacts are mainly through the medium of writing, e.g. published literature of foreign science and technology. Hence, loan adaptation into Mainland Mandarin is generally done by Chinese speakers who are professional translators and have adequate proficiency in the donor language(s). Considering this, I conjecture that the input to Mandarin loanword phonology is the source pronunciation of the borrowed words in the donor language, and that sometimes orthography exerts considerable influence on the phonological processes (e.g. in the adaptation of foreign plosives, see §3.3.1).

It needs to be pointed out that this assumption is more or less idealized. In reality, language borrowing involves diverse factors other than phonology and/or phonetics. Even in the same recipient language community, borrowing may be undertaken under different conditions. For instance, it is observed in sociolinguistic studies that loan adaptation and loan usage are closely related to the degree of bilingualism of either individual speakers or the recipient language community as a whole (Fries & Pike 1949, Haugen 1950, Weinreich 1968, Poplack & Sankoff 1984, Poplack et al. 1988, Rose 1999a). Moreover, other factors such as socio-cultural and aesthetic values, language attitudes and social conventions of loan adaptation all

play important roles in regulating the borrowing process (Weinreich 1968, Poplack et al. 1988, Hock & Joseph 1996, Hualde 1999).

1.3 Loanword adaptation in Chinese: Literature review

The Chinese language is noted for its resistance to lexical importation from foreign languages, and especially for its disfavor against loan adaptation through phonemic transliteration (Cheng 1985, Liu 1986, Norman 1988: 16-22, Chan & Kwok 1990: 1-32, Kuiper 1993, Masini 1993, Hock & Joseph 1996: 274-285, Chen 1999: 99-106, Alleton 2001). The reasons are usually argued to be the linguistic disparities between Chinese and western languages, including phonological, morphological, and orthographic differences (Cheng 1985, Liu 1986, Chan & Kwok 1990, Kuiper 1993, Masini 1993, Chen 1999). Other factors such as national or social attitudes towards loan integration are also considered important forces contributing to the intolerance towards foreign borrowings in Chinese (Cheng 1985, Hock & Joseph 1996, Alleton 2001).

Previous works on lexical importation into Chinese mainly focus on historical, etymological and sociolinguistic descriptions. Gao & Liu (1958) provide the first systematic research of this type. They discuss the history of word borrowing into Chinese from the 3rd century B.C to the 1950s as well as the issues of language planning (e.g. standardization) concerning the adaptation and use of loans. They also touch upon phonological adjustments of borrowings, but the discussions are limited to a brief description of phoneme substitution patterns and methods of resolving consonant clusters and consonant codas. Shi (2000, 2004) focus on the cultural and sociolinguistic dimensions of language borrowing, with data ranging from the 3rd century B.C to the late 20th century. Descriptions of a similar type are presented in Zhou & You (1986) and Chen (1999), although the historical survey is much sketchier.

Some scholars have studied contact between Chinese and Western languages of a specific period. Masini (1993) investigates the development of the Chinese vocabulary during 1840-1849. He traces the etymology of over 500 English and Japanese loans which were borrowed into China along with the importation of Western science, technology and religion. An anthology edited by Lackner, Amelung & Kurtz (2001) examines linguistic and cultural exchanges between China and the West from the late 19th century to the early 20th century. The contributors to this collection look into the translation of Western knowledge, mainly science and philosophy, from various perspectives, for example, by focusing on the rendition of a single term or the terminology of a particular field. Kuiper (1993), for example, studies the influence of Japanese, discussing the importation of Dutch words into Chinese (via Japanese) between 1890s and the 1930s.

Research on contemporary loans in Chinese is also mainly concerned with sociolinguistic descriptions. Cheng (1985) discusses the influence of socio-political and cultural factors by comparing the practices of loan adaptation in Mainland China and Taiwan. Liu (1986) examines issues of language planning and language standardization regarding new terminology borrowed from foreign languages. Lou (1992) compares the translation of foreign proper names (especially surnames and place names) in three varieties of Mandarin, the standard varieties spoken in Mainland China, Taiwan and

Hong Kong. He also analyzes the cultural and social factors that contribute to the differences between these varieties.

Loan adaptation into non-Mandarin dialects of Chinese are rarely studied, except for Cantonese. All works so far reported are based on the Cantonese variety in Hong Kong, which has had close contact with and has borrowed extensively from English since the mid 19th century. Chan & Kwok (1990) study social as well linguistic factors, discussing the integration of English loans on various levels, including phonological, orthographical, morpho-syntactic and semantic adjustments. Bauer & Benedict (1997: 347-405) describe the Cantonese methods of borrowing and the phonological adaptations with respect to segmental, syllabic and tonal mapping. In both studies, however, the discussions of the phonological aspects of loan integration are presented in a descriptive manner, and no formal analysis within contemporary phonological theories is advanced.

Silverman (1992) and Yip (1993) are among the very few studies that have provided theoretical accounts of loanword phonology in a Chinese dialect. Both investigate English loans in Hong Kong Cantonese. The former argues for a multiple-scansion model and gives a rule-based analysis from a phonetic-perceptual perspective. The latter follows Silverman's perception model and proposes a constraint-ranking analysis within the OT framework (see §1.2).

For Standard Chinese (i.e. Mandarin), no comprehensive phonological analyses of loanword adaptation have been advanced. This may be partly due to the fact that Mandarin speakers accord the highest priority to the semantic (vs. phonemic) approach of borrowing. In view of the increasing influence of Western languages (especially English) on Mandarin in recent decades, it is necessary to study Mandarin loanword phonology, and such research can lead to insights into contemporary Mandarin grammar. This dissertation aims to fill the need, by investigating the phonological adaptation of foreign loans in modern Mandarin and proposing formal theoretical explanations for the adaptation processes.

1.4 Research goals

In view of the recent proposals concerning perceptual similarity in loanword adaptation and the lack of comprehensive research on Mandarin loanword phonology, this dissertation is intended to investigate two aspects of loan integration in Mandarin. Firstly, how are foreign phonemes, and in particular consonants, adapted into Mandarin? It is predicted that the variability in segmental mapping is constrained by phonology so that the adapted form will retain sufficient similarity with the source form. Secondly, how do Mandarin speakers nativize foreign syllable structures that are incompatible with their native phonology? Based on the studies reviewed above, it is conjectured that contextual factors (e.g. stress) may influence the likelihood of various repair strategies (e.g. vowel epenthesis and consonant deletion). Thirdly, given that lexical exchanges between languages involve various socio-cultural and socio-linguistic factors, how do these factors influence the phonological adaptation of foreign loans in Mandarin?

To answer these questions, this research analyzes loans borrowed into modern Mandarin from three Indo-European languages, namely, English, German and Italian.

The three languages are chosen as the subject donor languages for three reasons. One is that phonotactically they differ from Mandarin in similar ways. All permit a rich inventory of consonant codas (either obstruents or sonorants) and consonant clusters, although these structures are more restricted in Italian than in English and German (see §2.4). In contrast, Mandarin allows only nasal codas /-n/ and /-ŋ/, with obstruent codas and tautosyllabic consonant clusters being banned entirely. Analysis of how Mandarin speakers adapt similar syllable structures in the three lending languages may not only help construct a comprehensive theory of Mandarin loanword phonology but also reveal universal rules of loanword adaptation in general. The second reason for choosing English, German and Italian is that each of them differs from Mandarin to varying degrees. German and English have far more complex syllable structures than both Italian and Mandarin, and hence words borrowed from these two languages face more adaptations than Italian words. In addition, there are certain phonetic differences among the three languages (e.g. greater degree of velarization of a liquid coda /-l/ in English than in German). Hence, a comparative study of how Mandarin speakers borrow words from these languages can provide a cross-linguistic perspective on loanword phonology and enhance our understanding of the role of phonetic details in phonology.

This research will focus on the phoneme substitution patterns for consonants and the adaptation of foreign syllable structures illicit in Mandarin. Analyses to be presented are mainly based on foreign loans borrowed into Mandarin since the mid-1950s (see Appendices I-III). The general patterns and variability in adaptations of the corpus data will be investigated in detail, and a perceptual analysis within the OT framework (Prince & Smolensky 1993, McCarthy & Prince 1993, McCarthy & Prince 1995) will be proposed. In addition, the influence of sociolinguistic and socio-cultural factors (e.g. the medium of borrowing) on both segmental mapping and phonotactic processes will be examined. Furthermore, online loan perception and adaptation experiments were carried out to test the phonological analysis developed on the basis of the corpus data. Results from the experiments will be compared with the adaptation patterns observed in the existing loans, and the validity of the OT approach proposed earlier will be discussed.

1.5 Data

1.5.1 Data collection

For the purpose of this study, a corpus of modern loans in Mandarin Chinese was compiled. It contains a total of 2423 words, including 1177 English loans, 977 German loans and 269 Italian loans (see Appendices I-III). To avoid regional differences between the standard Mandarin variety spoken in Mainland China (Pǔtōnghuà") and that in Taiwan (Guóyǔ), all data collected are limited to the Mainland variety. They are mostly new lexical items introduced into Mandarin after the mid-1950s, when Mandarin was officially established as the standard variety of Chinese and Pinyin was formally adopted as the standard phonetic notation system for Mandarin. Furthermore, the majority of the words entered Mandarin after the late 1970s, a period during which China has experienced the most dramatic economic development and the most active language contact with the West.

The data were collected during the period of June 2002 and September 2004 from four types of resource. The first type includes a variety of websites operated in Mainland China. Some of them are primarily news-oriented such as the official sites of news agencies (e.g. Xinhua News Agency at <www.xinhuanet.com>). Others are business-oriented or specialize in online shopping (e.g. Yì Qǔ Wǎng at <www.eachnet.com>). Data sources of the second type include some overseas Chinese websites which mainly target Chinese readers from the Mainland. These websites are chosen because they usually contain the latest information on foreign societies and hence stand as a good source of new borrowings. Commodity displays at department stores and supermarkets are the third type. Due to the fact that China-foreign, especially China-West, contact in recent decades lies mainly in the economic and business fields, a large proportion of the most recent loans are related to brand names of products and company names. For the purpose of collecting such words, the author visited a group of department stores and supermarkets in Shanghai, one of China's major economic centers on the east coast where China-foreign contact is very frequent, during her visit to the city in July-August 2002, and recorded the Chinese translations of foreign products displayed for sale. The fourth type of data resource is print materials such as dictionaries (e.g. for Italian loans) and sales promotion brochures. (See Appendix V for the lists of websites, dictionaries and other print materials that were used as data resources.)

1.5.2 Data composition

The corpus data can be classified in two ways: according to the approach by which they are adapted into Mandarin, and according to their meaning category. In terms of adaptation method, the data consist of four types, namely (A) phonemic loans, i.e. words adapted by means of phonemic transcription; (B) semantic loans, words borrowed by meaning translation; (C) graphic loans, words introduced into Mandarin with the original graphic form; and (D) hybrids, words adapted through a combination of more than one approach. (See §2.3 for a detailed introduction to these adaptation approaches.)

The proportions of these four types of loans in the corpus are listed in Table 1.1. It can be seen that phonemic loans and hybrids constitute the bulk of the data. Semantic loans make up a higher percentage in the English loans than in the German and Italian loans. Graphic loans are scant and are only seen in the English data.

Table 1.1. Classification of data by adaptation approach

SL / Loan type	English		German		Italian	
	n	%	n	%	n	%
Phonemic loans	494	41.97	644	65.92	154	57.25
Semantic loans	317	26.93	81	8.29	17	6.32
Graphic loans	4	0.34	0	0	0	0
Hybrids	362	30.76	252	25.79	98	36.43
Total	1177	100.00	977	100.00	269	100.00

According to meaning, the data can be divided into 8 categories, which are: (A) brand name of product; (B) name of company; (C) name of organization; (D) name of person; (E) name of place; (F) name of school; (G) name of sports club/team; and (H) others. For

example, a word standing for the name of a certain product brand (e.g. "ke3kou3ke3le4" < "Coca-Cola") will be categorized as a "brand name of product." The "others" category covers items that cannot be grouped into the other seven. Examples of this type are names of English tests, technological terms and movie titles.

The breakdown of the data based on meaning category is displayed in Table 1.2. Each of the three donor languages contributes to new vocabulary in Mandarin in different ways. The composition of loans borrowed from each language reflects the social reality of economic and cultural communications between China and the donor language nation(s). In the English loans, the dominant categories are "name of company" (50.98%), "brand name of product" (15.38%) and "name of person" (14.44%). The dominance of company names and brand names correlates with the fact that China and the English nations (especially the United States) have close and dynamic economic exchanges in contemporary eras.

Table 1.2. Classification of data by meaning category

SL / Categories	English		German		Italian	
	n	%	n	%	n	%
Brand name of product	181	15.38	54	5.53	27	10.04
Name of company	601	51.06	121	12.38	16	5.95
Name of organization	34	2.89	17	1.74	0	0
Name of person	170	14.44	59	6.04	7	2.60
Name of place	18	1.53	595	60.90	193	71.75
Name of school	32	2.72	72	7.37	1	0.37
Name of sports club/team	45	3.82	39	3.99	25	9.29
Others	96	8.16	20	2.05	0	0
Total	1177	100.00	977	100.00	269	100.00

The German data consist mostly of "name of place" (60.90%), followed by "name of company" (12.38%) and "name of school" (7.37%). That company names and brand names constitute a much smaller proportion of the German loans than of the English loans partly reflects the fact that that the trade ties between China and Germany are relatively weak, so the extent of Chinese speakers' knowledge of German is not as widespread as that of English-speaking societies. In fact, it is hard to find German loans in the news and other information resources aimed at the general public. The overwhelming majority of German place names (441/595, 74.12%) come from a website named Zhong1de2qiao2, literally meaning *China-Germany bridge* at <http://www. brucca.de>, which specializes in professional translation between Mandarin and German.

Similar to the German data, Italian loans mainly consist of place names (193/269, 71.75%), while other categories such as brand names account for a small proportion. Almost all of the place names (191/193, 98.96%) are taken from a published dictionary, Dizionario Italiano-Cinese [*Chinese-Italian Dictionary*] (1985). The number of Italian loans available in various resources is very small, which is closely related to the social

reality that China-Italy economic contact is not as extensive as that between China and the other donor language nations.

Based on the composition of semantic categories as shown in Tabel 1.2, it can also be inferred that proper nouns, e.g. words referring to names of person or company, constitute the overwhelming majority of the data, whereas non-proper (or common) nouns (e.g. "wei1-bo1-lu2" *micro-wave-stove* < "microwave") and words of other classes such as verbs (e.g. "xia4-zai4" *down-load* < "download") are few. The proportions of proper nouns and other words in the data are listed in Table 1.3.

Table 1.3. Proper nouns vs. other words

Source language Word class	English		German		Italian	
	n	%	n	%	n	%
Proper nouns	1159	98.47%	978	100%	269	100%
Other	18	1.53%	0	0	0	0
Total	1177	100%	984	100%	269	100%

From the table, it can be seen that except for 18/1177 (1.53%) words in the English loans, all other terms are proper names. The dominance of proper nouns in the corpus results from the sociolinguistic reality of modern China, where a vast number of brand names and company names enter the Chinese language as a result of the influx of foreign products such as cosmetics, cars and domestic appliances in recent decades.

The English loans can be further broken down into three groups by national origin, as is shown in Table 1.4. There are four regional or national varieties that contribute to the English borrowings, namely, American English, British English, Canadian English, and Australian English. [1] The "unidentified" category includes words whose national origins are unknown or hard to trace. For one thing, it is impractical and unnecessary (although not impossible) to give the precise national origin of a word such as "Parkinson" (name of a disease) and "microwave" (name of product). For another, names of people are not classified since it is difficult to determine the nationality (or citizenship) of every name, especially in the United States, where there are immigrants from all parts of the world. The statistics in Table 1.4 show that American English stands as the most significant donor of English loans in modern Mandarin, making up 61.85%, followed by British English (15.55%), Canadian English (3.14%) and Australian English (1.44%). Furthermore, in the loans borrowed from each English variety, company names constitute the largest category. These features of the English data reflect that English-speaking countries are important trade partners of Mainland China.

---

[1] The German and Italian data are of a single national origin, i.e. Germany for German loans and Italy for Italian loans. Loans from German and Italian varieties spoken in countries other than Germany and Italy (e.g. Swiss German and Austrian German) were not collected because there were too few of them in Mandarin.

Table 1.4. English loans by national origin

	U.S.	U.K.	Canada	Australia	Unidentified
Brand of product	131	46	2	2	0
Name of company	477	84	27	13	0
Name of organization	20	6	1	0	7
Name of person	/	/	/	/	170
Name of place	16	2	0	0	0
Name of school	26	3	3	0	0
Name of sports club/team	13	32	0	0	0
Others	45	10	4	2	35
Total n	728	183	37	17	212
Total %	61.85%	15.55%	3.14%	1.44%	18.01%

1.5.3 Target structures: Consonants and consonant clusters

The phonological structures to be analyzed in this research are word-initial and word-final consonants and consonant clusters in the corpus data. They are categorized and calculated according to five criteria:

(a) If a term consists of more than one morpheme, the initial and final structures in each morpheme will be counted. For example, the word "Dodge Ram" (English, brand name of automobile) is considered to contain four target structures, i.e. onset /d-/ and coda /-dʒ/ in "Dodge," plus onset /ɹ-/ and coda /-m/ in "Ram."

(b) If a source element appears in different terms and has an identical adapted form, it will be counted only once. For example, the token "Bill" in "**Bill** Clinton" (English, person name) and "**Bill** Gates" (English, person name) is adapted as 比尔 "bi3-er3" /pi-ɚ~/ in both cases, thus it will be analyzed only once, rather than separately each time it appears.

(c) If a source element appears in different terms and has different Mandarin forms, it will be analyzed separately. For example, "Eric" in "**Eric** Lonergan" (English, person name) is borrowed as 艾利克 "ai4-li4-ke4" /ai-li-kʰɤ/, but in "**Eric** Roth" (English, person name), it is adapted to be 埃里克 "ai1-li3-ke4" /ai-li-kʰɤ/. In such cases, the recurrent form will be counted each time it has a different Mandarin form.

(d) If a source form entered Mandarin before the 1950s or was borrowed via a language other than the original source language, its adaptation will be excluded from phonological analysis. Examples are the German terms "Union Berlin" (name of a soccer club) and "Fortuna Köln" (name of a soccer club). The former is classified as a semantic loan (rather than a hybrid with "Berlin" being a phonemic adaptation) in that "Berlin" entered Mandarin before the 1950s and is already a well-established lexical item in Mandarin. In the latter, "Köln" was borrowed via English "Cologne" as 科隆 "ke1-long2" /kʰɤ-luŋ/, and hence in analyzing the adaptation of consonantal structures, only the first part "Fortuna" is considered.

16

(e) If a foreign term has two or more Mandarin forms, only the most commonly used adaptation will be considered for phonological analysis. (The degree of "commonness" is judged according to the author's personal experience as a native Mandarin speaker.) For example, English "Intel" (name of a U.S. company) has two adapted forms, namely 英特尔 "ying1-te4-er3" /iŋ-tʰɤ-ɚ/ and 因特尔 "yin1-te4-er3" /in-tʰɤ-ɚ/. The first version ("ying1-te4-er3") is used more commonly and thus is taken as a subject form for phonological analysis, while the other one is excluded.

Word-internal consonantal structures are excluded due to the potential ambiguity in syllabification. For instance, a nasal /-m/ in "Hu**mm**er" (English, brand name of automobile) may be pronounced as ambisyllabic, which renders it hard to determine whether it should be considered as an instance of coda (or the preceding syllable) or onset (of the following syllable).

The total numbers of word-initial and -final structures calculated according to the above criteria are listed in Table 1.5. Mandarin adaptation of these structures will be analyzed in detail to investigate segmental mapping from the lending languages to Mandarin and phonotactic repairs of syllable structures illicit in Mandarin, which include simplex codas, onset clusters and coda clusters.

Table 1.5. Summary of consonant structures

Structure	English		German		Italian	
	Onset	Coda	Onset	Coda	Onset	Coda
C	797	632	663	560	177	8
C_1C_2	130	186	125	228	30	0
$C_1C_2 C_3$	3	17	6	7	1	0
$C_1C_2 C_3 C_4$	0	1	0	1	0	0
Total	928	835	794	796	208	8

1.6 Outline

The rest of this dissertation is structured as follows. Chapter 2 provides a survey of the language situation in China and loanword adaptation in the Chinese language. In addition, it introduces Mandarin phonology as well as its writing system and presents a brief comparison between the three donor languages on the one hand and Mandarin on the other. Chapters 3 and 4 constitute the bulk of the dissertation, in which Mandarin nativization of foreign consonant structures is investigated in detail and an OT analysis from a perceptual perspective is proposed for the adaptation patterns observed in the corpus data. More specifically, Chapter 3 examines the phoneme mapping of consonants, and Chapter 4 analyzes the repair processes for syllable structures illicit in Mandarin. Both chapters also touch upon the influence of socio-linguistic and socio-cultural factors on both phoneme substitution and the choice of phonotactic strategies. Chapter 5 reports results from three experiments that were designed to test the perceptual hypotheses

proposed in Chapters 3 and 4. Lastly, Chapter 6 concludes the dissertation, summarizing the major findings and discussing the contributions of this study as well as directions for future research.

Chapter 2
Background

This chapter introduces some background knowledge for discussions in the following chapters. Section §2.1 gives a survey of the language situation in China and the history of lexical borrowing into Chinese. §2.2 discusses the major approaches to loanword adaptation in Mandarin and in the Chinese language in general. A brief introduction to the Mandarin phonology and writing system is presented in §2.3. Lastly, §2.4 discusses the major phonological and orthographic differences between the donor languages (English, German and Italian) and the recipient language (Mandarin) (§2.4).

2.1 The Chinese language

2.1.1 Languages and dialects in modern China

China is a multilingual nation, with over 80 languages spoken by 56 ethnic nationalities (e.g. Dai & Dong 1999). These languages belong to five different language families: Sino-Tibetan, Altaic, Malayo-Polynesian, Austro-Asiatic and Indo-European (Tseng 1985, Zhou & You 1986: 6). Chinese, the native language of the Hàn nationality in Mainland China, has the largest population. According to China's fifth National Population Census undertaken in November 2000, the Hàn people constitute 91.59% of China's total population, with the remaining 55 nationalities, often referred to as "ethnic minorities," together accounting for 8.41% (Zhōnghuá Rénmín 2000). Two nationalities, Mǎn (Manchu) and Huí, have almost entirely assimilated into the Hàn culture and speak Chinese as their only native language. The remaining 53 ethnic minorities speak more than 80 languages (Lǜ & Dai 2000).

The Chinese language belongs to the Sino-Tibetan language family. It consists of seven major dialect groups or dialect families, generally classified as Mandarin, Wú, Xiāng, Gàn, Mǐn, Kèjiā (Hakka) and Yuè (Cantonese) (Chen 1999, Norman 1988, Ramsey 1987, cf. DeFrancis 1984). Mandarin is also known as the Northern Dialect, and the six non-Mandarin dialect groups are collectively referred to as the "Southern Dialects." Mandarin is the base dialect of the national standard language Pǔtōnghuà (also "Standard Mandarin," "Standard Chinese" or "Modern Standard Chinese"), the Mandarin variety spoken in China's capital, Běijīng (Peking). Each of the seven dialect groups can be further divided into various sub-varieties or sub-variety groups. The different varieties of Mandarin are mutually intelligible, but varieties of the six Southern dialectal groups are not mutually intelligible either with Mandarin or among themselves.

Uses of the English term "Mandarin" are not consistent in the Western literature on Chinese linguistics. In the classification system given above, "Mandarin" is taken as a cover term for the group of dialects called by Chinese linguists as "Běifāng fāngyán" *northern dialect* (e.g. Zhou & You 1986) or "Guānhuà" *official speech* (e.g. Lǚ & Dai 2000). There are some other works which use "Mandarin" to refer to "Standard Chinese" (e.g. DeFrancis 1984: 39). In this dissertation, I follow the latter school, using "Mandarin" (or interchangeably "Mandarin Chinese") to mean the standard Chinese language spoken in Mainland China.

2.1.2 History of Chinese

The recorded history of the Chinese language can be traced back to the Shāng dynasty (17th - 11th century BC). The language spoken in the area of Yīnxū, the capital of Shāng between the 14th and 11th century BC, was probably the lingua franca for communications between different clans and tribes (Chen 1999). Yīnxū was located in the north of today's Hénán Province in the Yellow River region. The language of Shāng may be the ancestor of the modern northern Mandarin dialect. The earliest written records in Chinese history were "Jiǎgǔwén" (*shell-bone-writing*), which were texts inscribed on tortoise shells and animal bones. The Jiǎgǔwén symbols are known to be the primitive form of the Chinese writing system (De Francis 1984).

Based on Chen (1999), Norman (1988) and Xiàndài Hànyǔ Cídiǎn *Modern Chinese Dictionary* (2001), the chronology of the Chinese language is outlined in (1). The development of Chinese is divided into four stages, namely Archaic Chinese (Shànggǔ Hànyǔ), Middle Chinese (Zhōnggǔ Hànyǔ), Pre-modern Chinese (Jìndài Hànyǔ) and Modern Chinese (Xiàndài Hànyǔ) (see Norman 1988, Chen 1999). Archaic Chinese was spoken before the Western Hàn (206 BC - AD 24) dynasty. The Eastern Hàn period (AD 25-220) marked the beginning of Middle Chinese, which lasted until the Táng dynasty (AD 618-907). The development of a vernacular literary genre in Late Táng represented the start of Pre-modern Chinese. Modern Chinese, which differs little from contemporary Chinese speech, began in the Qīng dynasty (AD 1616-1911).

After the Qín-Hàn period, gradual expansion of the Chinese territory and migration of the Hàn people led to the development of different regional dialects of the Chinese language (Norman 1988, Zhou & You 1986). These various dialects carry traces of Chinese in different historical stages. For instance, Wú and old Xiāng dialects originated from the southward movement of the Hàn people whose language was very close to Archaic Chinese, whereas other dialects such as Yuè and Gàn developed as a result of later migration.

In the long imperial history of China lasting from the 3rd century BC until the early 20th century, there had always been certain varieties of Chinese serving as the norms for oral communications in the vast territory. The speech standards evolved along a route of

(1) History of Chinese

Pre-historic period	Five Kings period (Wǔdì) (ca. 26th - ca. 21st century BC)
	Xià dynasty (ca. 21st - 17th century BC)
Archaic Chinese	Shāng dynasty (ca. 17th - ca. 11th century BC)
	Western Zhōu dynasty (Xīzhōu) (ca. 11th century - 771 BC)
	Spring and Autumn period (Chūnqiū) (770 - 476 BC)
	Warring States period (Zhànguó) (475 - 221 BC)
	Qín dynasty (221 - 207 BC)
	Western Hàn dynasty (Xīhàn) (206 BC - AD 24)
Middle Chinese	Eastern Hàn dynasty (Dōnghàn) (AD 25 - 220)
	Three Kingdoms period (Sānguó) (AD 220 - 265)
	Western Jìn dynasty (Xījìn) (AD 265 - 316)
	Eastern Jìn dynasty (Dōngjìn) (AD 317 - 420)
	Southern and Northern dynasties (Nánběicháo) (AD 420 - 589)
	Suí dynasty (AD 581 - 618)
	Táng dynasty (AD 618 - 907)
Pre-modern Chinese	Late Táng dynasty
	Five Dynasties period (Wǔdài) (AD 907 - 960)
	Northern Sòng dynasty (Běisòng) (AD 960 -1127)
	Southern Sòng dynasty (Nánsòng) (AD 1127 - 1279)
	Yuán dynasty (AD 1206 - 1368)
	Míng dynasty (AD 1368 - 1644)
Modern Chinese	Qīng dynasty (AD 1616 - 1911)
	Republic of China (AD 1911 - 1949, in Mainland China; 1949 - , in Taiwan)
	People's Republic of China (AD 1949 -)

(Based on Chen 1999: 2, Norman 1988: 23-28, XiàndàiHànyǔ Cídiǎn 2001)

yǎyán - tōngyǔ - guānhuà - guǒyǔ - pǔtōnghuà. Yǎyán 雅言 *elegant speech* developed from the lingua franca of Shāng and served as the official language for educational and political activities in the Western Zhōu dynasty and centuries afterwards (Chen 1999, Lǚ & Dai 2000). The term "tōngyǔ" 通语 *common speech* first appeared in the late Western Hàn dynasty to refer to the common language spoken in North China. Similar to yǎyán, it was based on the language spoken in the Yellow River region. It was also referred to as "zhōngyuán zhīyīn" 中原之音 *pronunciation of the Central Land* by scholars of later dynasties. During the more recent Míng and Qīng dynasties, the official speech was called "guānhuà" 官话 *official speech*, which was more or less the same as tōngyǔ, except for differences in name. All of these standards of the Chinese speech were Mandarin varieties spoken in Central and Northern China.

Since the middle of the 19th century, i.e. the late Qīng period, the Mandarin variety spoken in the area of Běijīng gained prestige and gradually replaced "zhōngyuán zhīyīn" as the official speech. This was largely because Běijīng had been the capital of several

dynasties from Liáo (AD 916-1125) to Qīng (AD 1616-1911). Běijīng Mandarin was officially designated as the national standard, i.e. guóyǔ 国语 *national language*, by the government of the Republic of China in the 1920s. The term "guóyǔ" has continued to be used in Taiwan until today. After the People's Republic of China was founded in 1949, the new government largely adopted the same language policy as the former Nationalist government and advocated Běijīng Mandarin as the standard variety of Chinese. In October 1955, Modern Standard Chinese was formally named "Pǔtōnghuà" 普通话 *the common speech* (Norman 1988, Chen 1999, Ramsey 1987, Lü & Dai 2000). The history of the standard spoken language in China shows that Mandarin has always been the prestige dialect due to the lasting political and cultural importance of North China.

In contrast to the constant evolution of speech, the written language of Chinese has changed little ever since it took shape in the Western and Eastern Hàn periods until the early 20th century (Norman 1988). This particular style of writing, called "Wényán" 文言 *literary language*, was the standard for literary writing and other formal texts. Although the oral vernacular, "Baihua" 白话 *plain speech*, began to be used in the literature at the end of the Táng dynasty, it was limited to informal writings (Chen 1999). With the spoken language constantly developing, but the written language staying almost unchanged, the disparity between speech and writing increased over time.

It was only in the 1920s that scholars proposing social and political reforms in China advocated the unification of speech and writing. As a result of the language reform, vernacular writing gradually gained ground. Modern written Chinese is very close to Mandarin speech.

2.1.3 History of lexical borrowing into Chinese

Generally speaking, Chinese has been very resistant to borrowing from other languages (e.g. Norman 1988: 16-22, Amelung, Kurtz & Lackner 2001). By the middle of the 19th century in the late Qīng dynasty, China held a pre-eminent political and cultural position in East Asia. Chinese was a major exporter of vocabulary to the neighboring languages, and the Chinese writing system was adopted by a number of languages such as Vietnamese, Korean and Japanese (Norman 1988: 16-22, Zhou & You 1986 1986: 272-288). Even after the Sino-British Opium War (AD 1840-1842), when foreign loans, especially words from European languages, increased dramatically, Chinese speakers still tended to minimize the foreign color of borrowed terms as much as possible. For instance, they gave high priority to the semantic method of borrowing (e.g. meaning translation) rather than adapting the foreign pronunciation directly (see §2.2).

In the following, I will review briefly the history of major contacts between Chinese and other languages by focusing on lexical borrowing into Chinese. For the sake of brevity, the donor languages will include only languages of foreign countries, whereas non-Chinese languages within the Chinese border (i.e. languages of ethnic minorities) will not be addressed. Discussions will be presented in the following order: (1) Borrowing from Central Asian languages during the Western Hàn and Eastern Hàn dynasties; (2) Importation of Buddhist terms from Sanskrit and other terms from Central Asian languages during the late Eastern Hàn and the Táng dynasty; (3) Introduction of

Christianity and western learning during the Míng and Qīng dynasties; (4) Borrowing of modern knowledge from European languages and Japanese from the 1840s to 1940s; (6) Influx of Russian, English and other European languages from 1949 to present. Discussions below draw heavily from Gao & Liu (1958), Zhou & You (1986), Masini (1993), Chen (1999) and Shi (2000), (2004).

During the Western Hàn (206 BC - AD 24) and Eastern Hàn (AD 25 - 220) dynasties, Chinese had close contacts with languages in the central Asian region, known as "Xīyù" 西域 *western land*, on its northwestern border. It was during this period that an important inner land trade route, the Silk Road, took shape. Along with trade and cultural exchanges between China and various ancient tribes along the Silk Road, a large number of terms related to material objects produced in the region were introduced into Chinese. Many of these words were from Elam, the ancestor of ancient Persia and today's Iran. Examples of ancient Elamite loans are given in (2). (An asterisk on a source form represents a reconstructed form.).

(2)　Loans from ancient Elamite

SF	MC Pinyin	IPA	WF	Gloss
sēr	shi1-zi	/ʂɻ-tsẓ/	狮子	lion
*buksuk	mu4-xu1	/mu-ɕy/	苜蓿	lucerne (alfalfa)
budāwa	pu2-tao2	/pʰu-tʰɑu/	葡萄 ＜ 蒲桃	grape
arsak	shi1-liu ＜	/ʂɻ-liu/ ＜	石榴 ＜	pomegranate
	an1-shi2-liu	/an-ʂɻ-liu/	安石榴	

(Sources: Zhōu & Yóu 1986, Shi 2000, 2004)

In addition, the name of an ancient tribe, Xiōngnú 匈奴 or Hú 胡 (the Huns), became extensively used in Chinese.[2] It developed into a prefix that refers to things imported into China from the non-Chinese cultures on the northern and western borders. The data in (3) are examples of Hú-prefixed words in modern Chinese.

The period from late Eastern Hàn to the Táng dynasty saw an influx of Buddhist terms from Sanskrit and various words from Central Asian languages (e.g. Persian and Arabic). Buddhism entered China probably in late Eastern Hàn from ancient India via the Central Asian region along the Silk Road (Shi 2000). It gained great popularity during the Southern and Northern dynasties (AD 420-589) on account of support from the ruling class. The spread of Buddhism and translation of Buddhist texts reached its peak in Suí (AD 581-618) and Táng (AD 618-907) (Gao & Liu 1958, Zhou & You 1986, and Shi 2000, 2004).

---

[2] The English terms for the ancient ethnic groups and their languages on the Chinese border are based on resources retrieved June 2005 from the online encyclopedic "Wikipedia" at <www.wikipedia.org>.

(3) Hú-prefixed words in modern Chinese

MC Pinyin	IPA	WF	Gloss
<u>hu</u>2-luo2-bo0	/<u>xu</u>-luɔ-puɔ/	胡萝卜	carrot
<u>hu</u>2-qin2	/<u>xu</u>-ɕin/	胡琴	Hun instrument
<u>hu</u>2-yue4	/<u>xu</u>-yɛ/	胡乐	Hun music
<u>hu</u>2-jiao1	/<u>xu</u>-tɕiɑu/	胡椒	pepper
<u>hu</u>2-gua1	/<u>xu</u>-kua/	胡瓜	cucumber

(Sources: Zhōu & Yóu 1986, Shi 2000, 2004)

Most Buddhist texts were translated from Sanskrit, although some were from other languages (e.g. Paali 巴利文, spoken in ancient India). Among the large number of Buddhist words borrowed into Chinese, some are used only in Buddhist texts (e.g. "ni2li2" 泥犁 *the hell*), while there are others that have undergone semantic changes and become lexical items in everyday speech (e.g. "cha4na4" 刹那 *a short second*) (Zhou & You 1986). More examples of Buddhist terms are given in (4).

Borrowings from Central Asian languages (e.g. Persian and Turkic), were mainly terms related to the material culture and social system of ancient nations and tribes in the region. The nomadic peoples on the northern and western frontier of China (e.g. Xiānbēi 鲜卑 and Tūjué 突厥 *the Turks*) grew in strength during the Southern and Northern dynasties. Constant wars between these states and China led to frequent language contacts, which led to the introudciotn of words related to the social system in this region.

(4) Buddist terms borrowed into Chinese

SF	MC Pinyin	IPA	WF	Gloss
Buddho	fo2 / fo2-tuo2	/fuɔ/, /fuɔ-tʰuɔ/	佛 / 佛陀	Buddha
Samgha	seng1/seng1-jia1	/səŋ-tɕia/	僧 / 僧伽	monk
Dhyana	chan1/chan2-na4	/tʂʰan/, /tʂʰan-na/	禅 / 禅那	meditation
Kalpa	jie2/ jie2-bo1	/tɕiɛ/, /tɕiɛ-buɔ/	劫 / 劫波	destined disaster
Bodhi	pu2-ti2	/pʰu-tʰi/	菩提	supreme wisdom
Bhiksuni	bi3-qiu1-ni2	/pi-tɕʰiu-ni/	比丘尼	nun

(Sources: Shi 2000, Gao & Liu 1958)

Furthermore, during Suí and Táng, China entered one of the most prosperous periods in its history. The Táng dynasty conquered a vast area in Central Asia, and the Silk Road running from China through Central Asia continued to be an important trade route. Thus, contacts between Chinese and the languages spoken along the road remained active and frequent. Examples of words imported into Chinese during this period are given in (5).

(5) Terms borrowed from frontier states or tribes

SL	SF	MC Pinyin	IPA	WF	Gloss
Persian	mor	mo4-yao4	/muɔ-iɑu/	没药	medicine
	sirsir	se4-se4	/sɤ-sɤ/	瑟瑟	green precious stone
	taburah	da2-la4-gu3	/ta-la-ku/	答腊鼓	musical instrument
Tocharian	sale	sha1-la4/	/ʂa-la/	沙腊	music term
	pancam	ban1-shan4	/pan-ʂan/	般嬗	music term
Turkic	beri	bi4-li4	/pi-li/	筚篥	musical instrument
	Iduqu-qut	yi4-du1-hu4	/i-tu-xu/	亦都护	chief of a Turk tribe
	qaghan	ke3-han2	/kʰɤ-xan/	可汗	Turk king

(Source: Shi 2000)

During the Míng (AD 1368-1644) and Qīng (AD 1616-1911) dynasties, Christianity and European learning were introduced into China. Missionary activities of the European Jesuits began in China in the 1580s in the late Míng dynasty (Chen 1999: 100-101, Masini 1993: 5-8, Shi 2000: 58-59, 2004: 220-222).[3] The earliest missionaries were Italians, the most famous being Matteo Ricci, who was among the pioneers introducing western science into China. In the 17th and 18th centuries of the early and mid Qīng dynasty, there were missionaries from different European countries such as Belgium and Germany (Shi 2000: 58). Proselytization of the Christian religion in China was naturally accompanied by the translation of religious texts into Chinese. Some words may have been borrowed from Latin, especially in the early proselytizing activities, and others may have been imported via English (Gao & Liu 1958). Examples of Christian terms are given in (6). (Since it is hard to trace the origin of each individual term, only the English forms are given although English might not necessarily be the source language.)

(6)   Terms of Christianity borrowed in late Míng dynasty

English	MC Pinyin	IPA	WF
Jesus	ye1-su1	/iɛ-su/	耶稣
amen	a1-men2	/a-mən/	阿门
Satan	sa4-dan4	/sa-tan/	撒旦
Judas	you2-da4	/iou-ta/	犹大

(Sources: Chan & Kwok 1990: 11-12, Shi 2004)

---

[3] According to Shi (2004), Christianity was in fact introduced into China by the Syrians in as early as AD 635 during the Táng dynasty, but it soon disappeared at the end of Táng when the court banned Buddhism (and probably all foreign religions).

Jesuit missionaries were also the pioneers to bring Western science and technology to China. With the translation of modern European knowledge, a variety of terms related to such subjects as mathematics and astronomy were translated into Chinese. Examples are "ji3-he2" < "geometry," and "di4-qiu2" < "earth" (Chen 1999: 100-101).

The Sino-British Opium War of 1840-1842 was the turning point of lexical exchanges between Chinese and foreign languages. Before the 1840s, Chinese had been the major exporter of culture and vocabulary (e.g. Norman 1988: 16-22). After being defeated in the Opium War, the imperial government of the late Qīng dynasty was forced to open trade ports on the coast. For over a century after the war, China remained a semi-colonized country and experienced invasions by the major world powers such as Britain, France and Japan. Against this background, many Chinese scholars in the 19th century felt a strong need to learn from the West and to reform the country (Masini 1993, Chen 1999: 100-106, Shi 2000, 2004).

Starting from the 1860s, Western works were introduced into China on a massive scale by both governmental translation institutions and individuals. Most works translated into Chinese in the 19th century were from English. Borrowings from English included terms of diverse subjects, such as politics and science as well as words for daily life. Examples are given in (7). Loans entering Chinese during this time played an important role in the development of modern learning in China.

(7)	SF	MC Pinyin	IPA	WF
	democracy	de2-mo2-ke4-la1-xi1	/tɤ-muɔ-kʰɤ-la-ɕi/	德谟克拉西
	boycott	bei1-ge2	/pei-kɤ/	杯葛
	calorie	ka3-lu4-li3	/kʰa-lu-li/	卡路里
	aspirin	a1-si1-pi3-lin2	/a-sẓ-pʰi-lin/	阿斯匹林
	grammar	ge2-lang3-ma3	/kɤ-lɑŋ-ma/	葛朗玛
	camera	ka3-mai4-la1	/kʰa-mai-la/	卡麦拉
	toast	tu3-si1	/tʰu-sẓ/	吐司
	kiss	kai1-si1	/kʰai-sẓ/	开司
	darling	da2-ling4	/ta-liŋ/	达令
	mister	mi4-si1-tuo1	/mi-sẓ-tʰuɔ/	密斯脱

(Source: Shi 2000: 62-69)

In the late 19th and the early 20th centuries, Japanese translations of modern western knowledge gained popularity in China and became the predominant source of European learning for Chinese scholars (Gao & Liu 1958, Zhou and You 1986, Kuiper 1993, Masini 1993, Chen 1999, Shi 2000, 2004). The Sino-Japanese War of 1894-1895, which ended with China being defeated by the Japanese navy, marked the beginning of a reverse in the cultural and lexical exchanges between the two countries. Prior to the 1890s, China had been the primary resource of knowledge and vocabulary for Japanese. Japanese scholars also received their earliest knowledge of European societies and science through the Chinese translations of western works (e.g. Masini 1993: 106-108, Chen 1999: 101). After the Meiji restoration started in 1868, Japan began to learn

intensively from European countries like Holland and Germany, and western knowledge was translated directly into Japanese rather than via Chinese. Within decades, Japan transformed from a weak feudal society into a strong military power. After the Sino-Japanese war, Chinese intellectuals looked upon Japan as the model of modernization and social reforms. Japanese works on western learning were introduced into China in great numbers. For instance, Masini (1993: 107) observed that there were 958 Japanese works translated into Chinese between 1896 and 1911.

Japanese loans were mostly borrowed directly through the graphic form (instead of meaning translation or phonemic adaptations), since Japan used the same writing system as Chinese (also see §2.2.3). For this reason, Japanese loans were termed "Japanese graphic loans" (Masini 1993) or "rìběn hànzì cí" 日本汉字词 in Chinese (Shi 2000, 2004). When Japanese words were adapted, their source pronunciation was generally ignored, with Chinese speakers reading the written characters in their own way.

Graphic loans borrowed from Japanese consist of mainly three categories, examples of which are given in (8). The first is called "return loans" (Masini 1993). They were originally words in classic Chinese, borrowed into Japanese to denote new notions, and then imported back into Chinese with the meaning newly assigned in Japanese. The data in (8a) are of this type (e.g. "wen2-xue2" /uən-ɕyɛ/ 文学 *literature-study* < "bungaku" 文学 *literature*). The second category refers to words that were coined by Japanese speakers by use of Chinese characters and Chinese meanings so as to translate western terms according to meaning. Examples of such words are in (8b) (e.g. "mei3-xue2" /mei-ɕyɛ/ 美学 *beauty-study* < "bigaku" 美学 *aesthetics*). The last group contains terms created in Japanese by the use of Chinese characters to phonemically transcribe the pronunciation (rather than meaning) of western words. Words in (8c) illustrate this category (e.g. "wa3-si1" /ua-sɹ̩/ 瓦斯 *"tile-this"* < "gasu" 瓦斯 *gas*). (See Gao & Liu 1958, Masini 1993, Chen 1999 and Shi 2000, 2004, for detailed discussions of Japanese graphic loans.)

(8) Japanese graphic loans

	Characters	Jap pronun.	MC Pinyin	IPA	English
a)	文学	bungaku	wen2-xue2	/uən-ɕyɛ/	literature
	艺术	geijutsu	yi4-shu4	/i-ʂu/	art
	自由	jiyaa	zi4-you2	/tsɹ̩-iou/	freedom
	革命	kakumei	ge2-ming4	/kɤ-miŋ/	revolution
b)	美学	bigaku	mei3-xue2	/mei-ɕyɛ/	aesthetics
	唯物论	yuibutsuron	wei2-wu4-lun4	/uei-u-lun/	materialism
	抽象	chuusho	chou1-xiang4	/tʂou-ɕiaŋ/	abstract
	电报	denpoo	dian4-bao4	/tiɛn-pɑu/	telegraph
c)	瓦斯	gasu	wa3-si1	/ua-sɹ̩/	gas
	淋巴	rinpa	lin2-ba1	/lin-pa/	lymph

(Sources: (a) - (b) Gao & Liu 1958: 83-98; (c) Shi 2004: 260)

Contacts between Chinese and other languages from 1949 to the present time can be divided into two periods. The first lasted from 1949 to the mid 1960s, when a large number of Russian words were borrowed. The second is from the late 1970s to the present, when words from various foreign languages, especially English, have entered as a result of China's opening policy and economic reforms.

The influence of Russian in the 1950s until the 1960s was mainly due to the political and diplomatic environment of China in that period (Shi 2000, Shi 2004). After it was founded in 1949, the People's Republic of China had Russia (formerly the Soviet Union) as its primary international partner and supplier of technological and industrial aids. Russian books and journals were the dominant media of foreign science and technology that China had access to. This situation lasted until the mid 1960s when the Cultural Revolution began and China entered a ten-year period of political turmoil.

Russian loans borrowed during the 1950s and 1960s involved terms in diverse fields, for example, political systems, science, literature, music and food. Most of them were imported through semantic translation, with only a small proportion adapted through phonemic transcription (Shi 2000: 79). Examples of phonemic loans from Russian are given in (9). Russian loans generally had a short life span. When the relationship between China and Russia deteriorated during the mid 1960s and 1970s, most terms disappeared from Chinese, except for a few (e.g. "fu2-te4-jia1" < водка, *vodka*) that are still commonly known (Shi 2004: 273-275).

(9) Russian loans borrowed during the 1950s and 1960s

SF	IPA	MC Pinyin	IPA	WF	Gloss
дума	/dumə/	du4-ma3	/tu-ma/	杜马	Russian congress
пуд	/put/	pu3-te4	/pʰu-tʰɤ/	普特	unit of weight
махорка	/maxoɾkə/	ma3-he2-[yan]	/ma-xɤ-iɛn/	马合烟	a kind of tobacco
рубль	/ɾubʎ/	lu2-bu4	/lu-pu/	卢布	unit of currency
водка	/votkə/	fu2-te4-jia1	/fu-tʰɤ-tɕia/	伏特加	a kind of liquor
платье	/platʲjɛ/	bu4-la1-ji2	/pu-la-tɕi/	布拉吉	dress
азарин	/azaɾʲin/	a1-zha1-lin2	/a-tʂa-lin/	阿扎林	a yellow dye

<div align="right">(Sources: Shi 2000: 78-81, 2004: 272-275)</div>

The second period during which China borrowed extensively from foreign languages was the late 1970s - present. From the mid 1960s to the late 1970s, China was in great political turmoil, and little contact between Chinese and foreign languages took place. The situation changed dramatically in 1978 when China formally initiated its economic reforms. Along with increased communication with Western countries, words and expressions from many languages have been borrowed. English loans in particular constitute the largest proportion. Since foreign loans introduced into Chinese during this period will be the focus of this study, detailed discussion will not be given here.

In summary, a variety of languages have contributed to the development of the Chinese lexicon throughout history. In ancient periods, especially before the 1840s, the donors were mainly languages on the border of the Chinese empire, or in the Central

Asian region where trade with China prospered. After the 1840s, languages coming into contact with Chinese through sea routes, i.e. those spoken in Europe and North America, had the greatest influence. The types of words borrowed (e.g. in terms of meaning categories like religion or science) reflect the social and cultural reality of China in different historical periods.

2.2 Adaptation approaches and types of loanwords in Mandarin

Foreign loans in Mandarin and other Chinese dialects are generally classified in terms of the method of adaptation, i.e. whether adaptation is done according to pronunciation or meaning, or otherwise (e.g. Gao & Liu 1958, Gao et al 1984, Chan & Kwok 1990, Chen 1999, Masini 1993, Shi 2000, Liu 2001). In this section, I will introduce in detail the four major adaptation approaches and hence four types of loanwords in Mandarin, namely phonemic loans, semantic loans, graphic loans, and hybrids. In addition, I will discuss the variability of borrowing methods in adapting the same loan and the socio-cultural preference of the Chinese speakers for semantic loans. (Unless otherwise noted, the examples given in this section are mostly English loans from the corpus data of this dissertation. The meanings of the source words are sometimes omitted due to lack of space. For such information, see the data lists in Appendixes I-III.)

2.2.1 Phonemic loans

Phonemic loans are known in Mandarin as "yīnyìcí" 音译词 (*sound-transliteration-word*). They are adapted by means of phonemic/phonetic transliteration, with the Mandarin pronunciation deriving from the pronunciation of the foreign source form. Phonemic loans can be further classified into two categories, "purely phonemic loans" (PP) and "phonemic loans with semantic association" (PS). [4] Words of the PP category have a Chinese form in which the written characters do not contribute to the meaning of the word, but only combine to represent a pronunciation close to the source form. The PS category is adapted in such a way that the Mandarin form simultaneously represents a pronunciation similar to the foreign origin and bears certain meaning associations to the source form. Since the semantic links thus attained usually help convey a desirable advertising image of the referent, PS loans are also termed "phonetic borrowing with special aesthetic and social functions" (Hong 1995).

In the corpus data of this research, the proportions of PP and PS in the phonemic loans borrowed from the three donor languages are respectively 71.05% and 28.95% in English loans, 95.81% and 4.19% in German loans, and 91.56% and 8.44% in Italian loans (see Table 2.1). The PS category takes up a higher percentage in English borrowings than in

---

[4] In Chinese linguistics, the two sub-categories of phonemic loans are termed respectively as "dānchún yīnyì" 单纯音译 (*pure-sound-transliteration*) or "quányīnyì" 全译音 (*entirely-transliteration-sound*) for "purely phonemic loans," and "xiéyīn yīnyì" 谐音音译 (*pun-sound-transliteration*) or "yīnyì jiāngù" 音义兼顾 (*sound-meaning-both-to consider*) for "phonemic-semantic loans" (see Gao & Liu 1958: 163-165, Masini 1993:130, Shi 2000: 127-128).

German and Italian borrowings. This correlates with the composition of semantic categories in the data. Company names and brand names of commercial products, which are more likely to be adapted with certain advertising effects than words of other categories (e.g. place or person names), make up higher proportions in the English loans than in loans from the other two languages (see §1.5.2).

Table 2.1. Composition of phonemic loans

SL / Category	English		German		Italian	
	n	%	n	%	n	%
PP	351	71.05	617	95.81	141	91.56
PS	143	28.95	27	4.19	13	8.44
Total	494	100.00	644	100.00	154	100.00

Notes: 1) PP: Purely phonemic loan; 2) PS: Phonemic loan with semantic associations

Examples of the two types of phonemic loans are given in (10). Words in (10a) are purely phonemic loans in that their pronunciation originates from the phonemic/phonetic form of the English source words. The individual characters in the written form do not contribute to the composite meaning of the term. For instance, in "di2-si1-ni2" 迪斯尼 (*to inspire-this-nun*) and "xi1-er3-si1" 西尔斯 (*west-you-this*), the constituent characters in combination compose an adapted phonological form corresponding to the respective English pronunciations of "Disney" (name of a U.S. company) and "Sears" (name of a U.S company), while the meaning of each individual character does not bear any link to

(10)	English	MC Pinyin	IPA	WF	Gloss
a)	Ashland	a1-shi2-lan2	/a-ʂɻ-lan/	阿什兰	ø-assorted-orchid
	Compaq	kang1-bai3	/kʰaŋ-pai/	康柏	health-cypress
	Disney	di2-si1-ni2	/ti-sz̩-ni/	迪斯尼	enlightenment-this-nun
	Mead	mi3-de2	/mi-tɤ/	米德	rice-virtue
	Nautica	nuo4-di2-ka3	/nuo-ti-kʰa/	诺迪卡	promise-enlightenment-card
	Sears	xi1-er3-si1	/ɕi-ɚ~-sz̩/	西尔斯	west-you-this
b)	Avon◊	ya3-fang1	/ya-faŋ/	雅芳	elegant-beauty
	Febreeze◊	fang3-bi4-shi4	/faŋ-pi-ʂɻ/	纺必适	fabric-certainly-suitable
	Hummer◊	han4-ma3	/xan-ma/	悍马	brave-horse
	Maybelline◊	mei3-bao3-lian2	/mei-pau-lian/	美宝莲	beauty-treasure-lotus
	Reebok◊	rui4-bu4	/ɻuei-pu/	锐步	agile-step
	Safeguard◊	shu1-fu1-jia1	/ʂu-fu-tɕia/	舒肤佳	to comfort-skin-good

the referent. Words in (10b), however, are PS loans. On the one hand, they are phonemic since their sound derives from adaptation of the English pronunciation, e.g. "shu1-fu1-jia1" 舒肤佳 (*to comfort-skin-good*) < "Safeguard" (brand name of soap) and "han4-

ma3" 悍马 (*brave-horse*) < "Hummer" (brand name of an automobile). On the other hand, they are semantic in that the written forms consist of characters (morphemes) that motivate semantic links to the referent. Thus, "to comfort-skin-good" and "brave-horse" respectively arouse an association of the soap product "Safeguard" with ideal skincare functions and the car "Hummer" with speed and strength.

2.2.2 Semantic loans

"Semantic loans," referred to as "yìyìcí" 意译词 (*meaning-translation-word*) in Mandarin, are words adapted according to meaning (rather than pronunciation). They can be divided into two types according to the method of creating the Mandarin form. One is morpheme translation, by which the loan form derives from a morpheme-by-morpheme literal rendition of its foreign origin. The other is holistic translation, by which a native word is created in such a way that it captures the distinct features or functions of the foreign object or concept, but with no morphemic correspondence between the borrowing and lending languages (see discussions in Chan & Kwok 1990, Chen 1999).[5]

Chinese linguists disagree on whether semantic loans should be considered borrowings or not (Masini 1993: 128-153, Gao & Liu 1958: 7-10). For instance, Gao & Liu (1958) and Gao et al. (1984) argue that semantic loans as not "foreign loans" on the ground that this type of words consists solely of native morphemes. Masini (1993) and Chan & Kwok (1990), however, include semantic loans in their studies. I follow this latter position and treat semantic loans as part of the loan vocabulary.

The examples in (11) illustrate the two types of semantic loans. The Mandarin forms in (11a) consist of morphemes that are literal translations of the constituent morphemes in the English words, e.g. "xia4-zai4" 下载 (*down-load*) > "download" (term of computer technology) and "wei1-ruan3" 微软 (*small-soft*) > "Microsoft" (name of a U.S. company). In contrast, the loans in (11b) are holistic renditions, expressing certain unique or prominent features of the referent instead of corresponding to the source form in a morpheme-by-morpheme manner. For example, the English words "Rejoice" (brand name of shampoo) and "Wrigley's" (brand name of chewing gum) are adapted to be "piao1-rou2" 飘柔 (*float-soft*) and "lü4-jian4" 绿箭(*green-arrow*) respectively. The former indicates the desirable function of "Rejoice" as a hair-care product, i.e. to make the hair soft enough to float. The latter describes the packaging features of "Wrigley's" the chewing gum, i.e. being green in color and bearing an arrow-shaped logo. In both methods of semantic adaptation, the Mandarin form is created by using native morphemes to convey the meaning (rather than pronunciation) of the source word.

---

[5] Terminologies for the two sub-categories of semantic loans vary in the literature, e.g. "loan translations" and "semantic loans" in Masini (1993), but "loan translation" and "semantic translation" in Chen (1999).

(11)	English	MC Pinyin	WF	Gloss
a)	download	xia4-zai4	下载	down-load
	Ebay	[dian4-zi3]-wa1	电子湾	electronics-bay
	FedEx	[lian2-bang1]-[kuai4-di4]	联邦快递	federal-express
	Microsoft	wei1-ruan3	微软	small-soft
	Old Navy	lao3-[hai3-jun1]	老海军	old-navy
	Silicon Valley	gui1-gu3	硅谷	silicon-valley
b)	Clinique	qian4-bi4	倩碧	beauty-green jade
	Crest	jia1-jie2-shi4	佳洁士	good-clean-gentleman
	Marriot	wan4-hao2	万豪	ten thousand-rich
	Rejoice	piao1-rou2	飘柔	float-soft
	Sprite	xue3-bi4	雪碧	snow-green jade
	Wrigley's	lü4-jian4	绿箭	green-arrow

2.2.3 Graphic loans

A third approach to loanword adaptation in Mandarin is to borrow the written (or graphic) form of foreign words directly. Loans formed in this way are called "graphic loans." Canonically the term refers to Japanese loans, which were mostly borrowed during the period from the 1890s to the 1930s when Chinese students and scholars in Japan introduced into China a large number of Japanese translations of Western terms. These words are mainly related to education, science and the military. Since the Japanese language was written in Chinese characters, Chinese speakers took the written form of the source terms directly and pronounced them in the Chinese way (rather than according to the original Japanese pronunciations), e.g. "bungaku" 文学 (*literature*) > "wen2-xue2" 文学 (*literature*). (Also see §2.1.3 for discussions on Japanese loans.)

Although Japan ceased to be the primary medium of Western knowledge for China after the 1940s, words from Japanese continued to be borrowed in the same way.[6] Contemporary contacts between Mandarin and Japanese involve mainly economic activity, which leads to the importation of a large number of company names and brand names into Mandarin. Examples are given in (12), where (12a) are company names and (12b) are brand names. In all cases of Japanese graphic loans, the borrowed terms have similar written form, but different pronunciation before and after adaptation, e.g. "Itochu" 伊藤忠 (name of a trade company) > "yi1-teng2-zhong1" 伊藤忠, and "Honda" 本田 (an automobile brand) > "ben3-tian2" 本田.

---

[6] It should be noted that the Chinese characters used in Japan are traditional characters, whereas in Mainland China, traditional Chinese characters have been replaced by simplified characters since the 1950s. As a result, graphic loans borrowed from Japanese after the 1950s, as those given in (12), do not have exactly the same written form before and after adaptation in that the source form is in traditional Chinese characters, and the Mandarin form is in simplified characters.

(12) Graphic loans from Japanese

	Characters	Jap. Pronoun.	MC Pinyin	Gloss	Notes
a)	伊藤忠	Itochu	yi1-teng2-zhong1	she-vine-loyal	trade
	鹿岛	Kajima	lu4-dao3	deer-island	construction
	小学馆	Shogakukan	xiao3-xue2-guan3	elementary-school-place	publishing
	清水	Shimizu	qing1-shui3	clear-water	engineering
b)	朝日	Asahi	zhao1-ri4	morning-sun	beer
	本田	Honda	ben3-tian2	root-field	automobile
	资生堂	Shiseido	zi1-sheng1-tang2	generate-life-hall	cosmetics
	东芝	Toshiba	dong1-zhi1	east-sesame	electronics

In addition to graphic loans from Japanese, a new type of graphic loans, words written in the Latin alphabet, has entered Mandarin since the late 1970s, spurred by increasing contact between Chinese and Western languages, especially English. These alphabetic words, called "zìmǔcí" (literally meaning "alphabetic word") by Chinese linguists (Shen et al. 2002, Liu 2001), are becoming important elements in modern Mandarin vocabulary. They are mostly related to economy, science and technology, e.g. "ATM" (Automated Teller Machine) and "CD" (Compact Disk). They are also commonly used in combination with Chinese characters to form various types of hybrid loans, e.g. "BP 机" ("BP-ji1" in Pinyin, literally "BP- machine") < "Beeper."

Since graphic loans are not the focus of this study, only a small number of this type was collected. There are four alphabetic words in the English borrowings, which are listed in (13). For example, the company name "DEC" (Digital Equipment Corporation) is adopted into Mandarin in its original form "DEC" without any modification.

(13) Graphic loans from English

English	Full Form	Mandarin	Notes
AMD	Advanced Micro Devices	AMD	terms of technology
CIO	Chief Information Officer	CIO	term of technology
DEC	Digital Equipment Corporation	DEC	name of company
3i	3i	3i	name of company

The primary sociolinguistic factor that contributes to the emergence and increase of alphabetic loans as shown in (13) is the establishment of Pinyin, a phonetic script using Latin letters, as the standard spelling system for Mandarin in 1958. Although designed as a tool to facilitate learning of pronunciation instead of as a substitute for the ideographic script, Pinyin is the standard system to spell Chinese proper names (e.g. place and person names) in translation and international communications. Use of Pinyin in Mainland China greatly promotes Mandarin speakers' acquaintance with alphabetic scripts, and its

compatibility with the Latin alphabet further facilitates direct adoption of foreign words written in a phonemic alphabet.

Different from Japanese graphic loans, which are read in the Chinese way disregarding the source pronunciation, graphic loans written in alphabetic letters generally retain their original foreign sound. For instance, "DEC" in (13) is pronounced as /di i si/, rather than as /tɤ ɤ tsʰʐ̩/, the Mandarin sounds represented by the three letters. Nevertheless, alphabetic loans may be pronounced with varying degrees of accuracy due to individual speakers' proficiency in the donor language. In addition, the frequencies with which these words are used may vary according to speakers' educational backgrounds and experience with foreign languages as well as other factors such as stylistic features.

2.2.4 Hybrids

Hybrids are words adapted from foreign languages using a combination of different strategies. They mostly consist of a phonemic part plus a semantic one, with the latter being either an added native morpheme which functions as a semantic indicator or a literal translation of part of the source form, or even both (cf. Shi 2000). For convenience, I will refer to borrowings formed in this way as "[phonemic + semantic] hybrids." In this type of loan, the phonemic and semantic components are two distinct parts, which distinguish them from PS loans, i.e. phonemic loans with semantic associations, in which a single phonemically-adapted form dually conveys phonological similarity and meaning links.

Canonical hybrid loans in Mandarin are those in which a native morpheme is added after the phonemic transliteration of the source form. The inserted morpheme serves to indicate the semantic category of the word and hence facilitates understanding (Chen 1999, Masini 1993). For example, "AIDS" (name of a disease) and "bowling" (name of a ball game) in (14a) are borrowed as "ai4-zi1-**bing4**" 爱滋病 (*love-generate-disease*) "bao3-ling2-**qiu2**" 保龄球 (*protect-age-ball*). The morphemes "bing4" *disease* and "qiu2" *ball*, added to the phonemic correspondent of the source form, indicate the semantic category of the loan.

[Phonemic + semantic] hybrids can alternatively be formed in such a way that the source form is partly phonemically transcribed and partly morphemically translated. Examples of such words are given in (14b). For instance, "Barbie **Doll**" (brand name of doll) entered Mandarin as "ba1-bi3-**[wa2-wa]**" 芭比娃娃 (*palm tree-to compare-doll*). The first half "i.e. Barbie" is adapted through phonemic transcription, giving rise to "ba1-bi3," and the second half, i.e. "doll," is literally translated as "-[wa2-wa]." Sometimes both morpheme translation and addition of semantic indicator are employed. For example, "Bell**South**" (company name) in (14c) is adapted as "bei4-er3-[*nan2-fang1*]-[*tong4-xin4*]" 贝尔南方通讯 (*shell-you-south-communication*). In the Mandarin form, "bei4-er3" is phonemically transcribed from "Bell," "-[nan2-fang1]" is a literal translation of "South," and the final part, i.e. "-[tong1-xin4]" *communication*, is added at the end to indicate the specialization of the company.

(14)	English	MC Pinyin	WF	Gloss
a)	AIDS[◊]	ai4-zi1-**bing4**	爱滋病	love-to generate-**disease**
	bowling[◊]	bao3-ling2-**qiu2**	保龄球	to protect-age-**ball**
	Gannett	gan1-nai4-te4-**[bao4-ye4]**	甘耐特报业	sweet-to bear-special-**press**
	Arsenal	a1-sen1-na4-**dui4**	阿森纳队	PREF-forest-accept-**team**
b)	Barbie Doll	ba1-bi3-*[wa2-wa]*	芭比娃娃	palm tree-to compare-*doll*
	Flint Ink	fu4-lin2-te4-*[you2-mo4]*	富林特油墨	rich-forest-special-*ink*
	Internet	ying1-te4-*wang3*	英特网	England-special-*net*
c)	BellSouth	bei4-er3-*[nan2-fang1]*-**[tong1-xun4]**	贝尔南方通讯	shell-you-***south-communication***

Besides [phonemic + semantic] hybrids, which are written entirely in Chinese characters, a new type of hybrid, which I will call "[graphic + phonemic/semantic] hybrids," appeared in Mandarin after the 1950s. These words are written partly in alphabetic letters, which correspond to part of the graphic form of the source term, and partly in Chinese characters, which derive from phonemic or semantic adaptation of the rest of the source form. Based on specific adaptation strategies, they can be further classified into three categories: (A) [graphic + phonemic] hybrids; (B) [graphic + semantic] hybrids, and (C) a combination of the two, i.e. [graphic + phonemic + semantic] hybrids.

The data in (15) illustrate various forms of [graphic + phonemic/semantic] hybrids. Words in (15a) are formed by retaining part of the alphabetic written form and adapting the other half phonemically. For example, "UTStarcom" (name of a U.S. company specialized in IT technology) has a Mandarin form "UT-si1-da2-kang1" UT 斯达康 *(ø-this - attain- prosperity)*, in which a graphic part "UT" is followed by "si1-da2-kang1," a phonemic adaptation of "Starcom." The formation of [graphic + semantic] hybrids is shown in (15b). For example, "Adobe Press" (name of a U.S. publisher) is adapted into "Adobe-*[chu1-ban3-she4]*" Adobe 出版社 *(ø-press)*, in which "Adobe" is part of the graphic form of the source word and "-[chu1-ban3-she4]" is a morpheme translation of English "press." Lastly, a [graphic + phonemic/semantic] loan may be also created by a combination of the previous two methods, which is illustrated by (15c). "W.B. Sanders Company" (name of a U.S. publisher) was borrowed as "W. B. -sang1-de2-si1-**[chu1-ban3]**-*[gong1-si1]*" W. B. 桑德斯出版公司 *(ø--mulberry-virtue-this-**to publish-company**)*, in which the initials "W.B.-" come from the source form intact, "-sang1-de2-si1-" derives from the phonemic adaptation of "Sanders," "-[chu1-ban]-" is an added semantic element to indicate the industrial field (i.e. publishing) that the company is engaged in, and finally "-[gong1-si1]" is the literal translation of English "Company." Despite differences in their formation, the three categories of [graphic + phonemic/semantic] hybrid share a

common feature of being written in a mixture of two graphic forms, i.e. alphabetic letters and Chinese characters.

(15)	English	MC Pinyin	WF	Gloss
a)	UTStarcom	UT - si1-da2-kang1	UT 斯达康	∅ - this – attain-prosperity
	W.W. Grainger	W.W - ge2-lei2-jie2	W.W 格雷杰	∅ - square-thunder-outstanding
b)	AAI	AAI-*[gong1-si1]*	AAI 公司	∅ - **company**
	Adobe Press	Adobe-*[chu1-ban3-she4]*	Adobe 出版社	∅ - *press*
	X-Men	X-*[zhan4-jing3]*	X 战警	∅ - *soldier*
	Accel Partners	Accel-*[he2-huo3]*-*[gong1-si1]*	Accel 合伙公司	∅ - *partners* – **company**
c)	W.B. Sanders Company	W.B. - sang1-de2-si1-*[chu1-ban3]*-*[gong1-si1]*	W. B. 桑德斯出版公司	∅ - mulberry-virtue-this-**to publish-***company*

Furthermore, similar to phonemic loans which may either be purely phonemic (PP) or phonemic with semantic associations (PP), hybrids which contain a phonemically-adapted component can also be divided into two groups according to the absence/presence of semantic effects. Table 2.2 shows the breakdown of hybrids in the corpus data. The PS approach is employed more often in English hybrids (56/362, 15.47%) than in German (9/252, 3.57%) and Italian (2/98, 2.04%) ones.

Table 2.2. Presence vs. absence of semantic associations in hybrids

SL / Hybrid category		English		German		Italian	
		n	%	n	%	n	%
[Phon + Others]	H-PS	56	15.47	9	3.57	2	2.04
	H-PP	290	80.11	239	94.84	96	97.96
[Graphic + Sem]	N/A	16	4.42	4	1.59	0	0
Total		362	100.00	252	100.00	98	100.00

Notes : 1) H-PS: Hybrid whose phonemic component conveys semantic associations
2) H-PP: Hybrid whose phonemic component conveys no semantic associations

2.2.5 Potentiality of variant forms and preference for semantic translation

Loan adaptations in Mandarin are characterized by two distinctive features in relation to the availability of multiple adaptation methods and the nature of the Chinese writing system. First, it is possible for a single foreign word to have variant adapted forms (e.g. a phonemic form and a semantic form.). This is typically seen at the early stage when a

foreign term is adapted (Masini 1993, Chen 1999). For instance, Chen (1999: 104) notes the following: "… There was a period, mainly in the 1920s and 1930s, when it was very common for a single notion from the West to be given two or more names in Chinese, frequently as a result of the term being introduced into Chinese by different methods … "

If variant adaptations are very likely to occur at the early stage of a loan's evolution, they are also expected to exist in the collected data of this study, which contain the latest foreign loans in modern Mandarin. Examination of the corpus data confirms this prediction. Out of the 1177 English loans, 138 (11.72%) have variant adapted forms. In the German and Italian loans, the numbers are respectively 99/977 (10.13%) and 10/269 (3.72%). (For a complete list of loans with variant forms, see Appendix IV.)

Variability in the adaptation of the same foreign term is shown in (16). The data show that variability may result from either the use of different adaptation methods or the choice of different written characters. For example, in (16a), the term "internet" has a fully semantic realization, hu4-lian2-wang3 互联网 (*mutual-to connect-net*), and two hybrid forms, "yin1-te4-**wang3**" 因特网 (*reason-special-**net***) and "ying1-te4-**wang3**" 英特网 (*England-special-**net***). The word "Gap" (brand name of jeans) in (16c) has two alternative forms, both of which are created through the phonemic approach, i.e. 加普 (*to add-common*) and 嘉普 (*good-common*). The two forms have the same pronunciation, but different written characters for the first syllable. Similar to phonemic transliteration, semantic translation can also result in alternative adaptations. For example, "Wrigley's" (brand name of a chewing gum) in (16e) has two Mandarin forms, "lü4-jian4" 绿箭 (green-arrow) and "jian4-pai2" 箭牌 (arrow-brand), both of which are created by semantic translation.

(16)	English	Method	MC Pinyin	Gloss	WF
a)	internet	S	hu4-lian2-wang3	mutual-to connect-net	互联网
		H-PP	yin1-te4-**wang3**	reason-special-**net**	因特网
		H-PP	ying1-te4-**wang3**	elite-special-**net**	英特网
b)	E-mail	PP	yi1-mei4-er	she-younger sister-you	伊妹尔
		S	[dian4-zi3]-[you2-jian4]	electronic-mail	电子邮件
c)	Gap	PP	jia1-pu3	to add-common	加普
		PP	jia1-pu3	good-common	嘉普
d)	Corning	PP	kang1-ning2	health-peace	康宁
		PP	ke1-ning2	stem-peach	柯宁
e)	Wrigley's	S	lü4-jian4	green-arrow	绿箭
		S	jian4-pai2	arrow-brand	箭牌

Notes: 1) PP: Purely phonemic loan; 2) PS: Phonemic loan with semantic associations;
3) S: Semantic loan; 4) H: Hybrid loan

It is hard to predict at this stage which adapted form will defeat other variants and survive as the standard. A semantic version seems more likely to win because morphologically it conforms with the native vocabulary better, with each syllable contributing to the meaning of the word, e.g. "[dian4-zi3]-[you2-jian4]" 电子邮件

electronic-mail (vs. "yi1-mei4-er3" 伊妹儿 *she-younger sister-son*) < "E-mail." Between the variant forms of the same type (e.g. two semantic forms), other factors such as brevity and existence/absence of semantic associations may play a role in the competition.

The second feature characteristic of loan adaptation in Mandarin is the preference for semantic translation over other adaptation approaches. Chinese speakers accord high priority to semantic loans, regardless of their dialectal background (e.g. Cheng 1985: 177, Liu 1986: 41, Norman 1988: 20-21, Chan & Kwok 1990: 18-23, Masini 1993: 135-145, Chen 1999: 100-106, Shi 2004: 234-237). As Cheng (1985: 177) notes, Chinese speakers tend to translate meaning and generally treat transcription (of pronunciation) "warily and disapprovingly." Norman (1988) and Masini (1993) observe that phonemic borrowings often serve a transitional purpose in the history of foreign loans. If a semantic adaptation of a foreign word is coined besides a phonemic one, the former will gradually gain popularity and eventually replace the latter version.

Masini (1993) provides rich data which evidence the uncertainty of foreign loans borrowed into Chinese during the period 1840-1898 and the stronger vitality of semantic adaptations than their phonemic counterparts. Examples are given in (17). The phonemic versions have now completely fallen out of use. The forms in boldface, which survive in modern Mandarin as the standard form, are always a semantic translation. For example, for the English word "parliament," the phonemic and hybrid forms, e.g. "ba1-li2-man3" 巴厘满 (*to cling to-centimeter-full*) and "ba1-li2-man3-[ya3-men]" 巴厘满衙门 (*to cling to-centimeter-full-[feudal government office]*), have been replaced by the semantic versions, "guo2-hui4" 国会 (*nation-meeting*) and "yi4-hui4" 议会 (*to discuss-meeting*).

(17)	English	Method	MC Pinyin	Gloss	WF
a)	president	PP	bo2-li3-xi3-dun4	uncle-truth-happy-to stop	伯理喜顿
		PS	bo2-li3-xi3-tain1-de3	uncle-truth-emperor's seal-heaven-virtue	伯理玺天德
		S	tong3-ling3	to govern-to lead	统领
		S	**zong3-tong3**	**general-to govern**	**总统**
b)	parliament	PP	ba1-li2-man3	to cling to-centimeter-full	巴厘满
		PP	ba1-li4-men2	to hope-strength-door	巴力门
		S	**guo3-hui4**	**nation-meeting**	**国会**
		S	**yi4-hui4**	**to discuss-meeting**	**议会**
		H-PP	ba1-li2-man3-[ya2-men]	to cling to-centimeter-full -[feudal government office]	巴厘满衙门
c)	science	PP	sai4-yin1-si1	compete-reason-to think	赛因思
		S	**ke1-xue2**	**subject-study**	**科学**
d)	telephone	PP	de3-li4-feng1	get-benefit-wind	得利风
		S	**dian4-hua4**	**electricity-speech**	**电话**

(Source: Masini 1993)

Notes: 1) PP: Purely phonemic loan; 2) PS: Phonemic loan with semantic associations; 3) S: Semantic loan; 4) H: Hybrid loan; 5) H-PP: hybrid with a PP component

The factors underlying Mandarin speakers' preference for semantic loans are both linguistic and socio-cultural. The incompatibility between the complex syllable constructions in Indo-European languages (e.g. onset clusters) and the Mandarin (C)V(C) template require various phonotactic adjustments in order for a loan to be adapted through the phonemic approach (see Chon & Kwok 1990: 14-32 for a similar view on loan adaptations in Hong Kong Cantonese).

Furthermore, Mandarin speakers tend to pay greater attention to "meaning" than to "sound." Since in the native system, each syllable represents a morpheme, Mandarin speakers are not accustomed to multisyllabic phonemic loans, in which individual syllables are not indicative of the meaning of the whole word (see Masini 1993, Chen 1999, Norman 1988). For example, in the phonemic loan "ka3-er3-ma3-te4" 卡尔马特 (*card-you-horse-special*) < "Kmart" (English, name of a U.S company), each individual syllable such as "ka3" (*card*) or "ma3" (*horse*) bears no obvious meaning association with the referent. Lack of direct meaning associations between constituent syllables and the word on the whole gives a distinctive color of "foreignness" to phonemic loans (Agnes Weiyun He, personal communication, November 30, 2005).

In addition, the cultural desire to preserve purity of the mother tongue disfavors phonemic loans, which are both phonologically and morphologically different from the core vocabulary. For instance, there have been heated discussions recently on the status of graphic loans written in alphabetic letters. Some scholars view them positively as fresh elements in Mandarin, whereas others advocate restriction of their usage (e.g. Liu 2001). Thus, it can be concluded that Mandarin speakers' preference for semantic translation over other adaptation methods develops under a combination of linguistic and sociolinguistic forces.

To summarize this section, Mandarin speakers employ four major approaches to adapt foreign words, namely phonemic transliteration, semantic translation, graphic borrowing and a hybrid method. Among phonemic loans and hybrids with a phonemic component, some can convey certain meaning associations with the source form and meanwhile have a pronunciation close enough to the latter. Furthermore, due to the availability of multiple adaptation methods and the logographic nature of the Chinese writing system, loan adaptations in Mandarin demonstrate two unique features. One is the existence of variant forms for the same foreign term, and the other is the socio-cultural preference for semantic translation over other adaptation approaches.

2.3 Mandarin phonology and writing system

2.3.1 Mandarin phonology: Phonemes, tones and syllable structure

The Mandarin phoneme inventory contains 22 consonants and 14 vowels, which are listed in Table 2.3 and Table 2.4. All consonants except the nasal /ŋ/ ("-ng" in Pinyin) can occur in the onset, while /ŋ/ appears only in coda positions. The Mandarin vowels include unrounded vowels /i, e, ɛ, ə, ə˞, a, ɑ, ɤ/, rounded vowels /y, œ, u, ɔ/, and apical

vowels /ẓ, ʐ̩/ (cf. Li 1999). (In each column of Table 2.3 and table 2.4, the symbol on the left is the Pinyin form, and the one on the right in slashes is the IPA representation.)

Table 2.3. Inventory of Mandarin consonants

	Labial	Alveolar	Dental	Retroflex	Alveo-palatal	Velar
Plosive	b /p/ p /pʰ/	d /t/ t /tʰ/				g /k/ k /kʰ/
Nasal	m /m/	n /n/				ng /ŋ/
Fricative	f /f/		s /s/	sh /ʂ/	x /ɕ/	h /x/
Affricate			z /ts/ c /tsʰ/	zh /tʂ/ ch /tʂʰ/	j /tɕ/ q /tɕʰ/	
Approximant		l /l/		r /ɻ/		

Note: /ŋ/ occurs only in the coda.

Table 2.4. Inventory of Mandarin vowels

	Front				Central				Back	
High	i	/i/	ü	/y/					u	/u/
Mid	e	/e/			e	/ə/	er	/ɚ/	e	/ɤ/
	e, a	/ɛ/	üe	/œ/					o	/ɔ/
Low					a	/a/	a	/ɑ/		

Apical vowels: i /ẓ/
  i /ʐ̩/

    Traditionally, the Mandarin syllable is divided into an initial and a final (Chen 1999, Li 1999, Ramsey 1987, Norman 1988). This Initial-Final template of Mandarin syllables is shown in (31). [7] The initial refers to the syllable-initial consonant. The final is further broken down into a medial and a rhyme. The medial is one of the three high vowels /i, u, y/, realized respectively as glides /j, w, ɥ/ in actual speech. The rhyme consists of a nucleus and an ending. The nucleus, which is the main vowel and the tone-bearing unit (TBU), is the only obligatory segment in the Mandarin syllable. The ending can be either vocalic (/i/ or /u/) or consonantal (i.e. /n/ or /ŋ/). The vocalic ending is realized phonetically as a glide /j/ or /w/.

---

[7] The structure of the Mandarin syllable has been a subject of great controversy in the study of Mandarin phonology. Disagreement lies mainly in two areas. One is whether the medial should be assigned to the onset position (together with the initial) or to the rhyme slot. The other is whether the vocalic ending should be in the coda or the nucleus position. In either case, the debate does not influence analyses in this research, which only concern adaptations of consonant structures (See Li 1999 and Duanmu 2000 for detailed discussions on the different ways of partitioning the Mandarin syllable.)

(18) Mandarin syllable

```
                        Syllable
                        [Tone]
              ┌───────────┴───────────┐
           Initial                   Final
                              ┌────────┴────────┐
                           Medial             Rhyme
                                         ┌───────┴───────┐
                                      Nucleus          Ending
              │              │          │                │
             (C)            (G)          V              (G/C)

                          /i, u, y/    [TBU]        /i, u/; /n, ŋ/
```
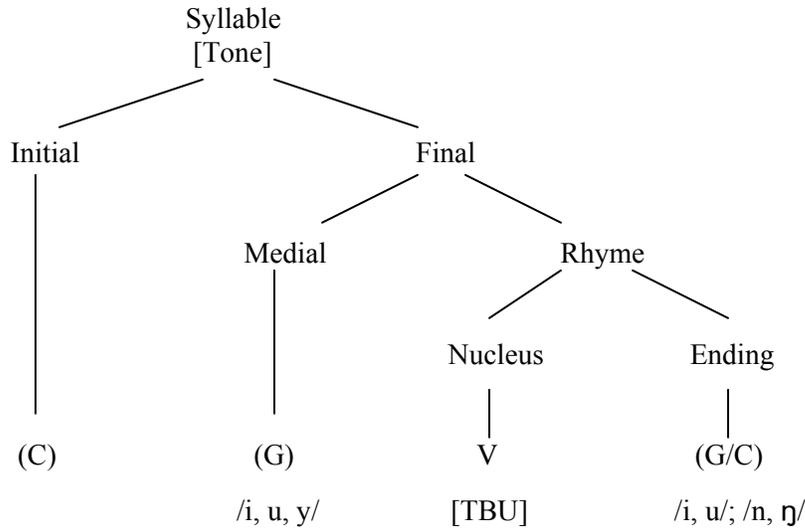
Note: TBU = Tone bearing unit

   There are a total of 37 finals, which are listed in Table 2.5, following the alphabetic order of the Pinyin form. The Mandarin finals differ along three dimensions, with or without a medial, with or without an ending, and with a vocalic or consonantal ending if there is one.[8]

   Besides segmental constituents, the Mandarin syllable has a suprasegmental tonal value. There are four canonical tones, often referred to as the 1st, 2nd, 3rd and 4th tone. In addition, there is a neutral tone, which does not have an intrinsic pitch value. The neutral tone is shorter than the four lexical tones, and it is mostly taken by grammatical morphemes (e.g. the past tense maker "le" 了 /lɤ/ and the question marker "ma" 吗 /ma/). Mandarin tones are contrastive, which is exemplified in (19), where syllables of an identical Initial-Final sequence but different tones have distinct meanings.

---

[8] There is slight disagreement on the exact number of Mandarin Chinese finals, depending on the degree of allophonic detail taken into account (see Norman 1988, Chen 1999). My count of 37 in Table 2.5 is based on a phonemic analysis.

Table 2.5. Inventory of Mandarin finals

Medial \ Ending	Open		Vocalic ending				Consonantal ending			
			-i	/-i/	-o/u	/-u/	-n	/-n/	-ng	/-ŋ/
None	a	/a/	ai	/ai/	ao	/ɑu/	an	/an/	ang	/ɑŋ/
	o	/uɔ/			ou	/ou/			ong	/uŋ/
	e	/ɤ/	ei	/ei/			en	/ən/	eng	/əŋ/
	er	/ɚ/								
	i	/i/								
	i	ʐ̩								
	i	ɻ̩								
	u	/u/					un	/un/		
	ü	/y/					ün	/yn/		
-i /-i/	ia	/ia/			iao	/iɑu/	ian	/iɛn/	iang	/iɑŋ/
	ie	/iɛ/			iu	/iou/	in	/in/	ing	/iŋ/
									iong	/yŋ/
-u /-u/	ua	/ua/	uai	/uai/			uan	/uan/	uang	/uɑŋ/
	uo	/uɔ/	ui	/uei/						
-ü /-y/	üe	/yɛ/					üan	/yɛn/		

Note: The letter "o" in the Pinyin form represents /uɔ/ after bilabial consonants /pʰ, p, m, f/ (e.g. "bo1" /puɔ/ *wave*); Otherwise, "uo" is used (e.g. "duo1" /tuɔ/ *many*).

(19) Mandarin tones

Tone	Numeral	Pitch contour	Diacritic	Example			Gloss
1st tone	1	High level	ˉ	bā	八	/pa/	eight
2nd tone	2	High rising	´	bá	拔	/pa/	to pull out
3rd tone	3	Falling rising	ˇ	bǎ	把	/pa/	handle
4th tone	4	Falling	`	bà	爸	/pa/	dad
Neutral tone	N/A	N/A	N/A	ba	吧	/pa/	AUX

2.3.2. Mandarin writing system

The Mandarin Chinese writing system is logo-syllabic or logo-morphemic, with the character as its basic unit representing one syllable and one morpheme (Norman 1988, Hoosain 1991, Wang 1997, Chen 1999). The estimated number of Chinese characters varies, ranging from 40, 000 to 80,000, of which only 3,500 are in frequent use (Jia & Zhang 2001). Homophones are very common in Mandarin since the number of syllables is limited, about 420 if tonal variations are ignored, and about 1,300 if the permutation of tones is counted (Chen 1999:36, Hoosain 1991:8, cf. DeFrancis 1984). In this sense, the written form of characters plays a crucial role in differentiating morphemes/syllables of the same sound. Examples of homophones that have identical initials, finals and tones are given in (20).

(20)	Character	Pinyin	IPA	Gloss
	廷	ting2	/tʰiŋ/	royal court
	亭	ting2	/tʰiŋ/	pavilion
	庭	ting2	/tʰiŋ/	front yard
	停	ting2	/tʰiŋ/	to stop

2.4 Comparison between the donor languages and Mandarin

Since Mandarin loanword phonology is regulated by both phonological and semantic-orthographic forces, I will discuss briefly the major differences between the three donor languages (i.e. English, German and Italian) and Mandarin. In particular, the discussion will focus on the differences that concern loan word adaptation into Mandarin.

The phonological differences between the three lending languages and Mandarin as related to this study, i.e. Mandarin adaptation of foreign consonants and consonant clusters, lie mainly in two areas. One concerns the contrastive features of consonants. In all three donor languages, consonants contrast in voice, with distinctions between voiced and voiceless sounds. Voiceless plosives in English and German 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 "pat" [**pʰ**æt], and "repeat" [ɹɪˈ**pʰ**it]. The unaspirated sound occurs elsewhere, e.g. as the second element in in a word initial cluster as in "spat" [s**p**æt] and word-finally as in English "tap" [tæ**p**]. Mandarin consonants contrast in aspiration, but not in voice, with distinctions between aspirated voiceless and unaspirated voiceless phonemes. The consonantal phonemes in English, German and Italian are listed in Table 2.6, Table 2.7 and Table 2.8. In the first two tables, only IPA symbols are listed. The orthographic letters representing each English and German consonant are omitted since there is not always a one-to-one mapping between letter and phoneme, especially in English. In Table 2.8, the alphabetic letters on the left of each column stand for spelling, and symbols in slashes on the right are IPA symbols. (Allophones are not listed but will rather be discussed in later analyses

when necessary. The vocalic inventories of these languages will not be given either since this study is primarily concerned with adaptations of consonantal structures.)

Table 2.6. Inventory of English consonants

	Labial	Labio-dental	Dental	Alveolar	Palato-alveolar	Velar	Glottal
Plosive	p b			t d		k ɡ	
Nasal	m			n		ŋ	
Fricative		f v	θ ð	s z	ʃ ʒ		h
Affricate					tʃ dʒ		
Liquid				ɹ l			
Glide	w				j		

(Based on Spencer 1996)

Table 2.7. Inventory of German consonants

	Labial	Labio-dental	Alveolar	Post-alveolar	Palatal	Velar	Glottal
Plosive	p b		t d			k ɡ	
Nasal	m		n			ŋ	
Fricative		f v	s z	ʃ		x	h
Trill			r				
Affricate		pf	ts		tʃ		
Liquid			l				
Glide					j		

(Based on Fox 1990: 28-46, with modifications)

Notes: 1) /x/ is realized as [ç] after front vowels and in word-initial positions.
    2) /r/ is pronounced with great variability in real speech.

Table 2.8. Inventory of Italian consonants

	Labial	Labio-dental	Alveo-dental	Palato-alveolar	Palatal	Velar
Plosive	p /p/ b /b/		t /t/ d /d/			c /k/ g /g/
Nasal	m /m/		n /n/		gn /ɲ/	
Trill			r /r/			
Tap			r /ɾ/			
Fricative		f /f/ v /v/	s /s/	sc /ʃ/		
Affricate			z /ts/ z /dz/	c /tʃ/ g /dʒ/		
Liquid			l /l/		gl /ʎ/	
Glide	u w				i j	

(Based on Repetti 2001: 342)

Note: It is not clear whether /ɾ/ is an allophone of /r/ or a distinct phoneme.

Based on these differences, it is predicted that when English, German and Italian words are adapted into Mandarin, the voicing contrast between consonants in the donor languages will be mapped to the aspiration contrast in Mandarin. Examinations of the phoneme substitution patterns show that generally a voiceless consonant in a source word is replaced by an aspirated phoneme in Mandarin, and a voiced consonant by an unaspirated phoneme (see Chapter 3). However, it is not uncommon that variations occur due to the diverse linguistic and socio-cultural factors influencing language contact.

Another difference between English, German, and Italian on the one hand and Mandarin on the other is that the former have more complex syllable structures. Table 2.9 presents the syllable structures of the three donor languages, in terms of an Onset-Rhyme template.

Table 2.9. Syllable structure of English, German and Italian

Constituents Language	Onset	Rhyme	
		Nucleus	Coda
English	(C) (C) (C)	V	(C) (C) (C)
German	(C) (C) (C)	V	(C) (C) (C) (C)
Italian	(C) (C) (C)	V	(C)

These three languages all allow a rich inventory of consonantal codas and consonantal clusters. In English, all consonants except /h/ are permitted in the coda, and a mono-morphemic syllable can contain up to three consonants in the onset and three in the coda, as in "Spring" /spɹɪŋ/, "lamp" /lamp/, and "glimpse" /glɪmps/. (See Spencer 1996, Chapter 3, for discussions of English syllable structures). Similarly, German allows both obstruents and sonorants in the coda. The German syllable is even more complex than the

English syllable in that it can have up to four consonants in the coda in addition to three in the onset (Fox 1990: 47) (e.g. "Sprit" /ʃprit/ *petroleum*, and "Herbst" /hɛrbst/ *autumn*). The Italian syllable permits one consonant in the coda and up to three in the onset (e.g. "strano" /strano/ *strange*) (Lori Repetti, personal communication, October 2005). Consonant codas in Italian occur in one of three situations: (1) the first half of a geminate (e.g. "gatto" /gatto/ *cat*); (2) a nasal homorganic with the onset of the following syllable (e.g. "tanto" /tanto/ *a lot*); (3) other consonants, either obstruents or sonorants (e.g. /s, r, l, j, w/). In contrast to the English, German and Italian syllables, the Mandarin syllable has a much simpler construction. Coda consonants are restricted to two nasals /n/ and /ŋ/. In addition, consonant clusters are entirely banned in both onset and coda positions.

In view of the differences in syllable structure, it is predicted that when English, German and Italian words are borrowed into Mandarin, consonant clusters and simplex consonant codas other than /n/ and /ŋ/ will undergo adaptation so that the resultant loan can conform to Mandarin phonotactics. For instance, a plosive coda in English may be either deleted or preserved through vowel insertion. The phonological processes that address these two structures will be investigated in detail in Chapter 4.

In addition to distinctions in phonology and phonotactics, differences in the writing system exert considerable influence on loan adaptation in Mandarin. In contrast to the ideographic script of Mandarin, in which each unit (i.e. a character) stands for a syllable and a morpheme, the writing systems of English, German and Italian are phonemic in nature, with the smallest unit, an alphabetic letter, representing a sound/phoneme. Thus, to assign a foreign loan a Chinese written form commits Mandarin speakers to the choice of particular characters, and hence particular morphemes. Moreover, the abundance of homophonous characters may lead to variations in the orthographic realization of a borrowing if different characters are chosen to represent the same syllable (see §2.2.5).

Based on the brief comparison between the three donor languages and Mandarin, it can be concluded that loan adaptation in Mandarin Chinese inevitably involves both phonological/phonotactic and orthographic nativization. Adaptations on the phonological level involve phoneme mapping from the foreign languages to Mandarin and phonotactic processes that bring a borrowed word into conformity with Mandarin syllable construction rules. On the orthographic level, decisions need to be made as to which character/morpheme should be chosen to represent the meaning and/or pronunciation of the borrowed term. Orthographic factors may interact with phonological adaptation, resulting in great variability in the adaptation. For instance, in order to choose a morpheme which may better convey the meaning of the loan, phonological similarity between the source form and the adapted form might sometimes be sacrificed (see Chapters 3 & 4).

In the following chapters, Mandarin nativization of English, German and Italian loans will be investigated in detail. Both phonological/phonotactic processes and orthographic factors will be discussed, with the focus on the former.

Chapter 3
Phoneme Substitution in Adaptation of
Phonemic Loans and Hybrids

Phonological adaptation of foreign loans involves two major tasks. One is to map foreign phonemes to the most similar phonemes in the native language. The other is to repair phonotactic structures which are well-formed in the donor language but illicit in the recipient language. In collaboration, the two types of transformation bring about an adapted form that sounds as close to the source word as possible and meanwhile conforms to the native phonology.

Investigation of these two aspects of Mandarin loan phonology will be presented in this chapter (Chapter 3) for phoneme substitution and the next chapter (Chapter 4) for adaptations of illicit syllable structures. Analysis is based on two types of data in the corpus, i.e. phonemic loans and hybrids with a phonemic component. Semantic loans, i.e. loans borrowed through semantic translation, will not be addressed since phonology is not involved in their formation. (See §1.5 and §2.2 for details of the composition of the corpus data.) Since this research focuses on the segmental adaptation of consonants and phonotactic adaptation of syllable structures, the substitution of vowels and the mapping between foreign stress and Mandarin tone will not be discussed. Furthermore, in view of the fact that language borrowing into Mainland Mandarin is predominantly done by bilinguals (§1.2), I assume that the input to Mandarin loanword phonology is the pronunciation of the source word in the donor language.

3.1 Introduction

In the process of segmental mapping from English, German and Italian to Mandarin, the general rule is that a foreign phoneme, if not deleted, will be matched to the closest phoneme available in the Mandarin inventory. For instance, an English voiceless bilabial plosive /p/ may be replaced by a Mandarin aspirated bilabial plosive /pʰ/. The substitution patterns do not demonstrate any differences between the adaptation of single consonants and that of consonants in clusters. Similarity between phonemes in a lending language and Mandarin may be determined by phonological and/or phonetic closeness (e.g. place and manner of articulation) as well as various other factors (e.g. spelling).

Mandarin loanword phonology displays variations in segmental adaptation in that a single foreign consonant can have alternative Mandarin outputs. In many cases, variations arise from Mandarin speakers' conscious efforts to choose a particular syllable that can convey proper semantic effects (e.g. a good advertising image for the brand name of a commercial product). For example, in "Simmo**n**s" (English, brand name of mattress) > "xi2-me**ng**4-si" /ɕi-məŋ-sz̩/ *mattress-to dream-to miss*, the English alveolar

nasal in the coda cluster /-nz/ is replaced by the Mandarin velar nasal (rather than the more faithful alveolar nasal). This somewhat deviant adaptation of English /n/ helps create meaning associations between the product "Simmons" and its ideal functions as a mattress. An adapted form with the more faithful /n/ (e.g. *"xi2-me**n**4-si" /ɕi-mə**n**-sʐ̩/ *mattress-stuffy-to miss*) is not as desirable as "xi2-me**ng**4-si" in meaning. There are also cases in which such phonological deviations do not bring about any semantic effect. For example, in "DuPo**n**t" (English, name of a U.S. company) > "du4-ba**ng**1" /tu-pɑŋ/ *to SUR-nation*, the substitution of Mandarin /ŋ/ for English /n/ does not create any better meaning for the word than a more faithful form "*du4-ba**n**1" /tu-pan/ *to prevent-class*.

Based on the phoneme substitution patterns observed in the corpus data, I will argue that variations in the segmental mapping between the donor languages and Mandarin are phonologically constrained, rather than random. I will adopt Steriade's (2002) P-map hypothesis and develop an analysis of the segmental mapping from the donor languages to Mandarin within the Optimality Theoretic framework (Prince & Smolensky 1993, McCarthy & Prince 1993, McCarthy & Prince 1995). It will be proposed that the ranking of various featural identity constraints is projected by the relative perceptibility of segmental features (e.g. manner, place and voicing/aspiration).

The rest of this chapter is organized as follows. Section §3.2 introduces the theoretical background for analysis of segmental adaptation, which includes the formal framework of the P-map hypothesis and cross-linguistic findings about the differential changeability of consonantal features. In §3.3, the substitution patterns for consonantal phonemes, both faithful and deviant, observed in the corpus data are discussed in detail. Section §3.4 presents an OT analysis for the variability of phoneme mappings in Mandarin loanword phonology. A summary of the chapter is given in §3.5.

3.2. Background

3.2.1 Perceptual salience and the P-map hypothesis

In recent years, the role of perceptual salience and perceptual similarity in phonology has gained increasing attention. A representative work in this vein is contributed by Steriade (2002), who postulates a P-map (Perceptibility-map) hypothesis, proposing that phonological processes are governed by native speakers' knowledge of the perceptual distinctiveness of "different contrasts in various positions" (pp. 14). According to Steriade, the P-map controls the grammar by projecting correspondence constraints and their ranking (but cf. Kabak 2003, who provides counter-evidence against the P-map proposal). The more distinct a contrast is, the higher the constraint aimed at preserving this contrast is ranked. As a result, more perceptible contrasts are more resistant to change. For instance, she argues that final devoicing (vs. nasalization) is the preferred strategy in resolving voiced obstruent codas (e.g. -Vb# $\rightarrow$ -Vp#, *-Vm) because for consonants in post-vocalic final positions, contrasts in obstruency are more distinctive (or less confusable) than contrasts in voicing. Thus change in obstruency is more costly than change in voicing, which can be formulated in the ranking of IDENT [±son] >> IDENT [±voice].

Similar proposals about the crucial role of perceptual similarity have been advanced to account for other phonological processes such as vowel epenthesis (Fleischhacker 2001) and onset reduplication (Fleischhacker 2002). Fleischhacker (2001) presents a typological study of vowel epenthesis patterns in word-initial CC clusters. Cross-linguistically, Sibilant-Stop (ST) clusters are generally simplified by vowel epenthesis before the cluster (e.g. /st/ → /Vst/), and Obstruent-Sonorant (OR) clusters by insertion into the cluster (e.g. /sn/ → /sVn/) (e.g. in Egyptian Arabic and Hindi). She argues that the location of epenthesis is chosen to produce maximal auditory similarity between the input and the output. Fleischhacker (2002) investigates the different behavior between OR CC clusters and other types of CC cluster in onset reduplication. For example, in Gothic, $C_1C_2V_3$ is reduplicated in full when the onset is a non-OR cluster (i.e. $C_1C_2V_3$ → $C_1C_2V_3$), whereas partial reduplication takes place when the onset is an OR sequence (i.e. $C_1C_2V_3$ → C_1V_3). She proposes that perceptual salience is the underlying factor triggering the phenomenon. The perceptual difference between $C_1C_2V_3$ vs. C_1V_3 is greater in non-OR clusters than in OR clusters, which motivates the two different copy strategies. In a broader perspective, Fleischhacker (2002) claims that phonological processes that create an output form of greater similarity to the input occur more often than processes that result in less similarity.

Notions of perceptual salience and perceptual similarity have also been applied to studies of loanword adaptation (Kenstowicz 2001, Kenstowicz 2003, Kang 2003, Adler 2004). Scholars along this line argues that that loanword processes (e.g. stress assignment and vowel epenthesis) function to maximize the perceptual (or auditory) similarity between the foreign source form and the adapted form (see discussions in §1.2.4).

With respect to segmental adaptation in loanword phonology, the P-map hypothesis predicts that if a particular phoneme in the recipient language is chosen to replace a certain phoneme in the donor language, changes should occur in the least perceptible feature. In this way, maximal similarity between the input segment and its substitute can be achieved.

3.2.2 Differential changeability of segmental features

It has been observed in various phonological phenomena that segmental features of consonants display differential changeability. The linguistic processes that demonstrate this pattern of featural change include loan adaptations (Broselow 1999, Kenstowicz 2003a), speech perception errors (Bond 1999), generation of imperfect puns (Zwicky and Zwicky 1986), imperfect rhyming (Zwicky 1976) as well as phonological processes in general (e.g. Steriade 2002, Fleischhacker 2001, 2002).

Broselow (1999) finds that in Selayarese loanword phonology, faithfulness to continuancy and nasality features are accorded greater priority than faithfulness to other features (e.g. place). Hence, in adaptation of Bahasa Indonesian coda segments, all word-final stops are realized as the only licit stop coda in Selayarese (i.e. the glottal stop), and all nasals as the only permissible nasal coda (i.e. the velar nasal). Fricatives and liquids, however, trigger vowel epenthesis to avoid identity violations of continuancy and nasality features.

Kenstowicz (2003a) argues that in Fijian adaptations of English consonants, the identity of nasality enjoys higher priority than identity of voice. Voiced stops, which are absent in Fijian phoneme inventory, are adapted as voiceless stops word-medially and

word-finally but never as nasals (e.g. "spee**d**" > /sipi**t**i/). Although word-initially, they are replaced by Fijian pre-nasalized stops (e.g. "balloon" > /ᵐbaluni/), the nasal feature of pre-nasalized stops in this context has such weak phonetic salience that they can be arguably ignored. Based on these observations, Kenstowicz proposes that faithfulness to nasality ranks higher than faithfulness to voice, which motivates retention of nasal features but modifications of voicing in the phoneme mapping from English to Fijian.

Similar patterns of featural changeability are reported in other studies. Bond (1999: 33) finds that slips of the ear involving consonants in English casual speech are more likely to result from confusion about place of articulation than from confusion about manner (e.g. /p/ in "parrot" → /k/ in "carrot"). In addition, Zwicky's (1976) study of imperfect rhyming in English indicates that in a pair of rhymed words, voicing and place features of consonants may be different, e.g. /d/ ~ /t/ as in "die**d**" ~ "ligh**t**," and /k/ ~ /p/ as in "forsa**k**e" ~ "ra**p**e," but nasality is rarely so (e.g. *rain - fade). This suggests that voicing and place contrasts at word-final positions are considered less distinctive than nasality (manner) contrasts (also see Steriade 2002: 19-20).

Based on studies reviewed above, it can be concluded that cross-linguistically, manner features (e.g. continuancy and nasality) are more resistant to change than place and voicing features. In terms of the P-map hypothesis, differential flexibility of consonantal features is motivated by the differential perceptibility of contrasts in these features. In particular, contrasts in manner are more perceptible, and hence more resistant to change, than contrasts in voicing and place.

3.3 Patterns of phoneme substitution: Faithful mappings and deviations

In view of the cross-linguistic findings about changeability of consonantal features, it is predicted that in Mandarin loanword phonology, segmental adaptation of foreign consonants may display similar patterns. More specifically, voicing/aspiration and place features are more flexible than manner features. Following Spencer (1996: 105-145), I assume that consonants have the distinctive features in (1), which include manner features of consonancy, approximancy, sonorancy, stridency, continuancy, nasality and laterality; place features of [labial], [coronal] and [dorsal]; and the voicing feature.

(1) Distinctive features of consonants

i) Manner	[±cons] (consonancy)	[±approx] (approximancy)	[±son] (sonorancy)
	[±strid] (stridency)	[±cont] (continuancy)	[±nas] (nasality)
	[±lat] (laterality)		
ii) Place	[labial]	[coronal]	[dorsal]
iii) Voicing /	[±voiced] /		
Aspiration*	[±asp]		

50

Spencer's system does not include the aspiration feature, which is contrastive in Mandarin but not in the three donor languages. For convenience, the aspiration feature is put in the same category as voicing.

In the following, segmental mappings from the three donor languages to Mandarin will be examined in detail. For each class of consonants, I will discuss the faithful and deviant mappings as well as factors that contribute to the deviations. Discussions to be presented below are based on analysis of substitution patters involving simplex onsets and simplex codas. Since the adaptation of consonants in onset and coda clusters does not demonstrate any difference from the adaptation of simplex onsets and simplex codas, conclusions drawn about the latter apply to the former as well.

3.3.1 Plosives

Mandarin has a similar inventory of plosives as the three donor languages, with distinctions in three articulatory places, namely, labial, alveolar and velar. The only difference is that in Mandarin, aspiration, but not voicing, is contrastive, while in the English, German and Italian, voicing, but not aspiration, is contrastive.

Based on this, it is predicted that foreign plosives will be replaced by Mandarin plosives of the same place feature, with voicing contrasts in the donor languages to be realized as aspiration contrasts in Mandarin. Faithful voicing/aspiration mappings will be for a foreign voiceless plosive to be substituted by a Mandarin aspirated plosive, and a voiced one by a Mandarin unaspirated plosive. Furthermore, if manner features must be preserved, possible variations are expected to involve voicing/aspiration and/or place features,

Predictions about faithful mappings are attested by the data. From the table in Table 3.1, it can be seen that faithful substitutes (indicated by "♦") make up the majority of the observed outputs. For example, in the adaptation of /p, t/, they contribute to 113/158 (71.52%) of all instances in the onset and 70/78 (89.74%) in the coda. These patterns occur regardless of the allophonic variations in the source language. For instance, English voiceless plosives are replaced by Mandarin aspirated plosives no matter whether they are aspirated (e.g. in the onset) or unaspirated (e.g. in the coda) in the English pronunciation.

Predictions about deviations are only partially confirmed. The results displayed in Table 3.1 show that unfaithful mappings of voicing/aspiration features are common, but those of place are non-existent. For example, English /t/ can be replaced by an unaspirated /t/, if not the faithful output /t^h/, but it is never adapted as /k^h/. Deviant realizations of the voicing feature take place in both onset and coda positions. For instance, in the adaptation of /p, t/, unfaithful outputs with a deviant aspiration feature account for 45/158 (28.48%) in the onset and 8/78 (10.26%) in the coda. That faithfulness of place is not violated suggests that place features may be more perceptible than voicing/aspiration features, and hence more resistant to change.

Table 3.1. Adaptation of plosives

SL Phoneme		Output	English	German	Italian	Total (%)
Onset	/p-, t-/	/pʰ-, tʰ-/ ♦	57	32	24	113 (71.52%)
		/p-, t-/	30	8	7	45 (28.48%)
	/b-, d-/	/p-, t-/ ♦	106	87	25	218 (98.64%)
		/pʰ-, tʰ-/	3	0	0	3 (1.36%)
	/k-/	/kʰ-/ ♦	69	44	18	131 (87.92%)
		/k-/	4	0	0	4 (2.68%)
		/tɕ-/	8	6	0	14 (9.40%)
	/g-/	/k-/ ♦	15	27	3	45 (71.43%)
		/tɕ-/	7	9	2	18 (28.57%)
Coda	/-p, -t/	/-pʰV, -tʰV/ ♦	29	38	3	70 (89.74%)
		/-pV, -tV/	2	6	0	8 (10.26%)
	/-b, -d/	/-pV, -tV/ ♦	15	N/A	0	15 (93.75%)
		/-tsV/	1	N/A	0	1 (6.25%)
	/-k/	/-kʰV/ ♦	30	15	0	45 (88.24%)
		/-kV/	0	6	0	6 (11.76%)
		/-tɕʰV/	1	0	0	1 (1.43%)
	/-g/	/-kV/ ♦	4	N/A	0	4 (66.67%)
		/-kʰV/	2	N/A	0	2 (33.33%)

Notes: 1) ♦: Faithful output; 2) V = Epenthetic vowel

In addition, it is seen from Table 3.1 that a foreign plosive can be replaced by a Mandarin affricate. This type of mapping seems to pose a challenge to the hypothesis that manner features have high priority of being preserved. Close examination of the phonetic and phonological contexts for plosive → affricate adaptation shows that this mapping, rather than being deviant, in fact originates from Mandarin speakers' efforts to preserve phonetic information in the source pronunciation (see details in §3.2.3).

Examples of faithful adaptations of plosive consonants are given in (2). For instance, "**P**uma" (English, brand name of sport shoes), "**P**eine" (German, place name) and "**P**adova" (Italian, name of a soccer club) are respectively adapted as "**p**iao1-ma3" /**p**ʰiɑu-ma/ (*to soar-horse*), "**p**ai4-na4" /**p**ʰai-na/ (*to assign-accept*) and "**p**a4-duo1-wa3" /**p**ʰa-tuo-wa/ (*handkerchief-many-tile*). The word-initial voiceless onset /p-/ has the Mandarin aspirated plosive /pʰ-/ as its correspondent. Voiced plosives are replaced by unaspirated plosives in Mandarin, e.g. in "Mea**d**" (English, company name) > "mi3-**d**e3"

/mi-tɤ/ (*rice-virtue*). The allophonic [±asp] details of the source phoneme have no effect on the mapping patterns. For example, in "**C**adilla**c**" (English, brand name of automobile) > **k**a3-di2-la1-**k**e4 /**kʰ**a-ti-la-**kʰ**ɤ/ (*card-to inspire-to pull-gram*), /k/ in the initial and the final positions are both realized as Mandarin aspirated /kʰ/ despite the fact that in the source pronunciation, /k/ is aspirated in the first case, but unaspirated in the second case.

(2) Faithful plosive-plosive mappings

SL	SF	MC Pinyin	IPA	Gloss
English	Buick◊	bie2-ke4	/piɛ-kʰɤ/	special-gram
	Cadillac	ka3-di2-la1-ke4	/kʰa-ti-la- kʰɤ/	card-to inspire-to pull-gram
	DINK◊	ding1-ke4	/tiŋ-kʰɤ/	population-to restrain
	Gateway	gai4-te4-wei3	/kai- tʰɤ-uei/	cover-special-leather
	Mead	mi3-de2	/mi3-tɤ/	rice-virtue
	Puma◊	piao1-ma3	/pʰiɑu-ma/	to soar-horse
	Tosco	tuo1-si1-ke4	/tʰuɔ-sẓ-kʰɤ/	to lift-this-gram
German	Bayer	bai4-er3	/pai-/ɚ/	to worship-you
	Daum	dao4-mu3	/tɑu-mu/	road-ø
	Gera	ge2-la4	/kɤ-la/	square-sausage
	Manaut	[ma3-nao3]-te4	/[ma-nau]-tʰɤ/	agate-special
	Peine	pai4-na4	/pʰai-na/	to assign-to accept
	Torgau	te4-er3-gao1	/tʰɤ-ɚ-kau/	special-you-tall
	Rostock	luo2-si1-tuo1-ke4	/luɔ-sẓ-tʰuɔ-kʰɤ/	net-this-to lift-special
Italian	Bari	ba1-li3	/pa-li/	to hope-inside
	Como	ke1-mo4	/kʰɤ-muɔ/	science-no
	Fiat	fei1-ya4-te4	/fei-ia-tʰɤ/	fragrant-second-special
	Gucci ◊	gu3-qi2	/ku-tɕʰi/	ancient-miracle
	Padova	pa4-duo1-wa3	/pʰa-tuɔ-ua/	handkerchief-many-tile
	Terni	te4-er3-ni2	/tʰɤ-ɚ-ni/	special-you-nun

The words in (3) demonstrate deviant mappings between the voicing feature of foreign plosives and the aspiration feature of Mandarin plosives. For example, the onset /p-/ in "**P**izza Hut" (English, name of a food sore) and "**P**olo" (German, brand name of automobile) has an unaspirated /p/ rather than the more faithful /pʰ/ as its Mandarin output. In the former case, the adapted form "**b**i4-sheng4-ke4" /**p**i-ʂəŋ-kʰɤ/ (*certainly-to*

win customer) creates a desirable advertising image for the restaurant, i.e. being certainly able to attract customers. A faithful output, such as "*pi2-sheng4-ke4" /pʰi-ʂəŋ-kʰɤ/ (*skin-to win customer*), does not have as good a meaning as the real output. In the case of "**P**olo" > "**b**o1-luo2" /**p**uɔ-luɔ/ (*wave-net*), the deviant realization of German /p-/ as Mandarin /p/ (rather than /pʰ/) does not contribute to any special semantic effect. Unfaithful mapping of the voice/aspiration features also occurs in coda plosives. For example, in the adaptation of "blo**g**" (English, term of computer technology), the final /g/ corresponds to /kʰ/ in the Mandarin form, instead of the expected unaspirated /k/. The adapted form, i.e. "bo2-ke4" /puɔ-**kʰɤ**/ (*extensive-visitor*), conveys meaning associations, suggesting that "blog" is something to be visited by an extensive group of readers (cf. the expected output, "bo2-*ge4" /puɔ-***kɤ**/ (*extensive-square*).

(3) Plosive-plosive mappings with a deviant aspiration feature

SL	SF	MC Pinyin	IPA	Gloss	Notes
English	C̲olgate◊	g̲ao1-lu4-jie2	/k̲ɑu-lu-tɕiɛ/	super-dew-to clean	k > k
	Pizza Hut◊	b̲i4-sheng4-ke4	/p̲i-ʂəŋ-kʰɤ/	certainly-to win-customer	p > p
	Portland	b̲o1-te4-lan2	/p̲uɔ-tʰɤ-lan/	wave-special-orchid	p > p
	Tic T̲ac◊	d̲i1-d̲a1	/t̲i-t̲a/	to tick	t > t
	T̲exco	d̲e2-shi4-gu3	/t̲ɤ-ʂɻ-ku/	virtue-gentleman-ancient	t > t
	blog◊	bo2-k̲e4	/puɔ-k̲ʰɤ/	extensive-visitor	g > kʰV
	Maytag◊	mei3-tai4-k̲e4	/mei-tʰai-k̲ʰɤ/	beauty-luck-gram	g > kʰV
	Ri̲te Aid◊	lai2-d̲e2-ai4	/lai-t̲ɤ-ai/	to come-virtue-love	t > tV
German	P̲olo	b̲o1-luo2	/p̲uɔ-luɔ/	wave-net	p > p
	T̲übingen	d̲i4-bin1-gen1	/t̲i-piŋ-kən/	fruit base-guest-root	t > t
	Jüterbog	yu2-te4-bo2-ge2	/y-tʰɤ-puɔ-k̲ɤ/	from-special-abundant-square	k > kV, p > pV
	Kau̲b	kao3-b̲o2	/kʰɑu-p̲uɔ/	to exam-uncle	p > pV
	Via̲g	wei2-er3-g̲e2	/uei-ɚ-k̲ɤ/	to maintain-you-square	k > kV
Italian	P̲alermo	b̲a1-le4-mo4	/p̲a-lɤ-muɔ/	to wait-to rein in-not	p > p
	P̲otenza	b̲o1-tan3-cha2	/p̲uɔ-tʰan-tʂʰa/	wave-smooth-to exam	p > p

The adaptation of a plosive as a Mandarin affricate is shown in (4). For example, in the transformation of "**G**arching" (German, place name) > "**j**ia1-xing4" /**tɕ**ia-ɕiŋ (*to add-to prosper*), the stop /g-/ is realized as a palatal affricate /tɕ-/. In "Ti**d**e" (English, brand name of detergent) > "tai4-zi" /tʰai-**tsɹ̩**/ (*to eliminate-stain*), the coda /d-/ is realized as an affricate /ts/, with the Mandarin output conveying semantic links with the source term. A

more faithful output such as "tai4-**de**3" /tʰai-**tɤ**/ (to eliminate-virtue) cannot present as good an advertising image for the product as the real output.

(4) Plosive-affricate mappings

SL	SF	MC Pinyin	IPA	Gloss	Notes
English	G̲ap	j̲ia1-pu3	/t̲ɕia-pʰu/	to add-to popularize	g > tɕ
	G̲atorade◊	j̲ia1-de2-le4	/t̲ɕia-tɤ-lɤ/	good-to attain-happiness	g > tɕ
	K̲ellogg's◊	j̲ia1-le4-shi4	/t̲ɕia-lɤ-ʂʅ/	family-happiness-surname	k > tɕ
	Ba̲ch	ba1-q̲i2	/pa-t̲ɕʰi/	to wait-wonder	k > tɕʰV
	Ti̲de◊	tai4-z̲i4	/tʰai-t̲sz̩/	to eliminate-stain	d > tsV
German	G̲arching	j̲ia1-xing1	/t̲ɕia-ɕiŋ/	to add-to prosper	g > tɕ
	G̲ießen	j̲i2-sen1	/t̲ɕi-sən/	luck-forest	g > tɕ
	K̲iel	j̲i1-er3	/t̲ɕi-ɚ/	foundation-you	k > tɕ
	K̲itzingen	j̲i1-qing1-gen1	/t̲ɕi-tɕʰiŋ-kən/	foundation-green-root	k > tɕ
Italian	L̲ago di G̲arda	j̲ia1-er3-da2-(hu2)	/t̲ɕia-ɚ-ta-(xu)/	to add-you-attain-(lake)	g > tɕ

Mandarin adaptation of foreign plosives reflect the influence of orthography, which can be seen from the treatment of allophonic variations in English and the substitution patterns of German word-final plosives. As has been discussed above, the allophonic [±asp] details of a foreign consonant in the source pronunciation are generally ignored by Mandarin speakers. This is arguably due to the sociolinguistic context of language borrowing in Mainland China, where contacts between Mandarin and Indo-European languages take place mainly through the medium of writing. Thus lexical borrowing into Mandarin relies heavily on spelling.

A contrary strategy of treating the allophonic details of foreign plosives is employed in the loanword phonology of Hong Kong Cantonese. Since Hong Kong is an English-Cantonese bilingual community, where oral contacts between Cantonese and English are extensive, English words are more likely to be borrowed through speech than writing.

The contrast between Mandarin and Cantonese is shown in (5). In Mandarin, English voiceless stops are generally replaced by aspirated sounds regardless of whether they are aspirated or not in the source pronunciation. For example, in "**P**uma" > /**pʰ**iɑu-ma/, and "S**p**rint" > /sz̩-**pʰ**u-lin-tʰɤ/, both the aspirated [pʰ] (in "**P**uma") and unaspirated [p] (in "S**p**rint") are realized as Mandarin /pʰ/. In Hong Kong Cantonese, however, the two allophones of English voiceless stops are treated differently. For instance, the aspirated variant of /p/ is adapted as Cantonese /pʰ/ (e.g. "**p**ie" > /**pʰ**ay/), and the unaspirated one patterns with /b/, both being adapted as Cantonese /p/ (e.g. "s**p**are" > /si **p**e/).

(5)	English	English > Mandarin	English > Cantonese
[+asp]	[pʰ]	**P**uma◊ > /**pʰ**iɑu-ma/	**p**ie > /**pʰ**ay/
	[tʰ]	**T**osco > /**tʰ**uɔ-sz̩-k**ʰ**ɤ/	**t**ie > /**tʰ**ay/
	[kʰ]	**C**arolee > /**kʰ**a-luɔ-li/	**c**ard > /**kʰ**at/
[-asp]	[p]	S**p**rint > /sz̩-**pʰ**u-lin-t**ʰ**ɤ/	s**p**are > /si **p**e/
	[t]	S**t**aples > /sz̩-**tʰ**ɤ-pʰu-ə̃-sz̩/	s**t**amp > /si **t**a:m/
[+voice]	[b]	**B**oeing◊ > /**p**uɔ-in/	**b**us > /**p**a si/
	[d]	**D**ove◊ > /**t**ɤ-fu/	**d**ockyard > /**t**ɔk ya/
	[g]	**G**ateway > /**k**ai-tɤ-uei/	**g**ame > /**k**ɛm/

(Source of Cantonese data: Silverman 1992)

The influence of writing is also shown in Mandarin adaptation of German word-final voiceless plosives that are represented in writing by the letters "b, d, g." These codas are voiced in the underlying form and become devoiced in the surface realization since German does not allow voiced obstruent codas. Although devoiced in the German pronunciation, final codas written as "b, d, g" demonstrate mapping patterns as if they were still voiced sounds, that is, they are generally replaced by Mandarin unaspirated phonemes /p, t, k/. On the contrary, voiceless plosives, which are voiceless in the underlying form and/or represented in writing with a letter that stands for a voiceless sound, tend to be mapped to Mandarin aspirated sounds /pʰ, tʰ, kʰ/. As can be seen from Table 3.2, German word-final simplex codas /-p, -t, -k/ represented by "p, t, k, c, ck" in spelling are predominantly adapted as [+asp] plosives, but the same sounds /-p, -t, -k/ with a voiced underlying form (i.e. spelled as "b, d, g") are generally replaced by [-asp] plosives.

Table 3.2. Orthographic influence (German post-vocalic final plosives)

German	Mandarin Output (Plosive)		Total
Phoneme (spelling)	[+Asp]	[-Asp]	
/-p, -t, -k/ (-p, -t, -k, -c, -ck)	**51**	1	52
/-p, -t, -k/ (-b, -d, -g)	2	**11**	13

The substitution patterns for German final voiceless plosives suggest that orthography is a major factor underlying the deviant voicing/aspiration mappings in Mandarin adaptation of German plosive codas. As is shown in Table 3.2, it contributes to 11/12 instances where a voiceless plosive coda in German is unfaithfully realized as an unaspirated plosive in Mandarin.

3.3.2 Fricatives

Foreign fricatives are expected to be replaced by their closest fricative correspondents in Mandarin. Mandarin fricatives (i.e. /f, s, ʂ, ɕ, x/) contrast only in place, whereas

fricatives in the three donor languages contrast in both place and voicing (see §2.3). In view of this difference, it is predicted that the faithful substitute for a foreign fricative will be a Mandarin fricative of the closest place feature, while voicing contrasts will not be realized. Moreover, in case of variations, the deviant output may differ from the expected substitute in place, in view of the fact that for Mandarin fricatives, place feature is the only feature possible to change if manner features are to be retained.

Analysis of the corpus data shows that faithful outputs make up the highest proportion in the adaptation of most phonemes, which can be seen from Table 3.3 (for onsets) and Table 3.4 (for codas). [9] For example, in the adaptation of /f/, the frequency of faithful mappings (i.e. /f/ > /f/) is 60/66 (90.91%) in the onset and 15/15 (100%) in the coda. The only exceptions are onset /θ-/ and coda /-z/: for the former, the faithful output /s-/ occurs with the same frequency as a deviant form /-ʂ/; for the latter, the expected output /-sV/ contributes to 3/15 (20%) instances, which is lower than a deviant form /-ʂV/ (8/15, 53.33%).

Unfaithful outputs of fricatives fall into two types: fricatives differing from the faithful substitute in place, and affricates with either a faithful or deviant mapping of the voice/aspiration feature. For example, English alveolar sibilant /s/ is expected to be replaced by Mandarin /s/. In reality, it has two other alternative substitutes, i.e. a retroflex /ʂ-/ and a palatal fricative /ɕ-/, both deviating from the faithful output in place. When a foreign fricative is adapted as a Mandarin affricate, the place feature tends to be retained (e.g. /z/ > /ts/), while the mapping of voice/aspiration features may be either faithful or deviant, since Mandarin affricates contrast in both place and aspiration. For instance, possible outputs for German voiced onset /z-/ include both /tɕʰ-/ and / tɕ-/ (in addition to other fricatives and affricates). Of these two types of deviation, the first one (i.e. fricative → fricative) conforms to predications, but the second one (i.e. fricative → affricate) is not.

The phoneme /v/ behaves differently from other fricatives, with its substitutes varying according to position. If in the onset, it is mostly replaced by a Mandarin labial vowel /u/. When in the coda, /-v/ is always adapted as /f/ (along with vowel epenthesis). The different strategies towards /v-/ onsets and /-v/ codas are shown in (6). For example, in "**V**odofone" (English, company name) > "**w**o4-da2-feng1" /uɔ-ta-fəŋ/ (*fertile-to attain-harvest*), the onset /v-/ is adapted as /u/, but in "Do**v**e" (English, brand of chocolate) > "de2-**f**u2" /tɤ-fu/ (*virtue-lotus*), the coda /-v/ is replaced by Mandarin /f/ and resyllabified through vowel insertion.

---

[9] The /h-/ > /kʰ-/ mapping, which occurs only in "Pizza **H**ut" > "bi4-sheng4-**k**e4" /pi-ʂəŋ-**k**ʰɤ/ (*certainly-to win-customer*), will be ignored since there are not enough data on this.

Table 3.3. Adaptation of fricatives (Onset)

SL Phoneme	Output	English	German	Italian	Total (%)
/f-/	/f-/ ◆	23	27	10	60 (90.91%)
	/x-/	0	1	0	1 (1.52%)
	/u/ ~ [w-]	0	5	0	5 (7.58%)
/v-/	[w-] ◆	12	68	13	93 (92.08%)
	/f-/	4	3	0	7 (6.93%)
	/ɥ-/	0	1	0	1 (0.99%)
/s-/	/s-/ ◆	17	N/A	9	26 (41.94%)
	/ʂ-/	14	N/A	2	16 (25.81%)
	/ɕ-/	14	N/A	6	20 (32.26%)
/z-/	/s-/ ◆	1	18	N/A	19 (47.50%)
	/ʂ-/	1	1	N/A	2 (5.00%)
	/ɕ-/	0	7	N/A	7 (17.50%)
	/ts-/	0	3	N/A	3 (7.50%)
	/tʂ-/	2	1	N/A	3 (7.50%)
	/tɕ-/	1	2	N/A	3 (7.50%)
	/tɕʰ-/	0	3	N/A	3 (7.50%)
/θ-/	/s-/ ◆	1	N/A	N/A	1 (50.00%)
	/ʂ-/	1	N/A	N/A	1 (50.00%)
/ʃ-/	/ʂ-/ ◆	2	11	N/A	13 (56.52%)
	/ɕ-/	8	1	N/A	9 (39.13%)
	/tɕʰ-/	1	0	N/A	1 (4.35%)
/ʒ-/	/i/ ~ [j-] ◆	1	N/A	1	1 (100.00%)
/h-/	/x-/ ◆	40	69	N/A	109 (88.62%)
	/ɕ-/	10	3	N/A	13 (10.57%)
	/kʰ-/	1	0	N/A	1 (0.81%)

Note : ◆: Faithful output

Table 3.4. Adaptation of fricatives (Coda)

SL Phoneme	Output	English	German	Italian	Total (%)
/-f/	/-fV/ ♦	4	11	N/A	15 (100.00%)
/-v/	/-fV/ ♦	4	N/A	N/A	4 (100.00%)
/-s/	/-sV/ ♦	37	18	2	57 (95.00%)
	/-ʂV/	1	2	0	3 (5.00%)
/-z/	/-sV/ ♦	3	N/A	N/A	3 (20.00%)
	/-ʂV/	8	N/A	N/A	8 (53.33%)
	/-tsV/	4	N/A	N/A	4 (26.67%)
/-θ/	/-sV/ ♦	6	N/A	N/A	6 (75.00%)
	/-ʂV/	1	N/A	N/A	1 (12.50%)
	/-fV/	1	N/A	N/A	1 (12.50%)
/-ʃ/	/-ʂV/ ♦	1	5	N/A	6 (85.71%)
	/-ɕV/	1	0	N/A	1 (14.29%)
/-ʒ/	/-ɻ/ ♦	1	N/A	N/A	1 (100.00%)
/-ɕ/	/-ɕV/ ♦	N/A	11	N/A	11 (100.00%)
/-x/	/-xV/ ♦	N/A	25	N/A	25 (96.15%)
	/-ɕV/	N/A	1	N/A	1 (3.85%)

Notes: 1) ♦: Faithful output; 2) V = Epenthetic vowel

(6) Adaptation of /v/

SL	SF	MC Pinyin	IPA	Gloss
English	<u>V</u>odofone◊	<u>w</u>o4-da2-feng1	/<u>u</u>ɔ-ta-fəŋ/	fertile-to attain-harvest
	<u>V</u>iagra◊	<u>w</u>ei3-ge1	/<u>u</u>ei-kɤ/	great-elder brother
	Do<u>v</u>e◊	de2-<u>f</u>u2	/tɤ-<u>f</u>u/	virtue-lotus
	Wa<u>v</u>e◊	wei1-<u>f</u>u2	/uei-<u>f</u>u/	power-fortune
German	<u>W</u>ingst	<u>w</u>en1-si1-te4	/<u>u</u>ən-sẓ-tʰɤ/	warm-this-special
	<u>W</u>edel	<u>w</u>ei2-de2-er3	/<u>u</u>ei-tɤ-ɚ/	to maintain-virtue-you
Italian	<u>V</u>eneto	<u>w</u>ei1-ni2-tuo1	/<u>u</u>ei-ni-tʰuɔ/	power-nun-to lift
	<u>V</u>erona	<u>w</u>ei1-luo2-na4	/<u>u</u>ei-luɔ-na/	power-net-to accept

Note: A syllable-initial /u/ in Mandarin is pronounced alternatively as a glide [w] or a fricative [v] in real speech.

The underlying factor for the /v/ > /u/ mapping is that in the native phonology of Mandarin, a syllable-initial /u/ (represented in Pinyin as "w-") surfaces mostly as a glide [w-] or alternatively as a fricative [v-]. According to Li (1999: 102-104), the frequency of [v] usage varies according to speakers' age and syllable-types. It occurs more in the speech of younger speakers and in syllables that have an unrounded nucleus (e.g. "wen" [vən] vs. "wo" [wɔ]). Thus, to Mandarin speakers, a word-initial /v-/ in foreign words sounds the same as a Mandarin /u/ or [w/v], and a "/v-/ > /u/ ~ [w-]" mapping stands as the best way to maintain similarity between the source pronunciation and the adapted form.

Faithful substitutions for fricatives are shown in (7). For instance, in "**F**anta" (English, brand name of soft drink) > "**f**en4-da2" /**f**ən-ta/ (*fragrance-to attain*) and "**F**ulda" (German, place name) > **f**u4-er3-da2 /**f**u-ə˞-ta/ (*fortune-you-to attain*), the onset fricative /f-/ surfaces as the expected output /f/. Adaptation of coda fricatives can be seen from "Oti**s**" (English, brand name of an elevator) > "ao4-di2-**s**i1" /ɑu-ti-**s**z̩/ (*profound-to enlighten-this*) and "Neu**ss**" (German, place name) > "nuo4-yi1-**s**i1" /nuɔ-i-**s**z̩/ (*promise-her-this*), in which the coda /-s/ is replaced by Mandarin /s/, the closest match.

(7) Fricative-fricative mapping with a deviant place feature

SL	SF	MC Pinyin	IPA	Gloss
English	<u>F</u>anta[◇]	<u>f</u>en1-da2	/<u>f</u>ən-ta/	fragrance-to attain
	<u>h</u>acker[◇]	<u>h</u>ei1-ke4	/<u>x</u>ei-kʰɤ/	black-guest
	<u>S</u>aid	<u>s</u>ai4-de2-(shang1-xue2-yuan4)	/<u>s</u>ai-tɤ-(ʂɑŋ-ɕyɛ-yɛn)/	competition-virtue-(business school)
	Davido<u>ff</u>	da4-wei4-du4-<u>f</u>u1	/ta-uei-tu-<u>f</u>u/	big-to protect-ø-husband
	Oti<u>s</u>	ao4-di2-<u>s</u>i1	/ɑu-ti-<u>s</u>z̩/	profound-to enlighten-this
German	<u>F</u>ulda	<u>f</u>u4-er3-da2	/<u>f</u>u-ə˞-ta/	fortune-you-to attain
	<u>H</u>agen	<u>h</u>a1-gen1	/<u>x</u>a-kən/	to breathe out-root
	<u>Sch</u>alke	<u>sh</u>a1-er3-ke4	/<u>ʂ</u>a-ə˞-kʰɤ/	sand-you-gram
	<u>S</u>aar	<u>s</u>a4-er3-(he2)	/<u>s</u>a-ə˞-(xɤ)/	SUR-you-(river)
	Auri<u>ch</u>	ao4-li4-<u>x</u>i1	/ɑu-li-<u>ɕ</u>i/	profound-benefit-rare
	Knau<u>f</u>	ke3-nai4-<u>f</u>u2	/kʰɤ-nai-<u>f</u>u/	able to endure-fortune
	Neu<u>ss</u>	nuo4-yi1-<u>s</u>i1	/nuɔ-i-<u>s</u>z̩/	promise-her-this
Italian	<u>F</u>erroli	<u>f</u>a3-luo2-li4	/<u>f</u>a-luɔ-li/	law-net-strength
	<u>S</u>alerno	<u>s</u>a4-le4-nuo4	/<u>s</u>a-lɤ-nuɔ/	SUR-to rein in-promise
	Juventu<u>s</u>	you2-wen2-tu2-<u>s</u>i1-(dui4]	/iu-uən- tʰu-<u>s</u>z̩-(tuei)/	particularly-culture-drawing-this-(team)

Examples of fricative outputs with a deviant place feature are given in (8). For instance, in "**S**afeway" (English) > "**xi**1-fu1-wei2" /ɕi-fu-uei/ (*west-husband-leather*) and "**S**ears" (English) > "**xi**1-er3-si1" /ɕi-ɚ˜-sʐ̩/ (*west-you-this*), the initial onset /s-/ is not realized as its closest Mandarin correspondent /s/, but rather as an alveo-palatal fricative /ɕ-/. Deviations in place features occur in the coda as well. For instance, the English word "hippie**s**" entered Mandarin as "xi1-pi2-**sh**i4" /ɕi-pʰi-ʂ̩ʅ/ (*playful-face-man*), with the coda /-z/ having a retroflex sibilant /ʂ/ (along with vowel epenthesis) instead of the expected output /s/, as its output. The adapted form for "hippies" creates an image of the referent as being funny and anti-social in that the Mandarin syllable "xi1" is often associated with anti-social behavior. The same type of /-s/ > /-ʂV/ (/*-sV/) in the adaptation of "Bo**ss**" (German, brand name of perfume) as "bo1-**sh**i4" /puɔ-ʂ̩ʅ/ (*wave-man*) does not convey any meaning associations to the source term.

(8) Fricative-fricative mappings with deviant place

SL	SF	MC Pinyin	IPA	Gloss	Notes
English	Vaseline	fan2-shi4-lin2	/fan-ʂ̩ʅ-lin/	all-gentleman-forest	v > f
	Safeguard◊	shu1-fu1-jia1	/ʂu-fu-tɕia/	comfort-skin-good	s > ʂ
	Cigna◊	xin4-nuo4	/ɕin-nuɔ/	to trust-promise	s > ɕ
	Sears	xi1-er3-si1	/ɕi-ɚ˜-sʐ̩/	west-you-this	s > ɕ
	Theragran◊	shi1-er3-kang1	/ʂ̩ʅ-ɚ˜-kʰɑŋ/	to grant-you-health	θ > ʂ
	Febreeze◊	fang3-bi4-shi4	/faŋ-pi-ʂ̩ʅ/	fabric-certainly-suitable	z > ʂV
	hippies◊	xi3-pi2-shi4	/ɕi-pʰi-ʂ̩ʅ/	playful-face-man	z > ʂV
	Wyeth◊	hui4-shi4	/xuei-ʂ̩ʅ/	benefit-surname	θ > ʂV
German	Fa◊	hua1-(pai2)	/xua-(pʰai)/	flower-(brand)	f > x
	Vechta	wei3-xi1-te4	/uei-ɕi-tʰɤ/	leather-rare-special	f > w
	Worms	fu2-mu3-si1	/fu-mu-sʐ̩/	to bend over-housekeeper-this	v > f
	Siemens	xi1-men2-zi3	/ɕi-mən-tsʐ̩/	west-door-son	z > ɕ
	Boss	bo1-shi4	/puɔ-ʂ̩ʅ/	wave-man	s > ʂV
Italian	Simeto	xi1-mei2-tuo1-(he2)	/ɕi-mei-tʰuɔ-(xɤ)/	west-plum-to lift-(river)	s > ɕ
	Sicilia	xi1-xi1-li3	/ɕi-ɕi-li/	west-west-inside	s > ɕ

Deviant realizations of a fricative into an affricate are illustrated in (9). In "Pitney Bowe**s**" (English, company name) > "pi3-ni2-bao4-**z**i1" /pʰi-ni-pɑu-**ts**ʐ̩/ (*MEAS-nun-abalone-this*), the final coda /z/ in "Bowe**s**" surfaces as a Mandarin affricate /ts/. An expected output will be "pi3-ni2-bao4-*si1" /pʰi-ni-pɑu-*sʐ̩/ (*MEAS-nun-abalone-this*). The word "**S**iegen" (German, place name) is borrowed as "**q**i2-gen1" /**tɕ**ʰi-kən/

(*parallel-root*), with the onset /z-/ corresponding to an aspirated palatal fricative /tɕʰ-/ in the Mandarin form. A faithful adaptation for this word would be "**s**i1-gen1" /sʐ̩-kən/ (this-*root*). In both examples, the deviation does not create any semantic links between the source word and the adapted form.

(9) Fricative-affricate mappings

SL	SF	MC Pinyin	IPA	Gloss	Notes
English	Pitney Bowe<u>s</u>	pi3-ni1-bao4-zi1	/pʰi-ni-pɑu-tsʐ̩/	MEAS-nun-abalone-this	z > tsV
German	<u>S</u>iegen	qi2-gen2	/tɕʰi-kən/	parallel-root	z > tɕʰ
	<u>S</u>aacle	zha1-ke4	/tʂa-kʰɤ/	to prick-gram	z > tʂ

3.3.3 Palatal outputs of velar plosives and non-palatal fricatives

As has been noted earlier, a foreign plosive may be replaced by a Mandarin palatal affricate. Further examination of substitution pattern shows that it occurs only with a velar onset /k-/ or /g-/, as is shown in Table 3.5.[10] The pattern is never observed in the other stops /p-, b-, t-, d-/.

Table 3.5. Palatal outputs of word-initial /k-, g-/ onsets

Phonemes	Output (cf. Expected)	English	German	Italian
/k-/	/tɕ-/ (cf. /kʰ-/)	8/81 (9.88%)	6/50 (12.00%)	0
/g-/	/tɕ-/ (cf. k-/)	7/22 (31.82%)	9/36 (25.00%)	2/5 (40.00%)

The factors underlying the mapping from a velar plosive to a Mandarin palatal affricate are both the phonetic details of the source words and the phonology of the recipient language. For one thing, the articulation of a consonant onset in the foreign input may be influenced by the following vowel. For instance, a consonant tends to be labialized when preceding a rounded vowel (e.g. /u/) and palatalized before a high front vowel (e.g. /i/). If a plosive is adapted as a palatal sound, it is likely that in the source form, it is followed by a high front vowel and becomes somewhat palatalized, as in "Kiel" /**k**i:l/ (German, place name) > "ji1-er3" /**tɕ**i-ɚ/ (*foundation-you*). Thus, a palatal phoneme in Mandarin is chosen as the substitute in order to maintain the perceptual similarity between the source pronunciation and the adapted form.

For another thing, in Mandarin phonology, velar plosives /kʰ-/ and /k-/ cannot be immediately followed by a high front vowel /i, y/ (e.g. "*ki" /kʰi/, "*kian" /kʰiɛn/). In

---

[10] Theoretically, the aspirated affricate /tɕʰ/ is also a possible output. It is not clear why all instances have the unaspirated /tɕ/ as the substitute sound, regardless of the voicing feature of the source phoneme.

contrast, it is licit for a bilabial and alveolar plosive to occur before /i/ (e.g. "pi1" /pʰi/ *criticize*, and "pian1" /pʰiɛn/ *slant*), although not before /y/ (e.g. "*pü" / pʰy/, "*püan" /pʰyɛn/). This means that adjustments are needed in adapting /k, g + V[+front] [+high]/ sequences, but not /p, b, t, d + V[+front] [+high]/ ones. Since in the source pronunciation, a consonant before a V[+front] [+high] is somewhat palatalized due to co-articulation, the choice of a Mandarin palatal affricate, which can readily co-occur with /i/ and /y/, stands as the best solution.

The frequency of /k-, g-/ palatalization in relation to the quality of the adjacent vowel confirms the above prediction. As is shown in Table 3.6, it is more likely for these two sounds to be adapted as a Mandarin palatal affricate when they come before a high front vowel. Along with the decrease in vowel height, the frequencies of palatal outputs become lower. The pattern is more obvious in the German loans than in the English loans. Out of a total of 15 instances in the German data, 12 (80.00%) occur in a high front vowel environment, but only 3 (20.00%) in a /_V[-high] [-front]/ context. In the English loans, the high front vowel environment contributes to 7/15 (46.67%) of all /k,g/ > /tɕ/ instances, the most among all contexts. [11]

Table 3.6 Vowel quality and palatalization of word-initial /k-, g-/ onsets

Adjacent V	Output	English	German	Italian
/i, ju, ɪ, ʏ/	/tɕ-/	7 (46.67%)	12 (80.00%)	0
/e, ɛ/	/tɕ-/	2 (13.33%)	0	0
/æ/	/tɕ-/	4 (26.67%)	0	0
Others (/ʌ, ɜ, a/)	/tɕ-/	2 (13.33%)	3 (20.00%)	2 (100.00%)
Total		15 (100.00%)	15 (100.00%)	2 (100.00%)

In view of the palatalization pattern for plosives, it is predicted that fricatives will demonstrate a similar process, that is, before a high front vowel, a non-palatal fricative (e.g. /s-/ or /h-/) in the donor languages may be replaced by the Mandarin alveo-palatal fricative /ɕ/. Like velar plosives, non-palatal fricative initials /s-, ʂ-, x-/ in Mandarin cannot precede high front vowels /i, y/ (e.g. "*si" /si/, and "*sian" /sian/). However, the palatal fricative /ɕ/ can freely occur in these environments (e.g. "xi1" /ɕi/ *east* and "xu1" /ɕy/ *need*).

The prediction is born out in the adaptation of non-palatal fricatives. It is shown in Table 3.7 that the mapping of an onset fricative like /s-/ or /z-/ to Mandarin /ɕ/ occurs in

---

[11] The Italian data seem contradictory to the postulation in that both cases of the palatal output occur in a /_V[-front] [-high]/ environment. The Italian loans are mostly collected from "Dizionario Italiano-Cinese" (Italian-Chinese Dictionary) (1985); It is not clear when these words were first introduced into Mandarin and whether there was any dialectal influence on the adaptation. Since there are only two cases in total, I will not attempt to explore reasons for this.

the data of all three donor languages. The relationship between the quality of the adjacent vowel and the frequencies of the palatal substitute can be seen from Table 3.8. In the table, the alveolar sibilants /s-, z-/ and glottal fricative /h-/ are grouped together, and the post-alveolar /ʃ-/, which is in nature somewhat palatal, is listed separately. It can be seen that increase in vowel height (in the source form) is positively related to the occurrence of Mandarin /ɕ-/. For instance, in the English data, 19/24 (79.17%) of /s-, z-, h-/ > /ɕ-/ mappings occur in the /_V$_{[+front]\,[+high]}$/ environment, while only 5/24 (20.83%) take place in other contexts.

Table 3.7. Palatal outputs of word-initial prevocalic fricatives

Onset	Output (cf. Expected)	English	German	Italian
/s-/	/ɕ-/ (cf. /s-/)	14/35 (31.11%)	N/A	6/17 (35.29%)
/z-/	/ɕ-/ (cf. /s-/)	0	7/35 (20.00%)	N/A
/ʃ-/	/ɕ-/ (cf. /ʂ-/)	8/11 (72.73%)	1/12 (8.33%)	0
/h-/	/ɕ-/ (cf. /x-/)	10/51 (19.61%)	3/72 (4.17%)	N/A

Table 3.8. Vowel quality and palatalization of word-initial prevocalic fricatives

Onset	Adjacent V	Output	English	German	Italian
/s-, z-, h-/	/i, ju, ɪ, ʏ/	/ɕ-/	19 (79.17%)	10 (100.00%)	6 (100.00%)
	/e, ɛ/	/ɕ-/	3 (12.50%)	0	0
	/æ/	/ɕ-/	0	0	0
	Others (/ʌ, ai/)	/ɕ-/	2 (8.33%)	0	0
	Total		24 (100.00%)	10 (100.00%)	6 (100.00%)
/ʃ-/	/i, ju, ɪ, ʏ/	/ɕ-/	0	0	0
	/ɛ/	/ɕ-/	4 (50.00%)	1 (100.00%)	0
	/æ/	/ɕ-/	2 (25.00%)	0	0
	Others (/u, a/)	/ɕ-/	2 (25.00%)	0	0
	Total		8 (100.00%)	1 (100.00%)	0

3.3.4 Affricates

Mandarin has a larger number of affricates than any of the three donor languages. The inventory includes six phonemes, i.e. /tsʰ, ts, tʂʰ, tʂ, tɕʰ, tɕ/, which contrast in place and aspiration. Similar to the adaptation of plosives, it is predicted that a foreign affricate will be mapped to a Mandarin affricate that has the closest place feature and meanwhile

abides by the faithful mapping of voicing/aspiration features, i.e. [-voice] → [+asp] (e.g. /tʃ/ > /tɕʰ-/) and [+voice] → [-asp] (e.g. /dʒ-/ > /tɕ-/). Assuming that manner features will be kept intact, possible deviations are expected to involve voicing/aspiration features or place.

The adaptation patterns observed in the data largely conform to the predictions. From Table 3.9, it can be seen that faithful outputs constitute the largest proportion for most phonemes (e.g. 60.00% for /tʃ-/, and 71.43% for /ts-/). The only exceptions are German /pf-/ onsets and English /-dʒ/ codas, for which the frequency of faithful mappings is equal to a deviant pattern (i.e. in the case of /pf-/) or lower (i.e. in the case of /-dʒ/).[12] Furthermore, the predicted patterns of variation are attested, with deviant substitutes being mostly affricates that differ from the faithful outputs in either voice/aspiration (e.g.

Table 3.9. Adaptation of affricates

Position	Phoneme	Output	English	German	Italian	Total (%)
Onset	/tʃ-/	/tɕʰ-/ ◆	6	N/A	3	9 (60.00%)
		/tɕ-/	2	N/A	0	2 (13.33%)
		/tʂʰ-/	4	N/A	0	4 (26.67%)
	/dʒ-/	/tɕ-/ ◆	11	2	2	15 (40.54%)
		/tɕʰ-/	10	0	0	10 (27.03%)
		/ts-/	1	0	0	1 (2.70%)
		/tʂ-/	6	0	3	9 (24.32%)
		/j-/	2	0	0	2 (5.41%)
	/pf-/	/pʰu f-/ ◆	N/A	2	N/A	2 (50.00%)
		/f-/	N/A	2	N/A	2 (50.00%)
	/ts-/	/tsʰ-/ ◆	N/A	10	0	10 (71.43%)
		/tɕʰ-/	N/A	1	0	1 (7.14%)
		/s-/	N/A	3	0	3 (21.43%)
Coda	/-tʃ/	/tɕʰV/ ◆	3	0	N/A	3 (75.00%)
		/ʂV/	1	N/A	N/A	1 (15.00%)
	/-dʒ/	/tɕV/ ◆	1	N/A	N/A	1 (16.67%)
		/tɕʰV/	4	N/A	N/A	4 (66.67%)
		/tʂV/	1	N/A	N/A	1 (16.67%)
	/-ts/	/tsʰV/ ◆	N/A	20	N/A	20 (100.00%)

Notes: 1) ◆: Faithful output; 2) V = Epenthetic vowel

---

[12] Alternatively both substitutes for /pf-/ (i.e. /pʰu f-/ and /f-/) may be considered as faithful outputs since there is no evidence showing one is preferred over the other.

/tʃ-/ > /tɕ-/, cf. */tɕʰ-/) or place (e.g. /tʃ-/ > /tʂʰ-/, cf. */tɕʰ-/). Although other deviant patterns, in which a foreign affricate is mapped to a Mandarin fricative (e.g. /ts-/ > /s-/ or a glide (e.g. /dʒ-/ > /i/ [j-]), are not expected, they constitute only a small number of cases.

Examples of faithful adaptations of affricates are given in (10). For instance, the voiced palatal onset /dʒ-/ in "**G**illette" (English, brand name of a razor) has an unaspirated palatal affricate /tɕ-/ as its output, i.e. "**j**i2-lie4" /**tɕ**i-liɛ/ (*lucky-column*). The German affricate /ts-/ in "Me**tz**" is mapped to /tsʰ/ in the Mandarin form, "mai4-ci4" /mai-**tsʰ**z̩/ (*wheat-puncture vine*).

(10) Faithful affricate-affricate mappings

SL	SF	MC Pinyin	IPA	Gloss
English	<u>Ch</u>eetos◇	<u>q</u>i2-duo1	/<u>tɕ</u>ʰi-tuɔ/	miracle-many
	<u>G</u>illette	<u>j</u>i2-lie4	/<u>tɕ</u>i-liɛ/	lucky-column
	Mi<u>dg</u>e	mi3-<u>j</u>i1-[wa2-wa]	/mi-<u>tɕ</u>i-[ua-ua]/	rice-lady-[doll]
German	<u>C</u>elle	<u>c</u>e4-le4	/<u>ts</u>ʰɤ-lɤ/	strategy-to rein in
	Me<u>tz</u>	mai4-<u>c</u>i4	/mai-<u>ts</u>ʰz̩/	wheat-puncture vine
	P<u>f</u>orzheim	pu3-<u>f</u>u2-er3-<u>c</u>i4-hai3-mu3	/pʰu-<u>f</u>u-ɚ-<u>ts</u>z̩-xai-mu/	popular-fortune-you-time-sea-housekeeper
Italian	<u>C</u>ervino	<u>q</u>ie4-er3-wei2-nuo4-(shan1)	/<u>tɕ</u>ʰiɛ-ɚ-uei-nuɔ-(ʂan)/	cut-you-to maintain-promise-(mountain)
	<u>G</u>iacomini	<u>j</u>ia1-ke1-mi3-ni2	/<u>tɕ</u>ia-kʰɤ-mi-ni/	good-subject-rice-nun

The data in (11) illustrates affricate-affricate mapping with deviant realizations of voicing/aspiration and place features. Unfaithful mapping of voicing/aspiration can be seen in "**Ch**ubb" (English, company name) > "**j**i2-bao3-[gong1-si1]" /**tɕ**i-pɑu-[kuŋ-sz̩]/ (to collect-*treasure-[company]*), where the voiceless onset /tʃ-/ is adapted as an unaspirated /tɕ-/ (instead of */tɕʰ-/). In contrast, in "**J**ohnson & Johnson" (English, company name) > "**q**iang2-sheng1" /**tɕ**ʰiaŋ-ʂəŋ/ (*to strengthen-life*), the voiced affricate onset /dʒ-/ is realized as an aspirated /tɕʰ-/ (instead of the faithful output */tɕ-/). In both cases, the choice of a deviant Mandarin output helps create desirable meaning associations between the adapted form and the source word, e.g. an image of "strengthening life" for "Johnson and Johnson" as a company specializing in hygiene and healthcare products. Examples of deviations in place are "**Ch**arlie Bell" (English, person name) > "**ch**a2-li3-bei4-er3" /**tʂ**ʰa-li-pei-ɚ/ (*to examine-reason-shell-you*), in which the onset /-tʃ/ is replaced by a Mandarin retroflex affricate /tʂʰ-/ (rather than a palatal */tɕʰ-/), and "**Z**ittau" /tsitau/ (German, place name) > "**q**i2-tao2" /**tʂ**ʰi-tɑu/ (*parallel-pottery*), in which the onset /ts-/ in "Zittau" surfaces as a palatal /tɕʰ-/ (rather than a dental */tsʰ-/).

(11) Deviant affricate-affricate mappings

SL	SF	MC Pinyin	IPA	Gloss	Notes
English	Chubb◇	ji3-bao3-[gong1-si1]	/tɕi-pɑu-[kuŋ-sz̩/	to gather -treasure [company]	tʃ > tɕ
	Johnson & Johnson◇	qiang2-sheng1	/tɕʰiɑŋ-ʂəŋ/	to strengthen-life	dʒ > tɕʰ
	Jonnie Walker	qiong2-ni-wo4-ke4	/tɕʰiyŋ-ni-uɔ-kʰɤ/	jade-nun-fertile-gram	dʒ > tɕʰ
	Orange	ao4-lan2-qi2	/ɑu-lan-tɕʰi/	profound-orchid -wonder	dʒ >tɕʰV
	Charlie Bell	cha2-li4-bei4-er3	/tsʰa-li-pei-ɚ/	to examine-reason- shell-you	tʃ > tsʰ
	Mead Johnson	mei3-zhan4-chen2	/mei-tsan-tsʰən/	beauty-to praise-official	dʒ > tʂ
German	Zittau	qi2-tao2	/tɕʰi-tɑu/	parallel-pottery	ts > tɕʰ
Italian	Geremia	zhan1-rui4-ming2	/tʂan-ɹuei-miŋ/	SUR-luck-inscription	dʒ > tʂ

The number of affricate → fricative/glide mappings is very small. The words in (12) show the adaptation of an affricate into a fricative. The coda /-tʃ/ in "Ko**ch** Industries" (English, company name) surfaces as a retroflex fricative /ʂ/ (instead of /tɕʰ/) in Mandarin, i.e. "ke-**sh**i4-[gong1-ye4]" /kʰɤ-ʂɻ-[kuŋ-iɛ]/ (*science-surname-[industry]*). In "**Z**ülpich" (German, place name) > "**s**u1-er3-pi3-xi1" /su-ɚ-pʰi-ɕi/ (*to revive-you-MEAS-rare*), the initial onset /ts-/ is replaced by a Mandarin /s/ rather than the expected affricate /tsʰ/.

(12) Affricate-fricative or -glide mappings

SL	SF	MC Pinyin	IPA	Gloss	Notes
English	Ko**ch** Industries	ke1-**sh**i4-[kong1-ye4]	/kʰɤ-ʂɻ-[kuŋ-iɛ]/	science-surname -[industry]	tʃ > ʂV
German	**Z**ülpich	**s**u1-er3-pi3-xi1	/su-ɚ-pʰi-ɕi/	to revive-you -MEAS-rare	ts > s

3.3.5 Nasals

Based on the hypothesis that manner features are less changeable, the substitutes for foreign nasals are predicated to the corresponding nasals in Mandarin (i.e. /m, n, ŋ/). If deviations take place, the only feature that is likely to show variability is place.

Alternative realizations of the voicing feature are not possible because the nasals in Mandarin and all donor languages are uniformly voiced.

The predicted patterns of faithful and deviant adaptations of nasals are confirmed by the corpus data. From Table 3.10, it can be seen that a foreign nasal is generally mapped to its respective counterpart in Mandarin (i.e. /m/ > /m/, /n/ > /n/, and ŋ/ > /ŋ/). In the onset, there are rarely any variations, except two instances of /m-/ > /u/ ~ [w-] (1.23%) and one instance of /n-/ > /l-/ (1.79%) mappings. Greater changeability is found in the coda, where deviations in place are quite common although faithful outputs do make up the majority. The bilabial coda /-m/, illicit in Mandarin, is mostly adapted as Mandarin /m/ although with vowel insertion (i.e. /-mV/). Alternatively, it can be adapted as a licit Mandarin coda (i.e. /-n/ or /-ŋ/), through change of the place feature. Even in the case of /-n, -ŋ/, which are licit codas in Mandarin as well, change in place are also observed, i.e. /-n/ > /-ŋ/ or vice versa. (The data do not provide any instance of the Italian palatal nasal /ɲ/.)

Table 3.10. Adaptation of nasals

Position	Phoneme	Output	English	German	Italian	Total (%)
Onset	/m-/	/m-/ ♦	91	53	16	160 (98.77%)
		/u/ ~ [w-]	2	0	0	2 (1.23%)
	/n-/	/-n/ ♦	19	32	4	55 (98.21%)
		/l-/	0	1	0	1 (1.79%)
Coda	/-m/	/-mV/ ♦	13	39	N/A	52 (80.00%)
		/-n/	5	0	N/A	5 (7.69%)
		/-ŋ/	7	1	N/A	8 (12.31%)
	/-n/	/-n/ ♦	127	163	0	290 (78.80%)
		/-nV/	1	0	0	1 (0.27%)
		/-ŋ/	34	41	2	77 (20.92%)
	/-ŋ/	/-ŋ/ ♦	8	7	N/A	15 (68.18%)
		/n-/	4	3	N/A	7 (31.82%)

Note: 1) ♦: Faithful output; 2) V = Epenthetic vowel

Faithful realizations of nasals are shown in (13). Onsets /m-/ and /n-/ are replaced by Mandarin /m-/ and /n-/ respectively, e.g. in "**M**aytag" (English, company name) > "**m**ei3-tai4-ke4" /**m**ei-tʰai- kʰɤ/ (*beauty-safety-gram)*, and "**N**apoli" (Italian, name of a soccer club) > "**n**a4-bo1-li" /**n**a-puɔ-li/ (*that-wave-benefit*). A coda /m/ remains /-m/ and undergoes resyllabification through vowel epenthesis, as in the adaptation of "Viacom"

(English, company name) into "wei2-ya4-kang1-mu3" /uei-ia-kɑŋ-mu/ (*to maintain-second-health-housekeeper*) and "Hamm" (German, place name) > "ha1-mu3-([shi4]" /xa-**m**u-(ʂɻ)/ (*to breathe out-housekeeper-(city))*. Alveolar and velar nasal codas, which do not need any adjustments, are faithfully mapped to their Mandarin counterparts, as in "Essen" (German, place name) > "ai1-sen1" /ai-sən/ (*dust-forest*) and "Corni**ng**" (English, company name) > "kang1-ni**ng**2" /kʰɑŋ-ni**ŋ**/ (*health-peace*).

(13) Faithful adaptation of nasals

SL	SF	MC Pinyin	IPA	Gloss
English	Maytag[◇]	mei3-tai4-ke4	/mei-tʰai- kʰɤ/	beauty-safety-to restrain
	Nautica	nuo4-di2-ka3	/nuɔ-ti-kʰa/	promise-to inspire-card
	Viacom	wei2-ya4-kang1-	/uei-ia-kʰɑŋ-	to maintain-second-health-
		mu3	mu/	housekeeper
	Amazon	ya4-ma3-sen1	/ia-ma-sən/	second-horse-forest
	Corning[◇]	kang1-ning2	/kʰɑŋ-niŋ/	health-peace
German	Melle	mei2-le4	/mei-lɤ/	plum-to rein in
	Metro	mai4-de2-long2	/mai-tɤ-luŋ/	wheat-virutue-dragon
	Neuental	nuo4-yin1-ta3-er3	/nuɔ-in-tʰa-ɚ/	promise-reason-tower-you
	Hamm	ha1-mu3-(shi4)	/xa-mu-(ʂɻ)/	to breathe out-housekeeper-(city)
	Essen	ai1-sen1	/ai-sən/	dust-forest
	Tönning	te4-ning2	/tʰɤ-niŋ/	special-peace
Italian	Matera	ma3-te4-la1	/ma- tʰɤ-la/	horse-special-to pull
	Napoli	na4-bo1-li4	/na-puɔ-li/	that-wave-benefit

The three terms in (14) demonstrate the only deviant instances of nasal onsets. In "**M**arlboro" (English, brand name of cigarette) > "**w**an4-bao3-lu4" /**u**an-pɑu-lu/ (*ten thousand-treasure-road*) and **M**asterCard (English, type of credit card) > "wan4-shi4-da2-[xing4-yong4-ka3" /**u**an-ʂɻ-ta-[ɕin-yŋ-kʰa]/ (*ten thousand-thing-to attain-[credit card]*), the onset /m-/ is realized as a labial vowel /u/ ~ [w-]. In the only deviant instance for onsets /n-/, the output is a liquid /l-/, which occurs in "Siemens **N**ixdorf Informationssystem AG" (German, company name) > "xi1-men2-zi3-**l**i4-duo1-fu2-[xin4-xi1]-[xi4-tong3]-[gong-si1]" /ɕi-mən-tsẓ-**l**i-tuo-fu-[ɕin-ɕi]-[ɕi-tuŋ]-[kuŋ-sẓ] (*west-door-son-to benefit-much-luck-[information]-[system]-[company]*). In all three cases, the place feature is faithfully retained, and deviations involve manner features (e.g. nasality and continuancy). Although change of manner features are not predicted, they help achieve

semantic effects: "wan4-bao3-lu4" creates an image of "Marlboro" as a brand that can bring fortune and treasure; "wan4-shi4-da-[xin4-yong4-ka3]" arouses associations between the name and the function of MasterCard as a convenient credit card; and "li4-duo1-fu2," corresponding to "Nixdorf" in Siemens **Nixdorf** Informationssystem AG," presents an image of a company that will bring "much benefit" to the customers.

(14) Deviant adaptation of nasals (Onset)

SL	SF	MC Pinyin	IPA	Gloss	Notes
English	Marlboro◊	wan4-bao3-lu4	/uan-pɑu-lu/	ten thousand-treasure-road	m > w
	MasterCard	wan4-shi4-da2-[xin4-yong4-ka3]	/uan-ʂʅ-ta-[ɕin-yŋ-kʰa]/	ten thousand-thing-to attain-[credit card]	m > w
German	Siemens Nixdorf Informations-system AG◊	xi1-men2-zi3-li4-duo1-fu2-[xin4-xi1]-[xi4- tong3]-[gong1-si1]	/ɕi-mən-tsʐ-li-tuɔ-fu-[ɕin-ɕi]-[ɕi-tuŋ]-[kuŋ-sʐ]/	west-door-son-to benefit-much-luck-[information]-[system]-[company]	n > l

Deviant adaptation of nasal codas is illustrated in (15).

(15) Deviant adaptation of nasals (Coda)

SL	Origin	MC Pinyin	IPA	Morph-trans	Notes
English	Centrum◊	shan1-cun2	/ʂan-tsun/	to benefit-to save	m > n
	Seagram Co.	shi1-ge2-lan2	/ʂʅ-kɤ-lan/	to bestow-square-orchid	m > n
	Random House, Inc.	lan2-deng1-[shu1-wu1]	/lan-təŋ-[ʂu-u]/	orchid-to climb-[press]	m > ŋ
	Pentium◊	beng1-teng2	/pən-tʰəŋ/	to run quickly-to soar	m > ŋ
	Avon◊	ya3-fang1	/ia-fɑŋ/	elegant-fragrance	n > ŋ
	Pantene◊	pan1-ting2	/pʰan-tʰiŋ/	ø-female beauty	n > ŋ
	Boeing◊	bo1-yin1	/puɔ-in/	wave-sound	ŋ > n
German	Bochum	Bo1-hong2	/puɔ-xuŋ/	wave-swan	m > ŋ
	Frechen	fu2-lei2-xing1	/fu-lei-ɕiŋ/	not-thunder-to-prosper	n > ŋ
	Menden	men2-deng1	/mən-təŋ/	door-to climb	n > ŋ
	Backnang	ba1-ke4-nan2	/pa-kʰɤ-nan/	to wait-gram-south	ŋ > n
	Winzling	wen1-ce4-lin2	/uən-tsʰɤ-lin/	warm-strategy-forest	ŋ > n

For example, the final coda /-m/ in "Centru**m**" (English, brand name of vitamin supplement) surfaces as an alveolar nasal /-n/. The adapted form is "shan4-cu**n**2" /ʂan-tsu**n**/ (*to benefit-to save*), which literally means "be good to keep" and has a more

desirable meaning than an otherwise faithful output such as "shan4-cu1-**m**u3" /ʂan-tsu-*mu/ (*to benefit-thick-mother*). The deviant mappings from a foreign /-n/ to Mandarin /-ŋ/ are seen in the transformation of "Avo**n**" (English, brand name of cosmetics) > "ya3-fa**ng**1" /ia-faŋ/ (*elegant-fragrance*), and "Mende**n**" (German, place name) > "men2-de**ng**1" /mən-təŋ/ (*door-to climb*). While the Mandarin output of "Avon" conveys a desirable image for the cosmetics product it stands for, the unfaithful adaptation of the nasal coda in "Menden" does not attain any special semantic effects. An example of unfaithful adaptation of /-ŋ/ as Mandarin /-n/ is "Backna**ng**" (German, place name) > "ba1-ke4-na**n**2" /pa-kʰɤ-na**n**/ (*to wait-to conquer-south*), where the deviant output creates no special semantic links between the source and adapted forms. These data show that it is common for foreign nasal codas to be realized with a deviant place feature.

   We might wonder whether the frequent mismatch of place features in the adaptation of foreign nasal codas is related to the distribution of nasal codas in the Mandarin native language. A survey of the native syllable inventory shows that codas /-n/ and /-ŋ/ contrast in a variety of environments, as is shown in the minimal pairs of (16). Thus, it seems unlikely that the flexibility in the adaptation of nasal codas can be attributed to the phonology of the native language.

   (16) Minimal pairs of codas /-n/ and /-ŋ/

	Pinyin	IPA	Character	Gloss
a)	ban1	/pan/	搬	to move
	bang1	/paŋ/	帮	to help
b)	kun1	/kʰun/	昆	mountain
	kong1	/kʰuŋ/	空	empty
c)	lin2	/lin/	林	forest
	ling2	/liŋ/	零	zero
d)	pen1	/pʰən/	喷	to spurt
	peng1	/pʰəŋ/	烹	to cook

3.3.6 Lateral and "r"

   The liquids and trills in the three donor languages have slightly different phonetic qualities. In English, the lateral in the coda has a velar allophone (i.e. the dark "-l" [ɫ]). In German and Italian, it is pronounced with a smaller degree of velarizaiton than in English. The "r-" sounds are generally alveolar in English and Italian, but are very flexible in German in terms of both place and manner. [13]

   The Mandarin sounds which are closest to the lateral and "r" sounds are the two approximants, i.e. lateral /l/ and retroflex /ɻ/. Since the two sounds are both permissible

---

[13] I avoid using the terms "liquid," "approximant" or "trill" for the various sounds spelled with the letter "r" because this sound has such a large variety of allophones (e.g. in Germany) that no single term can cover them all.

onsets in Mandarin, it is expected that they will be the faithful outputs of foreign laterals and "r-" onsets respectively. In the coda, Mandarin approximants are not allowed to take coda positions, thus lateral and "r" codas in the donor languages need to undergo phonotactic adjustments. Two solutions are possible. One is that foreign /l/ "r" are mapped to the Mandarin approximants along with vowel epenthesis (i.e. /-l/ > /-lV, "-r" > /-ɻV/), and the other is that they will be adapted as a vowel since a coda lateral and "r" are phonetically very similar to a back vowel, especially in American English (Espy-Wilson 1992).

The adaptation patterns for /l/ and "r" in the corpus loans are listed in Table 3.11. From the table, it can be seen that despite the fine phonetic differences between the lending languages, these sounds are adapted into Mandarin with great regularity. The outputs vary systematically according to their position in the syllable. In the onset, the expected /l-/ > /l-/ mapping is attested, but the "r-" > /ɻ-/ mapping is far less frequent than predicted. Instead, the preferred substitute is the Mandarin lateral. In adaptation of coda lateral and "-r," the most common output is a Mandarin rhotic vowel /ɚ/ ("er" in Pinyin), which represents a "rhotacized final" or "a retroflex central vowel" (Norman 1988: 144, Ramsey 1987: 45; cf. Li 1999: 37-41). This conforms to the second possibility predicted above (i.e. changing to a back vowel), whereas the other expected strategy (i.e. vowel epenthesis) is rarely used, except for 4/88 (4.35%) instances of coda /-l/.

Table 3.11. Adaptation of "l" and "r"

Position	Phoneme	Output	English	German	Italian	Total (%)
Onset	/l-/	/l-/ ◆	50	42	16	108 (100.00%)
	"r-"	/l-/ ◆	50	50	9	109 (95.62%)
		/ɻ-/	3	0	0	3 (2.63%)
		/x-/	0	2	0	2 (1.75%)
Coda	/-l/	/ɚ/ ◆	40	48	0	88 (95.65%)
		/-lV/	4	0	0	4 (4.35%)
	"r-"	/ɚ/ ◆	21	27	0	48 (100.00%)

Note: 1) ◆: Faithful output; 2) V = Epenthetic vowel

Examples of faithful realizations of "l" and "r" are given in (17). The examples show that /l-/ and "r-" onsets are both replaced by the Mandarin /l-/, as in "**L**ipton" (English, brand name of tea) > "**l**i4-dun4" /**l**i-tun/, and "**R**iesa" (German, place name) > "**l**i3-sa4" (/**l**i-sa/). Coda /-l/ and "-r" are mapped to a rhotic vowel /ɚ/, as in "Inte**l**" (English, company name) > "ying1-te4-**er**3" /iŋ-tʰɤ-**ɚ**/, and "Kalo**r**" (German) > "ka3-luo2-**er**3 /kʰa-luo-**ɚ**/.

(17) Faithful adaptation of /l/ and "r"

SL	SF	MC Pinyin	IPA	Gloss
English	L̲ipton	l̲i4-dun4	/l̲i-tun/	to stand-to pause
	R̲aytheon◊	l̲ei2-shen2	/l̲ei-ʂən/	thunder-deity
	Dee̲re	di2-e̲r3	/ti-ɚ/	to inspire-you
	Inte̲l	ying1-te4-e̲r3	/iŋ-tʰɤ-ɚ/	England-special-you
German	L̲aufen◊	l̲ao2-fen1	/l̲ɑu-fən/	labor-fragrance
	R̲iesa	l̲i3-sa4	/l̲i-sa/	inside-ø
	Kalo̲r	ka3-luo2-e̲r3	/kʰa-luɔ-ɚ/	card-net-you
	Keh̲l	ke4-e̲r3	/kʰɤ-ɚ/	gram-you
Italian	L̲azio	l̲a1-qi2-ao4	/l̲a-tɕʰi-ɑu/	to pull-equal-profound
	R̲avenna	l̲a1-wen2-na4	/l̲a-uən-na/	to pull-culture-to accept

The realization of /l-/ and "r-" sounds in the onset as the Mandarin lateral /l/ may be due to the relative unmarkedness of /l-/, in comparison to the retroflex /ɻ-/, as a syllable Initial in Mandarin. The preference for /l-/ to /ɻ-/ is evidenced by two facts. First, the number /l-/-initial syllables in Mandarin is much larger than /ɻ-/-initial ones. In Xiàndài Hànyǔ Cídiǎn" (2001) *Modern Chinese Dictionary*, there are listed 94 syllables with /l-/ as initial, but only 34 with /ɻ-/ as initial. This calculation includes tonal variations. If permutation of tones is ignored, the respective numbers of /l/-initial and /ɻ/-initial syllables are 26 and 15. Second, /l-/ has a wider distribution. As is shown in (18), it can occur before all three high vowels /i, u, y/, whereas the retroflex /ɻ-/ can only precede /u/

(18) Distribution of onset /l/ and onset /ɻ/ in Mandarin

Onset	Pinyin	IPA	Character	Gloss
/l-/	li4	/li/	力	strength
	lu4	/lu/	路	road
	lü4	/ly/	绿	green
/ɻ-/	*ri	*/ɻi/	N/A	N/A
	ru4	/ɻu/	入	to enter
	*rü	*/ɻy/	N/A	N/A

(see Ramsey 1987: 48). Based on these differences, I posit that the mapping of a foreign "r-" onset to the Mandarin lateral rather than the retroflex sibilant is partly due to the unmarkedness of /l-/ as a syllable onset.

   Deviant outputs for /l/ and "r-" onsets and codas are shown in (19). In onset positions, variations are observed only in the adaptation of "r-." For example, in "**R**eeebok" (English, brand name of sport shoes) > "**r**ui4-bu4" /ɻuei-pu/ (*vigorous-step*), an English onset "r-" is replaced by Mandarin /-ɻ/. In "**R**owenta" (German, brand name of an electronic appliance) > "**h**ao3-yun4-da2" /xɑu-yn-ta/ (*good-luck-to arrive*), the German "r-" onset is adapted as Mandarin /x-/. In both cases, the Mandarin form conveys semantic associations with the source form, i.e. "walking vigorously" for "Reebok" as a brand of sport shoes) and "good luck coming" for "Rowenta" as a brand of home appliances). The adaptations of "Dole Food' (English, brand name of food) and "Dunhill" (English, brand name of cigarette) illustrate deviant cases of coda /-l/. For example, in "Do**l**e Food" (English, brand name of food) > "dou1-**le**4-[shi2-pin3]" /tou-lɤ-[ʂɻ-pʰin]/ (*all-happy-[food]*), where the coda /-l/ in the source form undergoes vowel epenthesis and surfaces as /-lV/. The adapted form creates a desirable advertising image of making all people happy for the company "Dole Food." It is also plausible that orthography plays a role in this case since the English form ends with a "-le" string, so it might be transferred into the same sequence "-le" /-lɤ/ in Mandarin Pinyin, although the pronunciations are different in the two languages.

(19) Deviant adaptation /l/ and "r"

SL	SF	MC Pinyin	IPA	Gloss	Notes
English	Reebok◊	rui4-bu4	/ɻuei-pu/	vigorous-step	r > ɻ
	Rimmel◊	rui4-mei3-er3	/ɻuei-mei-/ɚ/	lucky-beauty-you	r > ɻ
	Dole Food◊	dou1-le4-[shi2- pin3]	/tou-lɤ-[ʂɻ-pʰin]/	all-happy-[food]	l > lV
	Dunhill◊	deng1-xi3-lu4	/təŋ-ɕi-lu/	to climb-happy-road	l > lV
German	Rainer Brüderl	hai3-na4-bu4-lü-de2-le4	/xai-na-pu-ly-tɤ-lɤ/	sea-that-cloth-ø- virtue-to rein in	ɻ > x
	Rowenta◊	hao3-yun4-da2	/xɑu-yn-ta/	good-luck-to arrive	ɻ > x

   The deviant adaptations of onset "r-"s are phonetically grounded. In fact, for an English "r-" onset, which is usually pronounced as a central approximant /ɹ-/, Mandarin /ɻ-/ is a closer match than the lateral /l-/. Hence, it is reasonable that occasionally Mandarin speakers may use the retroflex approximant to replace English /ɹ-/. The "r-" > /x-/ mapping in the adaptation of German loans can be attributed to the allophonic flexibility of "r-" in German. According to Hall (1992:60), the phoneme /r/ is known as the most variable phoneme in German. It can be pronounced as any of the consonants [r], [R], [ɾ], [ɣ] and [ʁ], or as a vowel [ɐ]. In careful speech, it is generally pronounced as an alveolar trill [r] or uvular trill [R]. In rapid and casual speech, [r] can be reduced to a tap

[ɾ], and [R] often comes out as the voiced fricative [ɣ] (velar) or [ʁ] (uvular), or with even less restriction, as a uvular approximant. The vocalic variant, a low central vowel [ɐ], occurs in such contexts as after a long vowel or in a word final "-er" sequence (e.g. in "Leher" and "Lart") (see discussions in Hall 1992, Lockwood 1987). Based on these observations, it can be argued that the two instances of "r-" > /x-/ mapping in German loans are related to the phonetic features of "r-" in the source pronunciation, where this sound may be pronounced as a fricative (i.e. velar [ɣ] or uvular [ʁ]).

The mapping from /-l/ and "r" codas to a Mandarin rhotic syllable /ɚ/ results from the similar phonetic features of these sounds and the Mandarin rhotic /ɚ/. Codas "-l, -r" are perceptually very close to a back vowel rather than a consonant. For instance, in American English, /-l/ and /-ɹ/ are often syllabic when they occur after a vowel or at the syllable-final positions (Ladefoged 2001, Small 1999). Acoustically they share great similarity with a back vowel (Espy-Wilson 1992). The Mandarin /ɚ/, representing "a retroflex central vowel' (Norman 1988:143), is articulatorily and perceptually similar to the postvocalic /-ɹ/ in American English. Similarly, German /-l/ and "-r" codas have weaker consonantal features than their onset counterparts.

3.3.7 Glides
For foreign glides (or semivowels) /j/ and /w/ in the onset, Mandarin high vowels /i, u/ are expected to be the best match. Mandarin high vowels /i, u, y/ in non-nuclear (e.g. syllable-initial and syllable-medial) positions are pronounced as glides [j, w, ɥ]. [14] In the Pinyin system, a syllable-initial /i, y/ ~ [j, ɥ] are represented by the letter "y" and /u/ ~ [w] by "w." For instance, the syllables /i/ and /ia/ are spelled as "yi" and "ya." Similarly, /uɔ/ and /ua/ are written as "wo" and "wa."

The prediction is confirmed. As is shown in Table 3.12, the faithful outputs account for 19/20 (95.00%) of /j-/ onsets and 41/53 977.36) of /w-/ onsets. Deviations occur commonly to /w-/, which is adapted as a velar fricative /x/ in 12/41 (22.64%) cases. In the adaptation of /j-/, variations are rarely found, with only one unfaithful mapping observed, i.e. /j-/ > /tɕ-/.

Examples of faithful substitutions for foreign glide onsets are given in (20). For instance, in "Yahoo" (English, company name) > "**y**a3-hu3" /**i**a-xu/, and "**J**abel" (German, place name) > "**y**a3-bei4-er3" /**i**a-pei-ɚ/, the onset /j-/ in the source forms is replaced by a Mandarin high front vowel /i/ ~ [j-] ("y-" in Pinyin). In "**W**almart" (English) > "**w**o-er-ma" /**w**ɔ-ɚ-ma/, the onset /w/ is realized as Mandarin /u/ ~ [w-].

---

[14] There is disagreement on whether Mandarin glides should be treated as independent consonantal phonemes (e.g. Li 1999) or as vowels (Ramsey 1987, Chen 1999). I consider them allophones of the three high vowels.

Table 3.12. Adaptation of glides

Position	Phoneme	Output	English	German	Italian	Total (%)
Onset	/j-/	/i/ ~ [j-] ♦	4	14	1	19 (95.00%)
		/tɕ-/	0	1	0	1 (5.00%)
	/w-/	/u/ ~ [w-] ♦	41	N/A	N/A	41 (77.36%)
		/x-/	12	N/A	N/A	12 (22.64%)
Coda	/-j/	N/A				
	/-w/	N/A				

Note: ♦: Faithful output

(20) Faithful adaptation of glides

SL	SF	MC Pinyin	IPA	Gloss
English	Y̱ahoo◊	y̱a3-hu3	/i̱a-xu/	elegant-tiger
	W̱almart	w̱o4-er3-ma3	/u̱ɔ-ɚ-ma/	fertile-you-agate
German	J̱abel	y̱a3-bei4-er3	/i̱a-pei-ɚ/	elegant-shell-you
	J̱üterbog	y̱u2-te4-bo2-ge2	/y̱-tʰɤ-puɔ-kɤ/	from-special-abundant-square
Italian	J̱uventus	y̱ou2-wen2-tu2-si1-(dui4)	/i̱u-uən-tʰu-sz̩-(tuei)/	particularly-culture-drawing-this-(team)

The data in (21) illustrate deviant adaptation of glides. The realization of /j-/ as /tɕ-/ (*/i-/ ~ [j-]) is seen in "**J**umo" (German, brand name of machinery) > "**j**iu3-mao4" /**tɕ**iou-mau/ (*permanent-exuberant*). The infuence of spelling may play a role in this case since the alphabetic letter "j" represents a glide /j/ in German, but an affricate /tɕ/ in Mandarin. Moreover, the Mandarin form has a desirable meaning, i.e. for the company to

(21) Deviant adaptation of glides

SL	SF	MC Pinyin	IPA	Gloss	Notes
English	Time W̱arner	shi2-dai4-ẖua2-na4	/[ʂ̩-tai]-x̱ua-na/	[times]-splendid-to accept	w > x
	W̱hirlpool◊	ẖui4-er3-pu3	/x̱uei-ɚ-pʰu/	reasonable price-and-popular	w > x
	W̱hisper◊	ẖu4-shu1-bao3	/x̱u-ʂu-pɑu/	to protect-comfortable-treasure	w > x
	W̱yeth◊	ẖui4-shi4	/x̱uei-ʂʅ/	benefit-surname	w > x
German	J̱umo◊	jiu3-mao4	/ṯɕiu-mau/	permanent-exuberant	j > tɕ

enjoy lasting success. A more faithful output like "you2-mao4" /iou-mɑu/ (*to swim-exuberant*), is not as effective a company name as "jiu3-mao4." The deviant mapping of /w-/ > /x-/ can be seen in "Time **W**arner" (English, company name) > "shi2-dai4-**h**ua2-na4" /[ʂɻ-tai]-**x**ua-na/ (*[times]-splendid-accept*), and "**W**hirlpool" (English, brand name of an electronic appliance) > "**h**ui4-er3-pu3 /**x**uei-ɚ̃-pʰu/ (*reasonable price-and-popular*). The Mandarin form of "Time Warner" does not arouse any particular advertising image for the company, but the adaptation of "Whirlpool" creates an image of a product being reasonably priced and popular.

The factors leading to deviant mappings of /w-/ > /x-/ (cf. */u/ ~ [w-]) may be due to variant pronunciations of word-initial "wh-" in the donor language. In American English, initial "wh-"" is pronounced as either a glide /w-/ or a voiceless labio-velar fricative /ʍ-/ (Ladefoged 2001: 56). To test this possibility, the /w-/ onset cases are divided into two groups according to whether the spelling is "w-" or "wh-." [15] The results are listed in Table 3.13, which show that /w/ spelled by "wh-" is indeed more likely to be replaced by Mandarin /x-/ (4/5) than by /w-/ (1/5). (The numbers in brackets are the numbers of cases in which the Mandarin form is a PS loan convey semantic associations.) However, the /x-/ output is not limited to words beginning with "wh-." It occurs also to words starting with "w-." In most cases (6/8), semantic factors contribute to this mapping, as in "**W**yeth" (English, brand name of milk power) > "**h**ui4-shi4" /**x**uei-ʂɻ/ (*benefit-surname*). As for cases in which no semantic effects are attained, the trigger for "w-" [w] > /x-/ mapping is not clear.

Table 3.13. Spelling and adaptation of English /w-/

Output Spelling	/w-/	/x-/	Total
"w-" [w-]	40 (2)	8 (6)	48
"wh-" [ʍ-]	1 (0)	4 (3)	5

Note: Numbers in brackets ( ) are cases of PS loans.

Theoretically, it is equally possible for [w-, ʍ-] to be realized as a labial consonant /f-/, considering that they have a dual place feature of [+labial, +velar]. However, this mapping never occurs. The reason may be that perceptually Mandarin /x-/ is more similar to a labio-velar sound in the foreign input than is /f-/. Acoustically, lip rounding and backness in the production of /w-, ʍ-/ lead to low frequency, whereas /f-/ as a labio-dental fricative has a much higher frequency. Thus, the Mandarin velar fricative /x-/ is a better match because it maintains greater similarity with the source pronunciation.

---

[15] There is one case of "w-" onset not included because the whole syllable containing /w-/ is deleted.

3.3.8 Semantic category and variability of phoneme mapping

As was seen in segmental adaptations discussed above, Mandarin speakers make conscious efforts to choose a particular written character so that the adapted form can convey desirable meaning links to the source term. Sometimes semantic considerations override phonological faithfulness, triggering a deviant output. In view of this phenomenon, it is predicted that loans that can achieve semantic effects will demonstrate higher variability in phoneme substitutions.

To test the hypothesis, the English loans in the corpus are further investigated. (The German and Italian data are not included since the numbers of words with semantic associations are too small, see §2.2 for details.) According to the presence/absence of semantic effects, English simplex onsets and simplex codas are divided into two groups, namely those in words that convey certain semantic links (With Sem-Assoc), and those in words that do not (Without Sem-Assoc).

Comparison between the variability of phoneme mappings in the two groups confirms the prediction. From the results displayed in Table 3.14, it can be seen that consonant mapping between English and Mandarin is more likely to deviate from the expected pattern in the "With Sem-Assoc" group than in the "Without Sem-Assoc" group ($p < 0.001$). The tendency holds for both simplex onsets and simplex codas. In the former, 36.59% of simplex onsets and 56.25% of simplex codas have a deviant substitute in the adapted form, which contrasts with only 15.09% of simplex onsets and 12.57% of simplex in the latter.

Table 3.14. Deviant substitutions in simplex onsets and codas (English loans)

Category		Onset C		Coda C	
		n	%	n	%
With Sem-Assoc	Deviant output	61	36.75	36	55.38
	Faithful output	105	63.25	29	44.62
Without Sem-Assoc	Deviant output	90	14.98	46	12.60
	Faithful output	511	85.02	319	87.40
		$p < 0.001$		$p < 0.001$	

3.3.9 Summary

In this section, I examined the major patterns of consonant mapping between the three donor languages and Mandarin, which are summarized in Table 3.15. The discussions show that phoneme substitutions, both faithful and deviant, are phonologically constrained so that adequate phonetic/phonological similarity between the foreign input and the Mandarin output can be achieved. For obstruents and nasals, voicing/aspiration and/or place features are more susceptible to change, whereas manner features (e.g. continuancy and nasality) tend to be kept intact. For sonoannts other than nasals, i.e. laterals, "r" sounds and glides, certain manner features (e.g. approximancy and sonorancy) show flexible mappings, as in the case of /-l/ > /ɚ/ and /w-/ > /x-/.

Table 3.15. Summary of variations in consonant substitutions

SL phonemes		Faithful output	Deviant output	Deviant features
Plosive		Plosive	Plosive	Voicing/aspiration
			Affricate	Place, voicing/aspiration
Fricative		Fricative	Fricative	Place
			Affricate	Place, Voicing/aspiration
Affricate		Affricate	Affricate	Place, Voicing/aspiration
			Fricative	Place
Nasal		Nasal	Nasal	Place
"l" & "r"	Onset	Liquid	Liquid	Laterality
	Coda	Vowel /ɚ/	Liquid	Consonancy
Glide		Glide	Fricative	Approximancy, Sonorancy

The factors contributing to the observed deviant mappings are diverse. Among them are: (1) orthographic influence (e.g. voicing/aspiration mismatch regarding German final plosives); (2) the phonetics and phonology of the donor language (e.g. in the case of plosive → affricate mapping before a high front vowel); and (3) the phonetics and phonology of the recipient language (e.g. the preference for /l-/ over */ɻ-/ as a syllable-onset in Mandarin). In addition, there are certain types of variation that cannot be explained by any linguistic factors, but rather by random factors in language contacts.

The segmental adaptation patterns as discussed above corroborate the P-map hypothesis (Steriade 2002) and cross-linguistic findings that the manner features of consonants are more resistant to change than voicing and place features (e.g. Zwicky 1976, Bond 1999, Broselow 1999, Kenstowicz 2003). Next, I will propose a perceptual analysis for the differential flexibility of segmental features in Mandarin loan phonology.

3.4 Perceptual similarity and constraint ranking for phoneme substitution

To account for Mandarin adaptations of foreign consonants, I follow Steriade's (2002) P-map hypothesis and propose that the changeability of various segmental features is governed by the perceptibility of these features. Within a constraint-ranking framework of Optimality Theory (OT), I posit that in loanword phonology, constraint rankings are projected by the perceptibility scale of various phonological and phonetic differences between the foreign input and the adapted form. With respect to segmental adaptation, a borrower chooses substitutes that maximize the perceptual similarity between the phonemes in the donor language and their outputs in the recipient language. In other

words, modifications made during loan nativization are intended to be as imperceptible as possible.

Before going into detail of the formal analysis, I first give a brief introduction to Optimality Theory.

3.4.1 Optimality Theory: An introduction

In the OT theory (McCarthy & Prince 1993, Prince & Smolensky 1993, McCarthy & Prince 1995), the grammar of a language consists of a set of universal constraints which are hierarchically ranked. The ranking of constraints arises from the interaction between well-formedness constraints, which define universal and language-specific unmarked structures, and faithfulness or correspondence constraints, which require the preservation of input structures and hence the identity between input and output. Constraints are violable, and possible output candidates are evaluated according to the seriousness of violations they incur. Violation of a higher-ranked constraint is considered more serious than violation of a lower-ranked one.

In the OT framework, generation of an output in phonological processes is schematically represented in the form of a tableau, where candidate outputs for an input structure are evaluated against a constraint hierarchy (see Kager 1999 for a detailed introduction). The winning output will be a candidate that incurs the least serious violations and hence optimally satisfies the constraint ranking. A sample tableau is given in (22) to illustrate the OT mechanism.

(22) Sample OT tableau

Input	Constraint-1	Constraint-2	Constraint-3	Constraint-4
☞ A				*
B		* !		
C			* !	
…				

For a certain input form, there are an unlimited number of output candidates, which are listed in the left-most column. These candidates simultaneously go through a selection system, i.e. a hierarchy of constraints listed in the top row in a descending order from left to right. In (22), candidate (A) is selected as the optimal output, indicated by a sign "☞," since it violates only the lowest-ranking constraint (i.e. Constraint-4) once. (Violations are marked by an asterisk "*.") Candidates (B) and (C) are ruled out because they fatally violate higher-ranked constraints. (Fatal violations are signaled by an exclamation mark "!.")

Compared with prior phonological theories (e.g. the rule-based generative grammar), the constraint-based OT theory has unique advantages in accounting for cross-linguistic universal structures and typological variations (Kager 1999). It is assumed that all languages have the same constraints, and differences between various languages lie in the ranking of these constraints.

3.4.2 Perceptual similarity and faithfulness of segmental features

Next, I will present an OT analysis for the phoneme substitution patterns in Mandarin loanword phonology. The analysis will show that the interaction between native phonological constraints and faithfulness constraints of various segmental features generates the faithful and deviant mappings in Mandarin adaptations of foreign consonants. I assume that the input to loanword phonology is the source pronunciation in the donor language, which contains both phonological information and phonetic details (e.g. allophonic variations or co-articulation) (also Kang 2003). Discussions will be presented in the following order: obstruents, nasals, /l/ and "ɾ," and glides.

As was seen in §3.2, when foreign obstruents are adapted into Mandarin, they generally remain as obstruents of the same manner and place. Voicing contrasts of foreign plosives and affricates are mapped to Mandarin aspiration contrasts. In the case of faithful adaptations, a [-voice] obstruent is replaced by a Mandarin [+asp] phoneme (e.g. /p/ > /pʰ/, as in "**P**uma" > "**p**iao1-ma3" /**p**ʰiɑu-ma/), and a [+voice] obstruent corresponds to a Mandarin [-asp] sound (e.g. /b/ > /p/, as "**B**oeing" > "**b**o1-yin1" /**p**uɔ-in/). Since Mandarin fricatives only contrast in place and not in aspiration, voicing contrasts of fricatives are not realized after adaptation (e.g. /s, z/ > /s/, as in "Corvi**s**" > "kao3-wei2-**s**i1" /kʰɑu-uei-**s**ʐ̩/, and "Levi'**s**" > "li3-wei2-**s**i1" /li-uei-**s**ʐ̩/).

When an output deviates from the expected substitute, the change mainly involves a mismatch of voicing/aspiration features for plosives (e.g. /p/ > /p/, cf. */pʰ/, as in "**P**ortland" > "**b**o1-te4-lan2" /**p**uɔ-tʰɤ-lan/), place features for fricatives (e.g. /h/ > /ɕ/, cf. */x/, as in "**H**ilton" > "xi1-er3-dun4" /**ɕ**i-ɚ-tun/), and either voicing/aspiration or place features, or both, for affricates (e.g. /tʃ/ > /tʂʰ/, cf. */tɕʰ/, as in "**Ch**arlie Bell" > "**ch**a2-li3 bei4-er3" /**tʂ**ʰa-li pei-ɚ/). Rarely do deviations of manner features occur (except in the case of /v-/ > /u/ ~ [w-] mapping).

Based on these observations, I postulate that contrasts in the manner features of obstruents are more perceptible than contrasts in place and voicing/aspiration. The manner features in concern are the major categorical features, which include [±approx], [±cons], [±cont], [±nas], and [±son]. [16] Furthermore, I conjecture that contrasts in place are more perceptible than contrasts in voicing/aspiration, based on the adaptation of plosives, in which an unfaithful plosive output always deviates from the expected substitute in voicing/aspiration, but never in place (e.g. /p/ > /pʰ/, /p/, */t/). The perceptibility scale of segmental features is formulated (23). This distinctiveness hierarchy projects a constraint ranking of (24), in which manner identity dominates place identity, which dominates voicing/asp identity. IDENT (Manner) contains a family of featural faithfulness constraints, namely IDENT [±approx], IDENT [±cons], IDENT

---

[16] The other two manner features, namely [±strid] and [±lat], listed in (1) (see §3.3), are not considered here as major categorical features in view of the fact that they serve to make finer distinctions within the categories, (i.e. [±strid] for fricatives) and [±lat] for approximants).

[+cont], IDENT [+nas], and IDENT [+son]. The ranking of (24) determines that manner features are more resistant to change than place and voicing/asp.

     (23) Perceptibility scale of featural distinctiveness
         Manner >> Place >> Voicing/Asp

     (24) Ranking of featural correspondence
         IDENT (Manner) >> IDENT (Place) >> IDENT (Voicing/Asp)

The tableau in (25) illustrates the constraint ranking in the adaptation of plosives. (Hereafter, an upward pointing hand "☝" is used to indicate a deviant but permissible output.) Candidate (a) is optimal since it satisfies all constraints. In cases when deviations occur, a tolerable output is candidate (b), the second most faithful form. This is because the voicing/asp contrast is not as distinctive as place and manner contrasts, and hence violation of IDENT (Voicing/Asp) will not lead to as great a loss of similarity between the foreign input and the Mandarin output as violation of other faithfulness constraints. Candidates (c) and (d) will never win because they violate the higher ranking constraints IDENT (place) and IDENT (Manner), respectively.[17]

(25) /p/ → /pʰ/ ~ /p/

/p/	IDENT (Manner)	IDENT (Place)	IDENT (Voicing/Asp)
☞ a) /pʰ/			
☝ b) /p/			*
c) /kʰ/		* !	
d) /m/	* ! [-son], [-nas]		

In the adaptation of foreign fricatives, the place feature of the output demonstrates great flexibility, while manner features stay unchanged. Furthermore, the substitution patterns observed in §3.2 show that variant outputs for a single fricative generally belong to the same major articulatory region. For instance, an alveolar /s/ can be replaced by a Mandarin /s/, /ʂ/ and /ɕ/, but never by a velar /x/. This type of constrained place changeability in Mandarin conforms to Broselow's (2001) observation that preservation of the major articulatory regions enjoys higher priority than preservation of other features such as voicing and stridency in phoneme substitutions of loanword phonology.

To account for the adaptation of fricatives, I propose a constraint IDENT (MajorArtic) of (26), which stipulates that an output segment has the same major articulatory region as the input. Major articulatory regions are defined along a dimension of (lips)-(tongue blade)-(guttural region) (Broselow 2001). This division of articulatory regions corresponds respectively to the distinction of articulatory groupings along a range of [labial]-[coronal]-[dorsal/guttural] (Spencer 1996: 17). IDENT (MajorArtic) ranks high,

---

[17] Since this chapters focuses on segmental mapping, I temporarily ignore the phonotactic processes (e.g. vowel epenthesis) that accompany phoneme substitutions (see Chapter 4 for constraint rankings that govern phonotactic adaptations).

but it is violable in cases when the recipient language does not have any segment in same articulatory region as the source phoneme of the donor language. I use IDENT (MajorArtic) an aggregate term to refer to a group of more specific constraints, namely, IDENT [Labial], IDENT [Coronal] and IDENT [Dorsal/Guttural].

(26) IDENT (MajorArtic): The major articulatory region of an output
segment is identical to that of the input.
(Major articulatory regions = labial, coronal, dorsal/guttural)

The tableau in (27) illustrates the constrained flexibility of place in the adaptation of fricatives. A foreign phoneme /s/ is optimally mapped to the Mandarin sound /s/, i.e. candidate (a). If this faithful output is not chosen, the next available choices will be fricatives of a different place feature within the coronal region. Candidates (b) (i.e. a retroflex /ʂ/) and candidate (c) (i.e. a palatal /ɕ/), which violate only IDENT (Place), are the second most faithful forms. They become the permissible alternative substitutes for /s/ in cases when deviations occur. Candidate (d), a velar fricative, differs from the input phoneme /s/ in the major articulatory place, so it is ruled out by the constraint IDENT (Major Artic). Lastly, candidate (e) loses due to its fatal violation of IDENT (Manner).

(27) /s/ → /s/ ~ /ʂ/ ~ /ɕ/

/s/	IDENT (Manner)	IDENT (MajorArtic)	IDENT (Place)	IDENT (Voicing/Asp)
☞ a) /s/				
⊘ b) /ʂ/			*	
⊘ c) /ɕ/			*	
d) /x/		* !	*	
d) /t/	* ! [+cont]			

The furthest deviations allowed for the adaptation of obstruents is for a velar stop or a fricative in onset positions to be realized as an affricate (e.g. /k-/ > /tɕ-/, */kʰ-/; and /z-/ > /tʂ-/, */s-/) and an affricate to be realized as a fricative (e.g. /tʃ/ > /ʂ/, */tɕʰ/), with or without place deviations (see §3.3.1, §3.3.2 and §3.3.4). To account for these types of mapping, we can consider affricates to be phonemes with a feature of [-cont & +cont], in which [-cont] defines the plosive element and the [+cont] the fricative element. Thus, replacement of a foreign plosive or fricative by a Mandarin affricate does not incur violation of IDENT [+cont] and IDENT [-cont], which are sub-members of IDENT (Manner). Instead, I argue that plosive → affricate mapping preserves the [-cont] feature and that fricative → affricate mapping retains the [+cont] feature. The mapping from a plosive to a fricative, or vice versa, will be banned because it violates IDENT (Manner), involving loss of a [-cont] feature (in plosive → fricative) or loss of a [+cont] feature (in fricative → stop) (Ellen Broselow, personal communication, October 2005).

In addition, the adaptation of plosives as affricates provides evidence that non-contrastive phonetic details in the source pronunciation can also be perceived and preserved in loanword adaptation. As discussed in §3.3.3, only velar plosives in onset

positions are likely to be adapted as Mandarin affricates, and in these cases the outputs are always the palatal sound /tɕ-/. Furthermore, this mapping is more frequent when in the source pronunciation the adjacent vowel is a high front vowel (e.g. /i/), which leads to co-articulation effects on the preceding consonant. In this way, the realization of a foreign velar stop in a string /CV$_{[+high]\ [+front]}$/ improves the perceptual similarity between the foreign input and the Mandarin output.

The tableau in (28) illustrates possible realizations of a velar stop /k-/ adjacent to a high front vowel. Since in this context the velar stop is phonetically somewhat palatalized, candidate (a), an aspirated palatal affricate /tɕʰ-/, optimally satisfies the ranking. Candidate (b), which differs from the faithful output in aspiration, is the second best match. In reality, however, the optimal output of (a) is not observed, but candidate (b) is always chosen if a velar stop is mapped to a Mandarin affricate. The reason for this is not clear. Candidates (c) and (d), which do not reflect the palatalization of the source phoneme, are still possible outputs in that they satisfy both of the two highest ranking constraints. Candidate (e), which is a palatal fricative, is ruled out in that its violation of the top-ranking IDENT (Manner) constraint renders the adaptation too costly.

(28) /kʲV-/ → /tɕV-/ ~ /kʰV-/ ~ /kV-/

/kʲV-/	IDENT (Manner)	IDENT (MajorArtic)	IDENT (Place)	IDENT (Voicing/Asp)
☞ a) /tɕʰV-/				
⌀ b) /tɕV-/				*
⌀ c) /kʰV-/			*	
⌀ d) /kV-/			*	*
e) /ɕV-/	* ! [-cont]	*		

Unlike in the earlier cases shown in (25) (/p/ → /pʰ/ ~ /p/) and (27) (/s/ → /s/ ~ /ʂ/ ~ /ɕ/), where possible substitutes are limited to the first and the second most faithful candidates, permissible outputs in (28) expands to include the third and the fourth best forms, i.e. candidates (c) and (d). It can be posited that in this case, the cut-off point is determined by the IDENT (Manner) and/or IDENT (MajorArtic) constraints. No matter how place and voicing/asp features change, a candidate will be a permissible substitute as long as it does not violate IDENT (Manner) or IDENT (MajorArtic) and the constraints above these two.

The only pattern that seems to challenge the undominated status of IDENT (Manner) is the adaptation of a foreign /v-/ onset into a Mandarin labial vowel /u/ ~ [w-]. As was discussed in §3.3.2, this /v-/ > /u/ ~ [w-] mapping is triggered by Mandarin native phonology, in which /u/ ~ [w-] in syllable-initial positions can be alternatively pronounced as [v-]. Since in the recipient language, /u/ ~ [w-] and [v-] in the onset positions are not distinctive, it can be postulated that Mandarin speakers consider the differences between these sounds as trivial. The constraint that stipulates the allophonic nature of /u/ ~ [w-] ~ [v-] variation in Mandarin is formulated in (29).

(29) [vV] = /u/ ~ [wV]: /u/, [w-] and [v-] in the onset are not contrastive.

The tableaux in (30) illustrate the adaptation of /v/ in onset and coda positions. In (30i), candidate (a), a labial glide /w-/, is the only form that satisfies the undominated [vV] = /u/ ~ [wV] constraint. Hence, although violating IDENT (Manner), it is the optimal substitute. The same ranking successfully generates the adaptation of /-v/ > /-fV/ in the coda, as is shown in (30ii). Candidate (a) is the best realization of a foreign /-v/ coda because the mapping incurs only a violation of the lowest ranking constraint IDENT (Voicing/Asp). In contrast, candidates (b) and (c) lose in the competition since they fail to satisfy the higher ranking constraints IDENT (MajorArtic) or DIENT (Manner).

(30) (i) /v-/ → /u/ ~ [wV] [w-] ; (ii) /-v/ → /-fV/

i) /v-/	[vV] = /u/ ~ [wV]	IDENT (Manner)	IDENT (MajorArtic)	IDENT (Place)	IDENT (Voicing/Asp)
☞ a) [w-]		* [-cons], etc			
b) /f-/	*				*
c) /x-/	*		* !	*	*
ii) /-v/					
☞ a) /-fV/					*
b) /-xV/			* !	*	
c) [-wV]		* ! –[cons], etc			

The substitution patterns for nasals display a contrast between uniform one-to-one mappings in the onset and variant outputs in the coda. In cases when deviations occur, what is susceptible to change is always the place feature, whereas manner features such as nasality and sonorancy are faithfully preserved, as in /-m/ > /-mV/ ~ /-n, -ŋ/, and /-n/ > /-n, -ŋ/. The same ranking of IDENT (Manner) >> IDENT (Place) can account for the adaptation of nasals. Furthermore, the variability of nasal codas evidences that IDENT (Manner) >> IDENT (MajorArtic). For instance, it is common for a coda /-m/ to be adapted as a licit coda /-n, -ŋ/, with change in the major articulatory region but retention of nasality; however, an opposite mapping which preserves the articulatory region but changes nasality feature (e.g. /m/ > /b/) never occurs.

The tableaus of (31) and (32) exemplify the constraint ranking for the adaptation of nasal codas. They show that the top constraint, IDENT (Manner), ensures that the output is a nasal segment, which leads to the loss of candidate (d) in (31) and candidates (c) in (32).

(31) /-m/ → /-mV_ø/ ~ /-n, -ŋ/

/-m/	IDENT (Manner)	IDENT (MajorArtic)	IDENT (Place)	IDENT (Voice/Asp)
☞ a) /-mV_ø/				
☜ b) /-n/		*	*	
☜ c) /-ŋ/		*	*	
d) /-pV_ø/	* ! [+son], [+nas]			

(32) (i) /-n/ → /-n, -ŋ/; (ii) /-ŋ/ → /-ŋ, -n/

(i) /-n/	IDENT (Manner)	IDENT (MajorArtic)	IDENT (Place)	IDENT (Voice/Asp)
☞ a) /-n/				
✧ b) /-ŋ/		*	*	
c) /-dV/	* ! [+son], [+nas]			
(ii) /-ŋ/				
☞ a) /-ŋ/				
✧ b) /-n/		*	*	
c) /-kV/	* ! [+son], [+nas]			

The dominance of IDENT (Manner) over IDENT (MajorArtic) and IDENT (Place) triggers changes of place tolerable, hence candidates (b) - (c) in (31) and candidates (b) in (32) are possible outputs. In the mapping patterns of all three nasals, permissible substitutes include the first and the second most faithful candidates.

The phonemes /l/ and "r" are both adapted into Mandarin as a lateral /l-/ in the onset and as a rhotic vowel /-ə˞/ in the coda. The substitution pattern for onset /l-/ and 'r-" supports the unmarkedness of /l-/ as a syllable initial in the recipient language (see §3.3.6). A constraint ranking in (33), which states that the rhotic approximant /ɻ-/ is a more marked onset than the lateral /l-/, can be argued to motivate the preference for /l-/ to /ɻ-/ as an initial consonant in Mandarin.

(33) */ɻV/ >> */lV-/: Approximant /ɻ/ is a more marked onset than
        approximant /l/.

In addition, I postulate that the [±lateral] feature of approximants has low perceptibility. Thus IDENT (Lateral) ranks low. When a foreign "r-" sound is realized as Mandarin /l-/, the output differs from the input in terms of laterality, but it satisfies a higher ranking constraint */ɻV-/, which bans a more marked onset.

The constraint ranking that triggers the mapping from /l-/ and "r-" onsets to Mandarin /l-/ is shown in (34) and (35). In both tableaux, the lateral, i.e. candidate (a), surfaces as the optimal output because it is the only form that satisfies the top two constraints, IDENT (Manner) and */ɻV/. Candidate (b) loses due to its fatal violation of the constraint */ɻV-/. Candidate (c), a plosive /tV-/, is the least likely to win since it violates the undominated IDENT (Manner).

(34) /lV-/ → /lV-/

i. /lV-/	IDENT (Manner)	*/ɻV-/	*/lV-/	IDENT (Place)	IDENT (Lateral)	IDENT (Voice/Asp)
☞ a) /lV-/			*			
b) /ɻV-/		* !			*	
c) /tV-/	* !				*	

(35) "-rV" → /lV-/

"-rV"	IDENT (Manner)	*/ɻV-/	*/lV-/	IDENT (Place)	IDENT (Lateral)	IDENT (Voice/Asp)
☞ a) /lV-/			*		*	
b) /ɻV-/		* !				
c) /tV-/	* !					

In the coda position, "-l" and "r" are adapted as a Mandarin rhotic vowel /ə˞/. The underlying factor that triggers the mapping is the phonetic similarity between "-l/-r" codas and a back vowel (see §3.3.6). Based on this, it can be posited that the absence of "-l/-r" codas in the native phonology and their acoustic closeness to a vowel in collaboration lead Mandarin speakers to interpret the two sounds as a vowel. To account for the mapping of "-l/-r" > /ə˞/, I propose the constraint of (36), which mandates that a coda "-l/r" in an input form cannot surface as an onset consonant. The constraint stands undominated in the adaptation grammar and triggers the choice of a vowel rather than a consonant as the substitute for "-l/-r" codas.

(36) *-Vl/-Vr" → /CV/: A coda "-l" or "-r" cannot be replaced by an onset consonant.

The tableaux in (37) illustrate the adaptation of coda "-l, -r" as the Mandarin rhotic vowel. (For brevity, constraints that are not directly relevant, e.g. IDENT (MajorArtic) and IDENT (Voicing/Asp), are omitted.) In both cases of (37), /ə˞/ surfaces as the winner by satisfying the highest-ranking constraint *-Vl/-Vr" → /CV/. An alveolar output along with vowel insertion, as in (37i-b) and (36ii-b), fares worse since it is perceptually too distant from the input sounds. In a similar way, the candidate /-ɻV/ in (37i-c) and (37ii-c) are ruled out. Thus, the mapping of "-l/-r" > /ə˞/ creates maximal perceptual similarity between the source pronunciation and the Mandarin form although it results in the violation of the manner feature [+cons].

(37) "-l/-r" → /-ə˞/

i. /-l/	*-Vl/-Vr" → /CV/	IDENT (Manner)	*/ɻV/	*/lV/	IDENT (Place)	IDENT (Lateral)
☞ a) /-ə˞/		* [+cons]				*
b) /-lV/	* !			*		
c) /-ɻV/	* !		*			
ii. "-r"						
☞ a) /-ə˞/		* [+cons]				
b) /-lV/	* !			*	*	*
c) /-ɻV/	* !		*			

Foreign glide onsets /j-/ and /w-/ are generally replaced by Mandarin vowels /i/ and /u/ respectively, since in Mandarin phonology, these two vowels are pronounced as glides in syllable-initial positions. The tableau in (38) illustrates this type of faithful mapping by the adaptation of /j-/ > /i/ ~ [j-].

(38) /j/ → /i/ ~ [j-]

i. /j-/	IDENT (Manner)	IDENT (MajorArtic)	IDENT (Place)	IDENT (Voice/Asp)
☞ a) /i-/ ~ [j-]				
b) /ɕ-/	* ! [-cons] [+son]			*

The only type of deviant adaptation for glides is for an English /w-/ to be replaced by a Mandarin velar fricative /x-/. As was noted in §3.3.7, some instances of /w-/ > /x-/ mapping are due to the variable pronunciations of word-initial "wh-" as a glide [w-] or a voiceless labio-velar fricative [ʍ-] in the donor language (American English). Thus when English /w-/ is pronounced as a glide, a Mandarin high vowel /u/, which surfaces as a glide [w-] in the syllable-initial position, is the faithful substitute; and when English /w-/ is produced as a fricative, a Mandarin fricative /x-/ is phonetically the closest match. Although more likely to occur when the spelling is of a "wh-" form, the /w-/ > /x-/ mapping also takes place in adaptations of words starting with "w-." An alternative plausible substitute /f-/ never occurs due to the greater perceptual distance between /w-/ and /f-/ than between /w-/ and /x-/ (e.g. in terms of frequency).

To account for this substitution pattern, I postulate that the major articulatory place feature of /w-/ is [velar], while the [labial] feature is secondary. Thus a /w-/ > /f-/ mapping in the adaptation of English /w-/ onset is banned because it violates IDENT (MajorArtic) in addition to IDENT (Manner). In contrast, /x-/ and /u/ ~ [w-] are possible outputs because the major articulatory region is preserved.

The constraint ranking that functions in the variable adaptation of English onset /w-/ is shown in (39). In (39i), when English /w-/ is pronounced as [w-], the best candidate is (a), i.e. the Mandarin vowel /u/, realized as [w-]. Candidate (b), a velar fricative /x-/, is not as faithful as (a) since it violates IDENT (Manner) and IDENT (Voicing/Asp). However, it is better than candidate (c) since the latter violate all constraints. In (39ii), when English /w-/ is pronounced as a fricative [ʍ-], candidate (a), a velar fricatives, satisfies all constraints and stands as the optimal substitute. Candidate (b), a labial vowel /u/ ~ [w-], is the second best output since it maintains the major articulatory feature although violating IDENT (Manner) and IDENT (Voicing/Asp). The last candidate, a labial fricative /f-/, incurs violations of all constraints and never wins in the competition.

(39) (i) /w-/ [w-] → /u/ ~ [w], or /x-/; (ii) /w-/ [ʍ-] → /x-/, or /u/ ~ [w]

i. /w-/ [w]	IDENT (Manner)	IDENT (MajorArtic)	IDENT (Place)	IDENT (Voicing/Asp)
☞ a) /u-/ ~ [w]				
✐ b) /x-/	* [-cons] [+son]			*
c) /f-/	* [-cons] [+son]	* !	*	*
ii. /w-/ [ʍ-]				
☞ a) /x-/				
✐ b) /u-/ ~ [w]	* [+cons], [-son]			*
c) /f-/	* [-cons], [+son]	* !	*	*

Discussions above show that the variability of phoneme mapping in Mandarin loanword phonology is governed by the rankings of featural identity constraints and that these rankings generate a range of possible substitutes. Permissible outputs are often limited to the first and the second best candidates (e.g. in the case of /-m/ > /-n, -ŋ/). Choice of a candidate that is further down (e.g. the third most faithful form) is only observed in the adaptation of /kʲV-/ → /tɕV-/ ~ /kʰV-/ ~ /kV-/, and in this case, IDENT (Manner) and IDENT (MajorArtic) are still obeyed.[18] Hence, it can be posited that in general the bottom line of permissible substitutes is the second best candidate, and in cases when candidates lower than this are chosen, IDENT (Manner) and IDENT (MajorArtic) sets the limit of variability. In this way, the mechanism of constraint ranking in cooperation with the cut-off point ensures adequate perceptual similarity between the input phoneme and the Mandarin output.

3.5 Summary

In this chapter, segmental mappings between the three donor languages and Mandarin were investigated in detail. Examination of the permissible Mandarin substitutes for foreign consonants showed that the variability of phoneme substitution in loanword phonology is phonologically constrained. Although under the influence of various factors (e.g. semantic considerations), an unfaithful deviant substitute may be chosen, the extent to which it can deviate from the expected substitute is determined by the degree of perceptual similarity between the input and the output segments. In addition, it was shown that in adapting foreign words, the recipient language speakers take into consideration both contrastive phonemic information and non-contrastive phonetic details of the source language (also see Kang 2003).

Based on the phoneme substitution patterns in Mandarin loanword phonology, I proposed a constraint-based analysis from a perceptual perspective. I argue that contrasts in manner features are perceptually more distinctive than contrasts in place, and the latter

---

[18] Ellen Broselow (personal communication, November 30, 2005) directed me to the possibility of defining a cut-off point for the range of permissible substitutes.

are more distinctive than constraints in voicing/aspiration. This perceptibility scale of consonantal features projects a constraint ranking of IDENT (Manner) >> IDENT (Place) >> IDENT (Voice/Asp), which triggers the constrained variability of segmental mapping from foreign languages to Mandarin. Furthermore, manner identity is violable if that is the only way to satisfy an even higher-ranked constraint (as in /v-/ > /u/ ~ [w-]). The analysis supports the P-map hypothesis that perceptual similarity plays an important role in regulating phonological processes.

Chapter 4
Phonotactic Processes in Adaptation of
Phonemic Loans and Hybrids

4.1 Introduction

In loanword adaptation, syllable structures that are permissible in the donor language but ill-formed in the recipient language need to undergo phonotactic adjustments so that the adapted form can conform to the syllable construction rules of the latter. For instance, if a word is borrowed from a language that allows CVC syllables into one that permits only CV syllables, the coda consonant in the source word may undergo either vowel insertion (i.e. CVC → CV.CV) or deletion (i.e. CVC → CV< >). Hence, the resultant loan form becomes compatible with the CV template of the borrowing language.

In this chapter, I will investigate the phonotactic processes in Mandarin adaptation of foreign syllable structures. The focus of analysis is the nativization of foreign consonant structures in word-initial and word-final positions. A summary of these structures in the corpus data given in Table 1.5 (see §1.5.3) is repeated here as Table 4.1. Constructions that are illicit in Mandarin and hence subject to phonotactic adaptations include simplex codas other than /-n/ and /-ŋ/, complex onsets and complex codas. As simplex onsets are permissible in all three donor languages, their adaptations, which do not involve phonotactic processes but only segmental nativization, will not be discussed except when comparisons with other structures are made.

Table 4.1. Summary of consonant structures

Structure	English		German		Italian	
	Onset	Coda	Onset	Coda	Onset	Coda
C	797	632	663	560	177	8
C_1C_2	130	186	125	228	30	0
$C_1C_2 C_3$	3	17	6	7	1	0
$C_1C_2 C_3 C_4$	0	1	0	1	0	0
Total	928	835	794	796	208	8

For simplex codas other than /-n/ and /-ŋ/, three repair strategies are logically possible, namely deletion, resyllabification (through vowel insertion), and change into a licit nasal coda. Since in segmental adaptation, preservation of manner features (e.g. nasality) is of high priority, the third solution is not expected to be used, except in the case of /-m/

codas (also see Chapter 3). Thus, it is predicted Mandarin speakers will employ either deletion or resyllabification to resolve non-nasal simplex codas.

Similarly, in the adaptation of complex onsets and codas, possible processes are deletion and vowel insertion unless the coda structures contain a nasal constituent. For instance, a coda -CC cluster such as /-st/ may surface as -CV.CV through vowel insertion after each constituent, or as -CV through deletion of either the first or the second segment, or even as null through truncation of the entire cluster.

Furthermore, the choice of adaptation strategies in Mandarin is expected to correlate with the phonological and/or phonetic context of the target structure. The P-map hypothesis (Steriade 2002) posits that perceptual distinctiveness of contrasts in relation to contextual features triggers the type of processes that are likely to occur. In line with this thought, it is predicted that preservation of a segment (e.g. through vowel insertion) will be preferred in loanword adaptation when the segment stands in a perceptually salient context since deletion would result in too distinctive a contrast between the pre- and post-adaptation forms; Deletion will be favored when the segment occurs in a non-salient context as the contrast between the pre- and post-deletion forms will be of high confusability (or low perceptibility). In addition, in cases of segment preservation through vowel epenthesis, the P-map hypothesis predicts that the inserted vowel will be as imperceptible as possible so that the foreign input and the adapted form can share adequate similarity.

In this chapter, the phonotactic adaptation of foreign syllable structures in Mandarin loanword phonology will be analyzed in detail. The types of repair process, the variations between alternative strategies and the quality of epenthetic vowels will be investigated. An OT analysis will be developed to account for the adaptation patterns observed in the corpus data.

The rest of the chapter is organized as follows. Section §4.2 reviews the literature on the adaptation of illicit syllable structures in loanword phonology. Discussions focus on studies that address the relationship between phonetic/phonological contexts and variations between segment preservation and deletion. Sections §4.3 to §4.5 examine Mandarin nativization of foreign syllable constructions that are incompatible with native phonotactics. The processes involving three types of structure are investigated, namely word-final simplex codas (§4.3), word-initial onset clusters and word-final coda clusters (§4.4 for CC clusters, and §4.5 for CCC and CCCC clusters). The interaction between contextual factors and the choice of repair strategies in the corpus loans is discussed in §4.6. Section §4.7 examines the quality of epenthetic vowels. A formal OT account for the adaptation patterns observed in Mandarin is proposed in §4.8. Lastly, §4.9 summarizes the chapter.

4.2 Background

4.2.1 Variation between preservation and deletion in loanword phonology

In loanword adaptation, illicit syllable structures can be resolved through either preservation or deletion of segments in the target structure. Vowel insertion and consonant deletion are the two most frequent strategies, and variations between the two

have been extensively studied in the research on loanword phonology. Some scholars claim that vowel insertion is the default strategy, whereas consonant deletion is far less used (Paradis 1996, Paradis & LaCharité 1997, Uffmann 2001, 2004). It has been proposed that perceptual salience and perceptual similarity are important factors regulating the variation of adaptation strategies (Silverman 1992, Yip 1993, Kang 2003, Kenstowicz 2003a) as well as the quality of epenthetic vowels (Kenstowicz 2003a, 2003b).

Silverman (1992) and Yip (1993) argue that the likelihood of consonant deletion correlates with the perceptual salience of the target segment. They observe that in Cantonese adaptation of English words, the choice of adaptation processes (e.g. vowel epenthesis vs. consonant deletion) correlates systematically with the phoneme class (or category) and the position of consonants. Sibilants are always retained, whereas liquids are optionally deleted under the minimal foot requirement of bisyllabicity in Cantonese. The cluster-final obstruent in C-Obstruent coda clusters (e.g. Sonorant-Plosive) always undergoes deletion even though the bisyllabicity requirement may be violated (e.g. "band" > [pɛn < >], and "lift" > [lip < >]) (Silverman 1992: 324-326), Yip 1993: 267-269). In addition, Silverman (1992) notices a contrasting pattern between English Obstruent-Sonorant onset clusters and Sonorant-Obstruent coda clusters. In a cluster of the former type, which has an obstruent in the initial position, both elements will be preserved (e.g. "pleat" > [pʰi lit]). However, in the latter type, in which an obstruent takes the post-consonantal position, the sound is always deleted (e.g. "length" > [lɛn < >]). To account for these patterns, Silverman propose that salient sounds will be preserved, but nonsalient segments tend to be deleted. Thus, the overwhelming dominance of obstruent deletion in the adaptation of English C-Obstruent coda clusters is due to the low perceptibility of the obstruent in word-final positions.

Similarly, Kang (2003) argues that the likelihood of vowel insertion correlates with the perceptual similarity between C and CV. In a survey of Korean adaptation of word-final stops from English loans, she shows that the likelihood of vowel insertion is higher when a final consonant follows a tense (rather than lax) vowel, when it is voiced (rather than voiceless), and when it is coronal (rather than non-coronal). She argues that the differential preference for vowel epenthesis in these contexts originates from Korean speakers' efforts to maximize the perceptual similarity between the English input and the Korean output. Vowel epenthesis after a tense vowel is more frequent than after a lax vowel because English final stops are more likely to be released following a tense vowel and hence be perceived by Korean speakers as more similar to a CV sequence (e.g. "peak" /pik/ > /pʰikʰɨ/ vs. "kick" /kɪk/ > /kʰik/). In addition, vowel epenthesis is more frequent after a voiced consonant than after a voiceless one. This is attributed to the native Korean rule that plain stops undergo voicing intervocalically. Therefore, insertion of a vowel after a voiced stop, as in "tag" /tæg/ > /tʰægɨ/, creates a structure of great perceptual closeness to the intervocalic voicing context in Korean. The higher frequency of vowel insertion after coronal stops than after non-coronal stops is related to the Korean morpho-phonemic rule that coronal-final words are restricted. Based on these analyses, Kang argues that the choice between vowel insertion and consonant deletion is largely determined by which process results in maximal perceptual similarity between the English pronunciation and the Korean output.

Kenstowicz (2003) also proposes a perceptual account for the differential frequencies of vowel epenthesis and consonant deletion in Fijian loanword processes. He finds that English final obstruent-obstruent clusters are treated differently from sonorant-obstruent clusters. In the adaptation of obstruent-obstruent clusters, deletion of the second segment is preferred to vowel epenthesis, while in the case of sonorant-obstruent clusters, vowel insertion occurs more frequently than deletion. He also notes that for Nasal-Plosive clusters, the voicing feature of the plosive influences the likelihood of vowel epenthesis. If the plosive is voiceless, it almost always survives by changing to a voiced sound and being resyllabified through vowel insertion (e.g. "elepha**nt**" > "élevá.**ⁿdi**"). If a plosive is voiced, the frequencies of vowel epenthesis and consonant deletion are about even (e.g. "almo**nd**" > à:mó.**ⁿdi**," and "ba**nd**" > "ba**ni**< >"). Kenstowicz suggests that perceptual salience is the crucial factor underlying the choice of a repair strategy. For instance, the second sound in obstruent-obstruent clusters is more likely to be deleted because it is of low auditory salience. In sonorant-obstruent clusters, however, the perceptual cues of the final obstruent are stronger, and thus vowel epenthesis is the preferred process.

In addition, Brasington (1997) finds that in Marshallese adaptation of English words, the choice between vowel insertion and consonant deletion is related to segment/cluster position and cluster structure. He observes that vowel insertion is the preferred strategy for onset clusters, whereas deletion is common for coda clusters. Furthermore, in the nativization of English final nasal-obstruent clusters, deletion occurs more often when the post-nasal obstruent is a stop than when it is a sibilant (also see §1.2.2).

Studies reviewed above show that the choice of phonotactic strategies in loanword phonology is influenced by various phonological/phonetic contexts. The factors that have been reported to bear on the likelihood of segment preservation vs. deletion are summarized below:

(a) Quality of the preceding vowel (tense vs. lax) (Kang 2003)
(b) Consonantal features (place and voicing) (Kang 2003)
(c) Phoneme class (e.g. sibilants vs. liquids, see Silverman 1992, Yip 1993)
(d) Segment/cluster position (onset vs. coda, see Silverman 1992, Brasington 1997)
(e) Cluster structure (e.g. obstruent-obstruent vs. sonorant-obstruent clusters, and nasal-stop$_{[-voice]}$ vs. nasal-stop$_{[+voice]}$ clusters, see Kenstowicz 2003a; and nasal-stop vs. nasal-sibilant clusters, see Brasington 1997)

In view of these findings, I will investigate the potential influence of various contextual factors on the alternation of phonotactic strategies in Mandarin adaptation of foreign syllable structures (see §4.6). The effects of the five factors listed above will be analyzed. In addition, considering that segments in stressed syllables display stronger resistance to certain phonological processes (e.g. Beckman 1997), the influence of stress will also be examined.

Regarding the quality of epenthetic vowels in loanwords, it has been observed that there are three common patterns (Uffmann 2004): (a) Insertion of a default or unmarked vowel, e.g. in Japanese (Shinohara 1997), Fijian (Kenstowicz 2003a) and Fon

(Kenstowicz 2003b); (b) Vowel copy (or vowel harmony), by which the inserted vowel shares the same quality as the vowel of the preceding syllable, e.g. in Tswana (Batibo 1996) and Fula (Paradis 1996); (c) Consonant assimilation, by which the epenthetic vowel shares the place feature of the preceding consonant, especially the [+labial] feature, e.g. in Swahili (Batibo 1996). Uffmann (2004) presents detailed studies of the typology of epenthetic vowels in loanword phonology. He observes that languages differ not only on the particular strategies they employ to define the quality of the inserted vowel but also on the exact vowel they chose (even if the same strategy is used).

To account for the choice of epenthetic vowels in loanword phonology, Kenstowicz (2003a) proposes that perceptual salience plays an important role. He argues that in Fijian adaptation of English words, a high vowel /i/ is the dominant vowel inserted to resolve illicit codas (e.g. in "bus" > /basi/) because it is of short phonetic duration and low auditory salience. Hence, /i/ insertion helps create a loan form that is minimally different from the source pronunciation (see Kenstowicz 2003b, for a similar view on vowel insertion in Fon).

In this chapter, I will examine the quality of epenthetic vowels in Mandarin loanword phonology (see §4.7). It will be shown that Mandarin speakers adopt the strategy of consonant assimilation, inserting a vowel that agrees with the onset in articulatory place. It will be proposed that a constraint against the insertion of place feature, i.e. DEP-IO (Place), ranks high in Mandarin and hence triggers place agreement between an epenthetic vowel and the preceding consonant.

4.2.2 P-map predictions about the choice of adaptation strategies in Mandarin

Based on findings in prior studies, I predict that the choice of adaptation strategies (segment preservation vs. deletion) in loanword phonology is regulated by the perceptibility of consonants in relation to various contextual factors. First, consonants are more perceptible (or distinctive) in a salient position, including: (a) in a stressed (rather than unstressed) syllable; (b) after a tense (rather than lax) vowel; (c) in the onset (rather than coda). Second, certain classes of sounds (e.g. fricatives) are intrinsically more perceptible than others (e.g. plosives). Thirdly, segments in certain types of clusters have stronger perceptual cues than in others. For example, the final obstruent in sonorant-obstruent clusters is more distinctive than in obstruent-obstruent clusters. Similarly, in nasal-obstruent clusters, a voiceless obstruent in the cluster-final position is more perceptible than a voiced obstruent; and in nasal-obstruent coda clusters, the final obstruent will be more distinctive when it is a sibilant (or fricative in general) than when it is a plosive.

From the perspective of the P-map (Steriade 2002), I posit that the perceptibility scales in (1) define the differential distinctiveness of consonants in relation to various contextual factors.

(1) Predicted perceptibility scales of consonants
   (a) Distinctiveness by syllable stress
      $C /V_{[+stress]}$ ___ $]_\sigma$ > $C /V_{[-stress]}$ ___ $]_\sigma$
   (b) Distinctiveness by vowel quality
      $C /V_{[tense]}$ ___ $]_\sigma$ > $C /V_{[lax]}$ ___ $]_\sigma$

    (c) Distinctiveness scale by phoneme category

       Nasal /V__]$_\sigma$ > Obs /V__]$_\sigma$ > Liquids /V__]$_\sigma$

    (d) Distinctiveness scale by segment/cluster position

       C /$_\sigma$[__ (C) V > C /V (C) __]$_\sigma$

    (e) Distinctiveness scale by cluster structure

       (i) Obs /V Son __]$_\sigma$ > Obs /V Obs __]$_\sigma$

       (ii) C $_{[-voice]}$ / VN__]$_\sigma$ > C $_{[+voice]}$ / VN__]$_\sigma$

       (iii) Fricative / VN__]$_\sigma$ > Plosive / VN__]$_\sigma$

The hierarchy of (1a) states the relationship between segmental perceptibility and syllable stress, that is, a coda consonant after a stressed vowel is more distinctive than one after an unstressed vowel. In (1b), consonants following a tense vowel are defined as more perceptible than those following a lax vowel. The differential salience of coda segments as related to phoneme category is formulated in (1c): Nasals are the most salient; liquids are the least, and obstruents stand in the middle range. (Affricates are omitted due to the small number of data.) The ranking scale in (1d) expresses positional effects: Onset consonants are more perceptible than coda consonants. Lastly, the hierarchies in (1e) formulate the perceptibility of segments in relation to cluster structure: A cluster-final obstruent in a coda cluster is more perceptible when it stands in a post-Sonorant position (1e-i); and in nasal-obstruent clusters, the cluster-final obstruent is more salient when it is voiceless (rather than voiced) (1e-ii), and when it is a fricative (rather than a plosive) (1e-iii). It is conjectured that the distinctiveness scales in (1) project the rankings of correspondence constraints (e.g. MAX-IO), rankings that regulate the variation between segment preservation and deletion in loanword phonology.

    Analysis of the interaction between phonological/phonetic contexts and the frequencies of segment preservation vs. deletion in Mandarin loanword phonology will show that four factors have significant effects on Mandarin adaptation of English loans. These factors are syllable stress (stressed vs. unstressed), phoneme category (e.g. nasals vs. obstruents vs. liquids), segment/cluster position (onset vs. coda), and cluster structure. More specifically, the last factor involves the voicing feature (voiceless vs. voiced) and phoneme category (fricative vs. plosive) of the obstruent in nasal-obstruent clusters. The findings confirm that the perceptibility scales of (1a), (1c), (1d), (ie-ii) and (1e-iii) are important components in Mandarin speakers' perceptual knowledge in their adaptation of English syllable structures. These five distinctiveness hierarchies generate the differential likelihood of preservation vs. deletion in those contexts (see §4.8.1).

    To account for the Mandarin adaptation patterns, I will develop an OT analysis for the variation between alternative repair strategies and the quality of epenthetic vowels (§4.8). It will be argued that the likelihood for a segment to be deleted (vs. preserved) is determined by the perceptibility of that segment as related to various contextual factors (§4.8.1). Furthermore, when vowel insertion takes place, the requirement for perceptual similarity between the foreign input and the adapted form motivates the choice of a vowel that shares the same place feature with the onset consonant (§4.8.2). To account for the free variations between segment preservation and deletion in the same context, I will propose that the respective correspondence constraints governing the two types of process have variable rankings (§4.8.3).

Before going into details about the relationship between phonological/phonetic contexts and the choice of phonotactic strategies, I will give an overview of the adaptation processes involving the three types of syllable structures illicit in Mandarin, namely simplex codas other than /-n, -ŋ/, complex onsets and complex codas.

4.3 Adaptation of foreign simplex codas in word-final positions

In Mandarin phonology, only the alveolar nasal /-n/ and the velar nasal /-ŋ/ are licit codas, which means that all other codas are subject to phonotactic nativization when foreign words are borrowed. As was mentioned in the introduction (§4.1), illicit simplex codas are predicted to undergo vowel epenthesis or consonant deletion. Although it is also logically possible for a non-nasal coda to be changed into a licit nasal coda (i.e. /-n/ or /-ŋ/, this process is not expected to occur since it will violate the constraint mandating manner identity in segmental adaptation (see Chapter 3). Analysis of the corpus data confirms these predictions. In Mandarin adaptation of foreign simplex codas, the following patterns are observed: (a) Obstruents are adapted through either vowel insertion or consonant deletion; (b) "-l/-r" codas either surface as a rhotic vowel (also see Chapter 3) or undergo deletion; (c) /-m/ codas are either resyllabified by vowel insertion or changed into a licit nasal coda /-n/ or /-ŋ/.

4.3.1 Obstruents

Simplex obstruent codas are resolved by either vowel epenthesis or consonant deletion, with the former being more frequent. As is shown in Table 4.2, instances of vowel epenthesis (V Epen) constitute the majority of all cases across the three donor languages. For instance, in the adaptation of plosive codas, the proportions of V Epen are 64.12% in the English data, 97.01% in the German data, and 100% in the Italian data. Consonant deletion (C Del) is the second most common process. Nasalization of an obstruent coda (i.e. to /-n, -ŋ/) is not observed, except in one instance of English plosives.[19] Lastly, there is another deletion process (σ Del), which truncates the entire syllable containing a coda segment, occurring occasionally. Since syllable deletion is not directly related to the coda segment proper and the exact factors underlying this process are not clear, it will not be discussed unless necessary.

---

[19] The only case of nasalization occurs in "Hanco**ck**" > "heng2-ka**ng**1" /xəŋ-kɑŋ/ (*permanent-health*) in the adaptation of "John **Hancock** Financial Services" (English, name of a U.S. insurance company). It is also plausible that the coda stop /-k/ is deleted, and meanwhile a velar nasal is inserted. Since this word is the only example of nasalization, it will be ignored in future analysis.

Table 4.2. Adaptation of simplex obstruent codas

Class	SL	V Epen	C Del	σ Del	To /-n, -ŋ/	Total
Plosive	English	84 (64.12%)	41 (31.30%)	5 (3.82%)	1 (0.76%)	131
	German	65 (97.01%)	1 (1.49%)	1 (1.49%)	0	67
	Italian	3 (100.00%)	0	0	0	3
Fricative	English	72 (76.60%)	14 (14.89%)	8 (8.51%)	0	94
	German	73 (91.25%)	3 (3.75%)	4 (5.00%)	0	80
	Italian	2 (100.00%)	0	0	0	2
Affricate	English	10 (71.43%)	1 (7.14%)	3 (21.43%)	0	14
	German	20 (100.00%)	0	0	0	20
	Italian	0	0	0	0	0

Examples of vowel epenthesis, consonant deletion and syllable deletion are given in (2). For instance, the final codas in "Fenbi**d**" (English, brand name of medicine), "Kau**b**" (German, place name) and "Fia**t**" (Italian, brand name of car) are adapted by vowel insertion and resyllabified as an onset. The Mandarin forms for the three words are respectively "fen1-bi4-**de**2" /fən-pi-t**ɤ**/ (*fragrance-must-to get*), "kao3-**bo**2-(shi4)" /kʰɑu-**buɔ**-(ʂɻ)/ (*exam-uncle (city)*) and /fei-ia-t**ʰɤ**/ (*fragrant-second-special*). Deletion of the final coda occurs in "Cheeto**s**" (English, brand name of leisure food) > qi2-duo1< >"

(2) SL	SF	MC Pinyin	IPA	Gloss	Process
English	Fenbi<u>d</u>◊	fen1-bi4-<u>de</u>3	/fən-pi-t<u>ɤ</u>/	fragrance-must-to get	V Epen
	Dallas	da2-la1-si1	/ta-la-s<u>ẓ</u>/	to arrive-to pull-this	V Epen
	Gatorade◊	jia1-de2-le4 < >	/tɕia-tɤ-lɤ/	good-to acquire-pleasure	C Del
	Cheeto<u>s</u>◊	qi2-duo2 < >	/tɕʰi-tuɔ/	wonder-many	C Del
	Dacro<u>met</u>	da2-ke-luo2 < >	/ta-kʰɤ-luɔ/	to attain-gram-net	σ Del
	Uni<u>sys</u>◊	you1-li4 < >	/iu-li/	superior-benefit	σ Del
German	Kau<u>b</u>	kao3-<u>bo</u>2-(shi4)	/kʰɑu-<u>buɔ</u>-(ʂɻ)/	exam-uncle-(city)	V Epen
	Auri<u>ch</u>	ao4-li4-<u>xi</u>1	/ɑu4-li4-<u>ɕ</u>i/	profound-benefit-rare	V Epen
	Ela<u>c</u>◊	yi4-li4 < >	/i-li/	will-power	C Del
	Ferdinand	fei-di2-nan2	/fei-ti-nan-pʰi-	to waste-to inspire-	C Del
	Pië<u>ch</u>	pi2-ye1 < >	iɛ/	south-skin-Q	
Italian	Fia<u>t</u>	fei1-ya4-te4	/fei-ia-tʰɤ/	fragrant-second-special	V Epen
	Juventu<u>s</u>	you2-wen2-tu2-<u>si</u>1	/iu-un-tʰu-<u>sẓ</u>/	particularly-culture-drawing-this	V Epen

/tʰɕi-tuɔ/ (*wonder-many*) and "Ela**c**" (German, brand name of audio equipment) > yi4-li4 < >" /i-li/ (*will-power*). In "Dacromet" (English, brand name of coating material) > da2-ke4-luo2 < >" /ta-kʰɤ-luɔ/ (to arrive-gram-net) the entire syllable containing the word final coda is truncated.

4.3.2. Nasals

Nasal codas are permissible in all three donor languages and Mandarin, with English and German allowing /-m, -n, -ŋ/, Italian the first two, and Mandarin the last two.[20] Since /-n/ and /-ŋ/ are licit codas in Mandarin, they are expected to be retained as codas without adjustment. The bilabial nasal /-m/, which is banned in the coda in Mandarin, needs to be adapted. A coda /-m/ may be nativized in one of the three ways: resyllabification through vowel insertion, deletion, and changing to a licit nasal coda.

These predictions are largely attested by the corpus data. As is shown in Table 4.3, the alveolar and velar nasals, which are permissible codas in Mandarin, are generally retained (N Coda Preserv.), except for rare instances of deletion (C Del) and vowel epenthesis (V Epen).[21]

Table 4.3. Adaptation of simplex nasal codas

	SL	V Epen	N Coda Retention	/-m/ to /-n, -ŋ/	C Del	σ Del	Total
/-m/	English	13 (46.43%)	0	12 (42.86%)	1 (3.57%)	2 (7.14%)	28
	German	39 (97.50%)	0	1 (2.50%)	0	0	40
	Italian	0	0	0	0	1 (100.0%)	1
/-n, -ŋ/	English	1 (0.54%)	173 (94.02%)	0	0	10 (5.43%)	184
	German	0	214 (97.27%)	0	2 (0.91%)	4 (1.82%)	220
	Italian	0	2 (100.00%)	0	0	0	2

---

[20] According to Castiglione (1957: 21), /-n/ is pronounced as /-ŋ/ in Italian when it precedes velar plosives /k/ and /g/ (e.g. in "fungo" [fuŋgo] *mushroom*). Since /-ŋ/ is not an independent phoneme and word-final coda clusters like "-nk" or "-ng" are impermissible, such allophonic variation will be dismissed in this study.

[21] The one case of vowel epenthesis, which occurs in "An**ne** Applebaum" (English, person name) > an1-**ni**2-ai4-bao4-mu3 /an-**ni**-ai-pɑu-mu/ (*safety-girl-to stop-abalone-housekeeper*), is very likely due to influence of the English spelling.

For instance, in a total of 184 cases of English /-n, -ŋ/ codas, 173/184 (94.02%) are preserved as codas after adaptation, but only 11/184 instances of other processes. The bilabial nasal coda /-m/ is commonly resolved by two processes: vowel insertion and changing to a licit coda (i.e. /-m/ > /-n, -ŋ/). The latter is especially common in the English data. Deletion of nasal codas, however, occurs very rarely. [22]

The examples in (3) illustrate the major processes involving nasal codas. For the bilabial nasal, vowel epenthesis and change to a licit nasal coda are both frequently used. For example, in "Viaco**m**" (English, company name) > "wei2-ya4-kang1-**mu**4" /uei-ia-kʰŋ-**mu**/ (*to maintain-inferior-health-housekeeper*), and "Mannhei**m** (German, place name) > "man4-hai3-**mu**3" /man-xai-**mu**/ (*graceful-sea-housekeeper*), the final coda /-m/ is resyllabified by insertion of a bilabial vowel /u/. Changing /-m/ to a legitimate Mandarin coda can be seen in "Centru**m**" (English, brand name of nutrition supplement) > "shan4-chu**n**2" /ʂan-tʂʰu**n**/ (*good-to save*), and Bochu**m** (German, place name) > "bo1-ho**ng**2" /puɔ-xu**ŋ**/ (*wave-swan*). The most common strategy towards alveolar and velar

(3) SL	SF	MC Pinyin	IPA	Gloss	Process
English	Viaco<u>m</u>	wei2-ya4-kang1-<u>mu</u>3	/uei-ia-kʰaŋ-<u>mu</u>/	to maintain-inferior -health-housekeeper	V Epen
	Centru<u>m</u>◊	shang4-chu<u>n</u>2	/ʂan-tʂʰu<u>n</u>/	good-to save	/-m/ to /-n/
	Pentiu<u>m</u>◊	ben1-te<u>ng</u>2	/pən-tʰə<u>ŋ</u>/	run quickly-to soar	/-m/ to /-ŋ/
	Lipto<u>n</u>	li4-du<u>n</u>4	/li-tu<u>n</u>/	to stand-to pause	N Retention
	Avo<u>n</u>◊	ya3-fa<u>ng</u>1	/ia-fa<u>ŋ</u>/	elegance-fragrance	N Retention*
	Corni<u>ng</u>◊	kang1-ni<u>ng</u>2	/kʰaŋ-ni<u>ŋ</u>/	health-peace	N Retention
	Boei<u>ng</u>◊	bo1-yi<u>n</u>1	/puɔ-i<u>n</u>/	wave-sound	N Retention*
German	Mannhei<u>m</u>	man4-hai3-<u>mu</u>3	/man-xai-<u>mu</u>/	graceful-sea -housekeeper	V Epen
	Bochu<u>m</u>	bo1-ho<u>ng</u>2	/puɔ-xu<u>ŋ</u>/	wave-swan	/-m/ to /-ŋ/
	Binge<u>n</u>	bin1-ge<u>n</u>1	/pin-gə<u>n</u>/	guest-root	N Retention
	Mende<u>n</u>	men2-de<u>ng</u>1	/mən-tə<u>ŋ</u>/	door-to climb	N Retention*
	Tönni<u>ng</u>	te4-ni<u>ng</u>2	/tʰɤ-ni<u>ŋ</u>/	special-peace	N Retention
	Backna<u>ng</u>	ba1-ke4-na<u>n</u>2	/pa-kʰɤ-na<u>n</u>/	to cling to -gram -south	N Retention*
Italian	Benneto<u>n</u>	bei4-na4-to<u>ng</u>1	/pei-na-tʰu<u>ŋ</u>/	shellfish-to accept -through	N Retention

* A nasal coda /-n, -ŋ/ whose output has a deviant place feature.

---

[22] It needs to be noted that in the N Coda Retention instances, the two nasal codas do not always surface as their faithful correspondents in Mandarin. Sometimes the place feature may change (i.e. /n/ > /-ŋ/, */-n/; or /-ŋ/ > /-n/, */-ŋ/), although the segment is retained as a nasal coda. Since this deviant realization of the place feature is largely an issue of segmental mapping (see §3.3.5 and §3.4.2), it will be ignored in this chapter.

nasals is N Coda Retention, e.g. in "Binge**n**" (German, place name) > "bin1-ge**n**1" /pin-gən/ (*guest-root*), and "Corni**ng**" (English, brand name of glassware) > "kang1-ni**ng**2" /kʰɑŋ-niŋ/ (*health-peace*). Sometimes, /-n, -ŋ/ codas are not mapped to their closest Mandarin match. Instead, it is common for their place features to be adapted with deviation, with /-n/ realized as /-ŋ/ and vice versa. For example, in "Avo**n**" (English, brand name of cosmetics) > "ja3-fa**ng**1" /ia-faŋ/ (*elegance-fragrance*), the final /-n/ in the source form is realized as /-ŋ/ in Mandarin, with the place feature changing from alveolar to velar.

4.3.3 Lateral and "r"

Similar to obstruents and nasal /-m/, approximants are not allowed to be codas in Mandarin. To address these codas, Mandarin speakers use two strategies frequently, i.e. Rhotic V and C Del (see Table 4.4). By Rhotic V, a foreign /-l/ or "-r" coda is replaced by a Mandarin rhotic vowel /ə˞/ ("-er" in Pinyin). In the case of C Del, the coda segment is deleted. For instance, in a total of 72 English /-l/ codas, 40 (55.56%) are realized as Mandarin /ə˞/, and 20 (27.78%) undergo deletion. In the case of English /-ɹ/, the frequencies of Rhotic V and C Del are respectively 21/109 (19.27%) and 77/109 (70.64%). Vowel epenthesis and deletion of the entire host syllable are used far less than the other two processes.

Table 4.4. Adaptations of simplex "-l" and "-r" codas

Phoneme	SL	V Epen	Rhotic V	C Del	σ Del	Total
/-l/	English	4 (5.56%)	40 (55.56%)	20 (27.78%)	8 (11.11%)	72
	German	0	48 (82.76%)	10 (17.24%)	0	58
	Italian	0	0	0	0	0
"-r"	English	0	21 (19.27%)	77 (70.64%)	11 (10.09%)	109
	German	0	27 (36.00%)	47 (62.67%)	1 (1.33%)	75
	Italian	0	0	0	0	0

The results shown in Table 4.4 contradict the predicted strategies to resolve illicit codas, i.e. vowel epenthesis, consonant deletion and nasalization. Vowel insertion occurs only occasionally in the adaptation of the lateral, accounting for 4/72 (5.56%) in the English data. As was analyzed in §3.3.6 and §3.4.2, the "-l/-r" → /ə˞/ mapping does not involve insertion of a vowel, but rather merely segmental substitution. In addition, the prediction that nasalization might occur is not attested. The only predicted strategy that is indeed used often is consonant deletion. Even in this case, an unexpected pattern is observed, that is, "-r" codas are deleted more frequently than "-l" codas. The frequencies of deletion for "-l" and "-r" are respectively 20/72 (27.78%) and 77/109 (70.64%) in the English data, and 10/58 (17.24%) and 47/75 (62.67%) in the German data.

The data in (4) illustrate the Mandarin strategies in addressing "-l/-r" codas. For example, Rhotic V is used in the adaptation of "De**ll**" (English, company name) and

"Lah**r**" (German, place name), which surface respectively as "dai4-**er**3" /tai-ɚ˞/ (*to wear-you*) and > "la1-**er**3" /la-ɚ˞/ (*to pull-you*). Examples of C Del are "Whirlpoo**l**" (English, brand name of electric appliances) > "hui4-er3-pu3< >" /xuei-ɚ˞-pʰu < >/ (*reasonable price-and-popular*), and "Ode**r**" (German, place name) > "ao4-de3 < >" /ɑu-tɤ < >/ (*profound-virtue*). In "Budwei**ser**" (English, brand name of beer) > "bai3-wei1 < >" /pai-uei < >/ (*hundred-power*), the entire final syllable is deleted. The rarely used strategy of vowel epenthesis is shown in "Dunhi**ll**" > "deng1-xi3-**lu**4" /təŋ-ɕi-**lu**/ (*to climb-happy-road*), where the final /-l/ undergoes resyllabification by vowel insertion and surfaces as the onset of an epenthetic syllable (i.e. "-lu" /-lu/).

(4) SL	SF	MC Pinyin	IPA	Gloss	Process
English	De**ll**	dai3-**er**3	/tai-ɚ˞/	to wear-you	Rhotic V
	Lea**r**	li3-**er**3	/li-ɚ˞/	inside-you	Rhotic V
	Whirlpoo**l**◊	hui4-er3-pu3 < >	/xuei-ɚ˞-pʰu/	reasonable price-and-popular	C Del
	Catepilla**r**	ka3-te4-bi3-le4 < >	/kʰa-tʰɤ-pi-lɤ/	card-special-that-coerce	C Del
	Budwei**ser**◊	bai3-wei1 < >	/pai-uei/	hundred-power	σ Del
	Dunhi**ll**◊	deng1-xi3-**lu**4	/təŋ-ɕi-**lu**/	to ascend-happy-road	V Epen
German	Keh**l**	ke4-**er**3	/kʰɤ-ɚ˞/	to restrain-you	Rhotic V
	Lah**r**	la1-**er**3	/la-ɚ˞/	to pull-you	Rhotic V
	Baye**r**	bai4-**er**3	/pai-ɚ˞/	to worship-you	Rhotic V
	Henke**l**◊	han4-gao1 < >	/xai-kɑu/	man-super	C Del
	Wisma**r**	wei2-si1-ma3 < >	/uei-sz̩-ma/	to maintain-this-horse	C Del
	Ode**r**	ao4-de2 < >	/ɑu-tɤ/	profound-virtue	C Del
	Bitbur**ger**	bi3-te4-bao3< >-(pi2-jiu3)	/pi- tʰɤ-pɑu-(pʰi-tɕiou)/	to compete-special-fort-(beer)	σ Del

The higher deletion rate of "-r" than /-l/ in the adaptation of English words may result from Mandarin speakers' linguistic experience with different English varieties. Up until the early 1990s, British English, in which /-ɹ/ is not pronounced in coda positions, was the dominant English variety taught in Mainland China. Even words originating from American English have been taught and learned according to British pronunciation (RP). Thus, Mandarin speakers' greater familiarity with RP leads to their preference for deletion in addressing English /-ɹ/ codas. Similar influence of British English in Hong Kong on Cantonese adaptation of this coda is noted in Yip (1993). In contrast with "-r," /-l/ codas are deleted at a far lower frequency since there are no similar sociolinguistic factors affecting the choice of repair processes.

The reasons for the higher deletion rate of German "-r" than /-l/ are not clear. It is possibly due to fact that "-r" codas in German are sometimes realized as a vowel. As was mentioned in §3.3.6, German "-r" has great variability in actual speech. When it follows a long vowel or comes in a word final "-er" sequence, it is frequently pronounced as a low central vowel [ɐ] rather than a consonant (see Hall 1992, Lockwood 1987). In view of this observation, it can be posited that the high deletion rate of German "-r" codas (vs. /-l/) is due to the allophonic variations in the source language.

4.3.4 Variation between preservation and deletion (Simplex codas)

To get an overview of variations between segment preservation (e.g. through vowel insertion) and deletion, all Mandarin processes (except syllable deletion) used to adapt foreign simplex codas are classified into two types: preservation and deletion. Any process that creates in the adapted form a correspondent segment of the foreign source phoneme is grouped under the "preservation" category. Examples of this type are vowel epenthesis in the case of obstruents and the adaptation of "-l/r" as the Mandarin rhotic vowel /ə~/. Consonant deletion is classified as the only "deletion" strategy. Syllable deletion (σ Del), which targets an entire syllable rather than the coda segment itself, is excluded from consideration. Based on these criteria, the classification of the various processes aimed at resolving foreign simplex codas is presented in Table 4.5.

Table 4.5. Classification of adaptation process (Simplex codas)

C Class		Preservation	Deletion
Obstruent		V Epe	C Deletion
Nasal	/-m/	V Epen, To /-n, -ŋ/	C Deletion
	/-n, -ŋ/	Nasal Coda Retention, V Epen	C Deletion
"-l/-r"		RhoticV, V Epen	C Deletion

The rates of preservation vs. deletion for each class of coda consonants are displayed in Table 4.6. Two conclusions can be drawn from the results. One is that deletion occurs more frequently in the English data than in the German data, and the least frequently in the Italian loans. Since there are very few coda instances in the Italian data (8 in total), Chi-square significance tests are conducted to compare only the English and German loans. As is shown in the table, there are significant differences between the two donor languages in the adaptation of plosives (< 0.01), fricatives (p <0.02) and "-r" (p < 0.04). The results show a tendency towards a higher deletion frequency for English /-l/ than German /-l/, but the difference is not significant (p < 0.08). For the other phonemes (i.e. affricates and nasals), no statistical tests were done due to the limited numbers of deletion cases. The second conclusion drawn from the results is that the frequencies of deletion (vs. preservation) vary across phoneme classes. For example, plosives are more likely to be deleted than nasals (see §4.7.3 for detailed discussion).

Table 4.6. Preservation vs. deletion in simplex codas (%)

SL / C Class			English	German	Italian	p (E vs. G)
Obstruent	Plosive	Preservation	67.20	98.48	100.00	< 0.01*
		Deletion	32.80	1.52	0.00	
	Fricative	Preservation	83.72	96.05	100.00	< 0.02*
		Deletion	16.28	3.95	0.00	
	Affricate	Preservation	90.91	100.00	/	N/A
		Deletion	9.09	0.00	/	
Nasal	/-m/	Preservation	96.15	100.00	/	N/A
		Deletion	3.85	0.00	/	
	/-n, -ŋ/	Preservation	100.00	99.07	100.00	N/A
		Deletion	0.00	0.93	0.00	
"-l/-r"	/-l/	Preservation	68.75	82.76	/	< 0.08
		Deletion	31.25	17.24	/	
	/-ɹ, -r/	Preservation	21.43	36.49	/	< 0.03*
		Deletion	78.57	63.51	/	

Notes: (1) p (E vs. G) = Chi-square p value of English loans vs. German loans
(2) The star "*" indicates a value is significant.

The higher frequencies of coda deletion in the adaptation of English words can be partly attributed to sociolinguistic and sociocultural reasons. For one thing, borrowing from English is more likely to be conducted through oral speech than borrowing from German. Although in general lexical borrowing from foreign languages into Mandarin relies heavily on writing (also §3.3.1), oral contacts between Mandarin and English are relatively more extensive than contacts between Mandarin and other languages like German and Italian. This is largely due to the influence of English as international lingua franca. Furthermore, considering that loan adaptation based on orthography tends to show certain patterns different from adaptation based on speech (Smith 2004, Vendelin & Peperkamp, in press), the higher preservation rates observed in the German data may well arise from the greater influence of spelling.

The features of the data composition may also play a role. In the English data, there are greater proportions of business terms (e.g. brand names and company names) than in the German data. As was introduced in §1.5.2, brand names of commercial products and company names constitute respectively 15.38% (181/1177) and 50.98% (600/1177) of the English loans, but only 5.53% (54/977) and 12.38% (121/977) of the German loans. Since conciseness is highly valued in the creation of business-related terms, deletion is expected to occur more frequently in the adaptation of English words.

To further examine the relationship between data composition and the choice of phonotactic strategies, the frequencies of deletion vs. preservation are calculated according to the semantic categories of the data. All English and German words that contain instances of word-final simplex codas are divided into two groups, with brand names and company names (Brands & companies) in one and the rest in the other (Others). From the results displayed in Table 4.7, it can be seen that deletion of a consonant (C Del) and an entire syllable (σ Del) occurs more often for brand names and

company names than for other terms. In the English loans, C Del and σ Del account for respectively 109/385 (28.31%) and 41/385 (10.65%) in the "Brands & companies" category, but only 42/242 (17.35%) and 6/242 (2.48%) in the others. The German data presents a similar pattern, with deletion occurring more frequently in "Brands & companies" than in other words. (The Italian data are excluded since the number of coda instances is too small.)

Table 4.7. Semantic categories and adaptation strategies (Simplex codas)

		C Del	σ Del	Preservation	Total
English	Brands & companies	109 (28.31%)	41 (10.65%)	235 (61.04%)	385
	Others	42 (17.35%)	6 (2.48%)	194 (80.17%)	242
German	Brands & companies	26 (31.33%)	5 (6.02%)	52 (62.65%)	83
	Others	37 (7.76%)	5 (1.05%)	435 (91.19%)	477

To summarize §4.3, foreign coda consonants are adapted through a variety of processes. Obstruents are generally either resyllabified by means of vowel insertion or deleted. Nasal codas are mostly preserved although deviant realizations of the place feature may occur. The lateral and "-r" either surface as a Mandarin rhotic vowel or undergo deletion. Furthermore, the discussions show show that diverse sociolinguistic and sociocultural factors interfere with the choice of phonotactic processes. The frequencies of preservation vs. deletion are related to the recipient language speaker's linguistic experience with the donor language variety, the medium of borrowing (speech vs. writing) as well as the semantic features of the borrowed terms.

4.4 Adaptation of foreign CC clusters in word-initial and -final positions

Besides simplex codas other than nasals /-n, -ŋ/, complex onsets and codas are also permissible in the donor languages but illicit in Mandarin. (Italian allows only onset clusters.) When a foreign word containing an onset cluster and a coda cluster is borrowed, phonological adaptations are called for to resolve such clusters, and hence to bring the adapted form into conformity with the native phonotactic patterns.

4.4.1 Onset CC clusters

To simplify a word-initial onset cluster C_1C_2V, three strategies are logically possible: (1) Vowel insertion after C_1 along with retention of C_2 in the original onset position (i.e. $C_1C_2V \rightarrow C_1V_\emptyset C_2V$, in which $V_\emptyset$ is an epenthetic vowel); (2) Deletion of C_1 along with retention of C_2 in the original onset position (i.e. $C_1C_2V \rightarrow <C_1> C_2V$); and (3) Deletion of C_2 along with C_1 becoming an onset (i.e. $C_1C_2V \rightarrow C_1 <C_2> V$). Simultaneous deletion of both consonants is not expected unless the entire host syllable is truncated.

All three processes are observed in the corpus data, as is shown in Table 4.8. The first strategy, i.e. $C_1C_2V \rightarrow C_1V_\emptyset C_2V$, rendered by [$C_1$: V Epen]-[$C_2$: Onset of orig. σ], is the most common, accounting for 103/130 (79.23%), 117/125 (93.6%) and 21/30 (70.0%) instances respectively of the English, German and Italian data. The second process, i.e. $C_1C_2V \rightarrow <C_1> C_2V$, created through [$C_1$: C Del]-[$C_2$: Onset of orig. σ], occurs rarely, with only one instance observed in the English loans (1/130, 0.77%) and none in the

German and Italian ones. The third solution, i.e. $C_1C_2V \rightarrow C_1 <C_2> V$, deriving from [$C_1$: Onset of orig. σ]-[$C_2$: C Del], constitutes respectively 15/130 (11.54%), 3/125 (2.40%) and 1/30 (3.33%) of the English, German and Italian data. There are also cases in which C_1 is retained as the onset of the source syllable and C_2, often a glide /j, w/, surfaces as a medial or a nuclear vowel (i.e. [C_1: Onset of orig. σ]-[C_2: Glide to V].

Table 4.8. Adaptation of word-initial C_1C_2 onset clusters

C_1	C_2	English		German		Italian	
V Epen	Onset of orig. σ	103	(79.23%)	117	(93.60%)	20	(66.67%)
	Rhotic V	0	0	1	(0.80%)	0	0
	σ Del	3	(2.31%)	0	0	0	0
C Del	Onset of orig. σ	1	(0.77%)	0	0	0	0
Onset of orig. σ	C Del	15	(11.54%)	3	(2.40%)	1	(3.33%)
	Glide to V	7	(5.38%)	1	(0.80%)	9	(30.00%)
σ Del	σ Del	1	(0.77%)	3	(2.40%)	0	0
Total		130	(100.0%)	125	(100.0%)	30	(100.0%)

Note: Onset of orig. σ = Onset of the original syllable

Examples are given in (5)-(7) for the three most frequent processes, i.e. vowel epenthesis after C_1 ($C_1C_2V \rightarrow C_1V_øC_2V$), C_2 deletion ($C_1C_2V \rightarrow C_1 <C_2> V$) and C_2 changing to a medial or nuclear vowel ($C_1G_2V \rightarrow C_1 V_2 V$) The first process, in which C_1 undergoes resyllabification and C_2 remains as onset of the original syllable, is illustrated in (5). For example, the English word "**cl**one" is adapted as "**ke**4-**l**ong2," /kʰɤ-luŋ/ *gram-prosperity*, with the initial cluster /kl-/ simplified by vowel epenthesis after /k/ (i.e. /k-/ >/kʰɤ/) and retention of /-l-/ as onset of the source syllable.

(5) [C_1: V Epen]-[C_2: Onset of orig. σ]

SL	SF	MC Pinyin	IPA	Gloss
English	clone	ke4-long2	/kʰɤ-luŋ/	gram-prosperity
	Grammy	ge2-lai2-mei3	/kɤ-lai-mei/	square-ø-beauty
German	Braun	bo2-lang3	/puɔ-laŋ/	rich-bright
	Grimma	ge2-li3-ma3	/kɤ-li-ma/	square-inside-horse
Italian	Brindisi	bu4-lin2-di2-xi1	/pu-lin-ti-ɕi/	cloth-forest-arrow-west
	Trento	te4-lan2-tuo1	/tʰɤ-lan- kʰuɔ/	special-orchid-hold

The second process, which deletes C_2 and retains C_1 (i.e. $C_1C_2V \rightarrow C_1 <C_2> V$), is shown in (6). For instance, in "**bl**og" > "**b**< >o2-ke4" /puɔ-kʰɤ/ *abundant-guest*, /b-/ in the cluster /bl-/ stays in the onset position, whereas the second constituent /l/ is deleted. Similarly, the Italian term "Monte **Bi**anco" (name of a mountain) > "**b**< >o2-lang3-

(feng1)" /puɔ-laŋ-(fəŋ)/ *vigorous-bright-(peak),* /b-/ in the onset cluster /bj-/ remains as onset, and /j-/ undergoes deletion. [23]

(6) [C_1: Onset of orig. σ]-[C_2: C Del]

SL	SF	MC Pinyin	IPA	Gloss
English	blog◊	b< >o2-ke4	/puɔ-kʰɤ/	abundant-guest
	Propet◊	b< >o1-pai4	/puɔ-pʰɤai/	wave-manner
German	Grohe	g< >ao1-yi2	/kɑu-i/	tall-ceremony
Italian	Monte Bianco	b< >o2-lang3-(feng1)	/puɔ-lɑŋ-(fəŋ)/	vigorous-bright-(peak)

The third process, $C_1G_2V \rightarrow C_1V_2V$, occurs only in a restricted set of clusters, including "kw-" in English, "kv-" in Germany, and "Cj-" clusters in Italian. ("C" stands for any consonant.) The words in (7) illustrate this pattern. For instance, the glide /-w-/ in the onset cluster /kw-/ of "Quaker" (English, brand name of cereal) is realized as a medial /u/ (whose surface realization is a glide [w]) in the Mandarin form, "**g**ui4-ge2-mai4-pian4" /k**u**ei-kɤ-mai-pʰian/. The onset cluster /rj-/ in "**Ri**eti" (Italian, place name) corresponds to the /li-/ syllable in the Mandarin form, i.e. "**li**3-ai1-di4" /**li**-ai-ti/ (*inside-dust-fruit base*), with the glide mapped to a Mandarin nuclear vowel. Since a C_2 /-j-/ in Italian /Cj-/ onset clusters can also be pronounced as a vowel, it can be alternatively argued that the "Glide to V" process at C_2 position is simply a faithful V-to-V mapping (see footnote (5)).

(7) [C_1: Onset of orig. σ]-[C_2: To Glide/V]

SL	SF	MC Pinyin	IPA	Gloss
English	Quaker	gui4-ge4-[mai4-pian4]	/kuei-kɤ-[mai-pʰian]/	laurel-square-[cereal]
German	Quedlinburg	kui2-de2-lin2-bao3	/kuei-tɤ-lin-pɑu/	ø-virtue-forest-fort
Italian	Rieti	li-ai1-di4	/li-ai-ti/	inside-dust-fruit base

Among the three processes discussed above, the first and the third result in retention of both sounds in a cluster, whereas in the second, only one sound (C_1) is retained, and the other (C_2) is deleted.

4.4.2 Coda CC clusters

Consonants in word-final -C_1C_2 coda clusters are expected to undergo similar processes used in the adaptation of different classes of simplex codas (see §4.3). An obstruent may be either deleted or resyllabified as an onset through vowel insertion. A bilabial nasal /-m/ will either undergo vowel epenthesis or change to a licit nasal coda /-n,

---

[23] /Cj-/ and /CCj-/ clusters in Italian may be alternatively pronounced as /Ci-/ and /CCi-/, in which the glide is realized as a vowel. In such cases, they are no longer consonant clusters (Repetti, personal communication, October 2005).

-ŋ/. Legal codas /-n/ or /ŋ/ will be retained as codas (although possibly with change in the place feature). Coda "-l/-r" will be mostly deleted or realized as the Mandarin rhotic vowel /ɚ/.

The adaptation strategies involving coda clusters are listed in Table 4.9. The results confirm the predictions. The cluster constituents undergo processes characteristic of their phoneme category (e.g. obstruents vs. nasals). Among these processes, some preserve both segments in the cluster (e.g. [C_1: V Epen]-[C_2: V Epen]), while others result in the retention of one segment and deletion of the other (e.g. [C_1: C Del]-[C_2: V Epen]), or deletion of both segments (e.g. [C_1: C Del]-[C_2: C Del].

Table 4.9. Adaptation of word-final C_1C_2 coda clusters

C_1	C_2	English		German		Total
V Epen	V Epen	17	(9.14%)	10	(4.39%)	27
	N Coda Retention	0		1	(0.44%)	1
	C Del	9	(4.84%)	1	(0.44%)	10
C Del	V Epen	54	(29.03%)	70	(30.70%)	124
	N Coda Retention	4	(2.15%)	8	(3.51%)	12
	Rhotic V	0		2	(0.88%)	2
	C Del*	16	(8.60%)	60	(26.32%)	76
N Coda Retention	V Epen	20	(10.75%)	21	(9.21%)	41
	C Del	19	(10.22%)	9	(3.95%)	28
Rhotic V	V Epen	16	(8.60%)	36	(15.79%)	52
	N Coda Retention	0		4	(1.75%)	4
	C Del	1	(0.54%)	0		1
Merge to C_2	V Epen	6	(3.23%)	0		6
/m/ → /n/	V Epen	2	(1.08%)	1	(0.44%)	3
σ Del	σ Del	22	(11.83%)	5	(2.19%)	27
Total		186		228		414

Note: [C_1: C Del]-[C_2: C Del] cases include include 53 "-burg" and 5 "-berg" sequences, both of which are conventionally realized as Mandarin "bao3 /pɑu/" *fort*.

The data in (8)-(10) illustrate the adaptation of coda CC clusters. In (8), the [C_1: V Epen]-[C_2:V Epen] strategy is employed. For instance, "Comca**st**" (English, company name) is adapted as "kang1-mu3-ka3-**si**1-**te**4" /kʰɑŋ-mu-kʰa-**sẓ**-**tʰɤ**/, where an apical vowel is inserted after C_1 /s/, and a central vowel is added after C_2 /t/.

(8) [C₁: V Epen]-[C₂: V Epen]

SL	SF	MC Pinyin	IPA	Gloss
English	Comca<u>st</u>	kang1-mu3-ka3- <u>si</u>1-<u>te</u>4	/kʰɑŋ-mu-kʰa- <u>sẓ</u>-<u>tʰɤ</u>/	health-housekeeper- card-this-special

	OfficeMa<u>x</u>	[ban4-gong1]-mai-
		    mai4-<u>ke</u>4-<u>si</u>1
			/[pan-kuŋ]-mai-
			    <u>kʰɤ</u>-<u>sẓ</u>/
				[office]-wheat-gram-
				    this

German	BA<u>SF</u>	ba1-<u>si</u>1-<u>fu</u>1	/pa-<u>sẓ</u>-<u>fu</u>/	to cling to -this-husband
	Li<u>st</u>	li3-<u>si</u>1-<u>te</u>4	/li-<u>sẓ</u>-<u>tʰɤ</u>/	plum-this-special

The final clusters in (9) are adapted through [C₁: C Del]-[C₂: V Epen], by which the first constituent is deleted and the second one is resyllabified by vowel insertion. For example, the /-rd/ cluster in "Fo**rd**" (English, brand name of automobile) is resolved by deletion of /r/ and insertion of /ɤ/ after /t/, with the adapted form being "fu2- < > **te**4" /fu- **tʰɤ**/ *fortune-special*.

(9) [C₁: C Del]- [C₂: V Epen]

SL	SF	MC Pinyin	IPA	Gloss
English	Ceda<u>nt</u>	sheng4-da2- < > -<u>te</u>4	/ʂəŋ-ta-<u>tʰɤ</u>/	holy-to arrive-special
	Fo<u>rd</u>◇	fu2- < > -<u>te</u>4	/fu-<u>tʰɤ</u>/	fortune-special
German	Bendo<u>rf</u>	ben3-duo1- < > -<u>fu</u>1	/pən-tuɔ-<u>fu</u>/	essence-much-husband
	Schwe<u>lm</u>	shi1-wei1- < > -<u>mu</u>3	/ʂɻ-uei-<u>mu</u>/	to execute-power-housekeeper

In the adaptation of words containing final nasal-obstruent clusters, the nasal is often preserved as a coda, and the obstruent may undergo vowel insertion, which is shown in (10). For example, "Sprint" (English, company name) enters Mandarin as "si1-pu3-li<u>n</u>2-<u>te</u>4 /sẓ-pʰu-lin-tʰɤ/. In the coda cluster /-nt/, /n-/ remains in the coda, and /-t/ is resyllabified by /ɤ/ insertion.

(10) [C₁: N Coda Retention]-[C₂: V Epen]

SL	SF	MC Pinyin	IPA	Gloss

English	Fli<u>nt</u> Ink	fu4-li<u>n</u>2-<u>te</u>4-
		    [you2-mo4]
			/fu-li<u>n</u>-<u>tʰɤ</u>-[iou-
			    muɔ/
				rich-forest-special-[ink]

	Spri<u>nt</u>	si1-pu3-li<u>n</u>2-<u>te</u>4	/sẓ-pʰu-li<u>n</u>-<u>tʰɤ</u>/	this-popular-forest- special
German	Kame<u>nz</u>	ka3-me<u>n</u>2-<u>ci</u>2	/kʰa-mə<u>n</u>-<u>tsʰẓ</u>/	card-door-puncture vine
	Sieme<u>ns</u>	xi1-me<u>n</u>2-<u>zi</u>3	/çi-mə<u>n</u>-<u>tsẓ</u>/	West-door-son

In the adaptation of clusters containing an initial "-l/-r" followed by an obstruent, a common process is [C_1: Rhotic V]-[C_2: V Epen], in which "-l/-r" is mapped to the Mandarin rhotic vowel /ɚ/ and the obstruent undergoes vowel insertion. Examples of this strategy are given in (11). For instance, in "Se<u>ars</u>" (English, company name) > xi1-<u>er</u>3-<u>si</u>1 /ɕi-ɚ-sz̩/, the final cluster /-rz/ is adapted into /-ɚ-sz̩/, with the liquid becoming a rhotic vowel and the fricative surfacing as onset of an epenthetic syllable.

(11) [C_1: Rhotic V]-[C_2: V Epen]

SL	SF	MC Pinyin	IPA	Gloss
English	Se<u>ars</u>	xi1-<u>er</u>3-<u>si</u>1	/ɕi-ɚ-sz̩/	West-you-this
	Ra<u>lph</u> Lauren	la1-<u>er</u>3-<u>fu</u>1-lau2-	/la-ɚ-fu-lɑu-	to pull-you-husband-
		lun2	lun/	labor-order
German	Ho<u>rb</u>	huo4-<u>er</u>3-<u>bu</u>4	/xuɔ-ɚ-bu/	suddenly-you-cloth
	Wo<u>lf</u>	wo4-<u>er</u>3-<u>fu</u>1	/uɔ-ɚ-fu/	fertile-you-husband

4.4.3. Variation between preservation and deletion (CC clusters)

To get an overview of the variations between preservation and deletion in Mandarin adaptations of initial onset C_1C_2- and final coda -C_1C_2 clusters, the frequencies of these two types of process are calculated in the same way as final simplex codas (see §4.3.4). The results are listed in Table 4.10 and Table 4.11 respectively for C_1 and C_2 in onset clusters. C_1 in onset clusters is almost never deleted, with the exception of 1.23% English plosives. As for C_2, truncation is used mainly in the adaptation of English "l, r" sounds. In the German and Italian data, neither C_1 nor C_2 undergoes deletion, except for 4.76% of German C_2 "r" and 10.00% of Italian C_2 /j/.

Table 4.10. Preservation vs. deletion of C_1 in onset C_1C_2 clusters (%)

SL / C_1 Class			English	German	Italian
Obstruent	Plosive	Preservation	98.77	100.00	100.00
		Deletion	1.23	0.00	0.00
	Fricative	Preservation	100.00	100.00	100.00
		Deletion	0.00	0.00	0.00
"r"		Preservation	N/A	N/A	100.00
		Deletion	N/A	N/A	0.00

Table 4.11. Preservation vs. deletion of C_2 in onset C_1C_2 clusters (%)

SL / C_2 Class			English	German	Italian
Obstruent	Plosive	Preservation	100.00	100.00	100.00
		Deletion	*0.00*	*0.00*	*0.00*
	Fricative	Preservation	N/A	100.00	N/A
		Deletion	N/A	*0.00*	N/A
Nasal	/m, n/	Preservation	100.00	100.00	0
		Deletion	*0.00*	*0.00*	*0*
"l, r"	/l/	Preservation	89.19	100.00	0
		Deletion	*10.81*	*0.00*	*0*
	"r"	Preservation	82.00	95.24	100.00
		Deletion	*18.00*	*4.76*	*0.00*
Glide	/w/	Preservation	81.82	0	0
		Deletion	*18.18*	0	0
	/j/	Preservation	N/A	N/A	90.00
		Deletion	N/A	N/A	*10.00*

The frequencies of preservation vs. deletion in the adaptation of C_1 and C_2 in coda C_1C_2 clusters are listed in Table 4.12 and Table 4.13. In the adaptation of C_1, the English loans tend to have higher frequencies of deletion than the German loans. For instance, the rates of deletion for C_1 plosives and /l/ are respectively 34.38% and 34.78% in the English data, but only 0% (for plosives) and 7.69% (for /l/) in the German data. In the adaptation of C_2, no consistent differences between the two donor languages are observed. For some classes of phonemes, the deletion rates in the English loans are higher than in the German ones (e.g. 23.46% vs. 3.23% in the case of fricatives). For others, however, deletion is less frequent in the English data than in the German data (e.g. 0% vs. 6.67% in the case of /n, ŋ/).

A note is needed for the German [-l/-r + plosive] clusters. The German data contain 53/54 instances of "-burg" and 5/37 of "-berg" that are conventionally adapted as Mandarin "bao3" /pɑu/ *fort*. In this process, both constituents in the "-rg" clusters are deleted, hence the deletion rates of trill C_1 and obstruent C_2 in the German loans are somewhat boosted. If the repeated cases of these two clusters (52 "-burg" and 4 "-berg") are excluded, the deletion rates for German C_1 trill and C_2 plosives become lower (see bracketed figures indicated by "♦" in Table 4.12 and Table 4.13)

111

Table 4.12. Preservation vs. deletion of C_1 in coda C_1C_2 clusters (%)

C₁ Class \ SL			English	German
Obstruent	Plosive	Preservation	65.63	100.00
		Deletion	34.38	0.00
	Fricative	Preservation	88.89	100.00
		Deletion	11.11	0.00
Nasal	/m/	Preservation	100.00	100.00
		Deletion	0.00	0.00
	/n, ŋ/	Preservation	92.86	100.00
		Deletion	7.14	0.00
"l, r"	/l/	Preservation	65.22	92.31
		Deletion	34.78	7.69
	"r"	Preservation	5.56	4.86 (7.95♦)
		Deletion	94.44	95.14 (92.05♦)

Notes: 1) Italian does not allow coda clusters;
2) ♦: German data that exclude repeated "-burg" > "bao3" and "-berg" > "bao3"cases.

Table 4.13. Preservation vs. deletion of C_2 in coda C_1C_2 clusters (%)

C₂ Class \ SL			English	German
Obstruents	Plosive	Preservation	67.11	56.21 (88.66♦)
		Deletion	32.89	43.79 (11.34♦)
	Fricative	Preservation	76.54	96.77
		Deletion	23.46	3.23
	Affricate	Preservation	66.67	94.12
		Deletion	33.33	5.88
Nasals	/-m/	Preservation	N/A	100.00
		Deletion	N/A	0.00
	/-n, -ŋ/	Preservation	100.00	93.33
		Deletion	0.00	6.67
"l, r"	/-l/	Preservation	N/A	100.00
		Deletion	N/A	0.00
	/-ɹ, -r/	Preservation	N.A	N/A
		Deletion	N/A	N/A

Notes: 1) Italian does not allow coda clusters;
2) ♦: German data that exclude repeated "-burg" > "bao3" and "-berg" > "bao3"cases.

To summarize §4.4, Mandarin speakers use a variety of strategies in adaptation of foreign CC clusters. The processes vary according to phoneme class (e.g. obstruents vs. nasals in coda clusters). In addition, deletion occurs more frequently in the English loans than in the German loans, especially in the case of C_1 in coda C_1C_2 clusters.

4.5 Adaptation of foreign CCC and CCCC clusters in word-initial and -final positions

Complex consonant clusters containing three or more constituents are very few in the data. In total, there are 34 CCC clusters (10 in onset and 24 in coda) and 2 CCCC coda clusters. Due to the limited number of data, adaptation of these structures will be only briefly discussed below.

The 10 $C_1C_2C_3$ onset clusters in the corpus data include 3 in English loans, 6 in German loans and 1 in Italian loans. The English and German instances are of a [fricative-stop-approximant] template (e.g. English /skw-/, /str-/; German /ʃpr-/ and /ʃtr-/). The one Italian cluster is "trj-," consisting of a stop, a trill and an approximant.

These onset $C_1C_2C_3$ clusters are resolved through strategies similar to those used in onset C_1C_2 clusters. In most cases, vowel insertion is applied to each of the first two phonemes, and the third sound remains in the original onset position (i.e. $C_1C_2C_3V$ → $C_1V_{\varnothing\text{-}1}C_2V_{\varnothing\text{-}2}C_3V$, in which $V_{\varnothing\text{-}1}$ and $V_{\varnothing\text{-}2}$ are epenthetic vowels (see Table 4.14).

Table 4.14. Adaptation of $C_1C_2C_3$ onset clusters

C1	C2	C3	English	German	Italian
V Epen	V Epen	Onset of orig. σ	2	6	0
	Onset of orig. σ	Glide to V	1	0	1

Examples for the adaptation of CCC onset clusters are given in (12). For instance, in "**Spr**int" /spɹɪnt/ (English, company name) > "**si**1-**pu**3-lin2-te4" (**sɹ̩-pʰu-l**in-tʰɤ/), C_1 and C_2 (i.e. /s/ and /p/) are both resyllabified through vowel epenthesis, and C3 (i.e. /ɹ/) surfaces as a lateral /l/, remaining in onset. When the final element in the cluster is a glide /w/ or /j/, it will change to a Mandarin medial vowel /i/ or /u/, which makes it possible for the preceding consonant to become an onset (see footnote (4) for an alternative explanation for Italian /CCj-/ clusters). For example, "**Sq**uibb" /skwɪb/ (English, company name) is adapted as "**shi**1-**gui**4-bao3" /**ʂɹ̩-ku**ei-pɑu/, with the second consonant (i.e. /k/) stands as onset of the source syllable due to the change of C3 (/w/) into a vowel.

(12) SL   SF   MC Pinyin   IPA   Gloss

SL	SF	MC Pinyin	IPA	Gloss
English	Sprint	si1-pu3-lin2-te4	/sz̩-pʰu-lin-tʰɤ/	this-popular-forest-special
	Squibb◊	shi1-gui4-bao3	/ʂɻ̩-kuei-pɑu/	execute-honor-treasure
German	Stralsund	shi1-te4-la1-er3-song1	/ʂɻ̩-tʰɤ-la-ɚ-suŋ/	to execute-special-to pull-you-pine
	Straubing	shi-te4-lao2-bin1-(shi4)	/ʂɻ̩-tʰɤ-lɑu-pin-(ʂɻ̩)/	to execute-special-labor-guest-(city)
Italian	Trieste	di2-li3-ya3-si1-te4	/ti-li-ia-sz̩-tʰɤ/	arrow-in-elegant-this-special

Adaptation strategies used to resolve word-final complex codas of the $C_1C_2C_3$ type show patterns similar to other coda structures (see Table 4.15). Obstruents undergo vowel epenthesis or deletion. Lateral and "r" sounds are mostly deleted and sometimes replaced by the Mandarin rhotic vowel. Licit nasal codas /-n, -ŋ/ generally remain in the coda position.

Table 4.15. Adaptations of $C_1C_2C_3$ coda clusters

C_1	C_2	C_3	English	German
C Del ("l/r")	V Epen	V Epen	4	4
	C Del	C Del	2	0
		V Epen	1	0
	Merge to C3	V Epen	5	0
	N Coda Retention	C Del	1	0
		V Epen	0	1
	Rhotic V	V Epen	1	0
N Coda Retention (/n, ŋ/)	V Epen	V Epen	1	1
	C Del	V Epen	1	0
Rhotic V ("l, r" > /ə /)	V Epen	V Epen	0	1
σ Del	σ Del	σ Del	1	0
Total			17	7

The data in (13) illustrate some of the processes aimed at -$C_1C_2C_3$ coda clusters. For instance, "Fo**rb**es" /fɔɹbz/ (English, title of a magazine) is adapted as "fu2 < > -**bu4-si1**" (/fu-**pu-sz̩**/ in which the first element in the coda cluster (i.e. the liquid "r-") is deleted, and the following two undergo resyllabification through vowel epenthesis. For another example, in "Wi**ngst**" /vɪŋst/ (German, place name) > "we**n**1-**si**1-**te**4" /uən-sz̩-tʰɤ/, all

114

three constituents of the coda cluster /-ŋst/ are preserved, with the nasal retained as a coda and the other two sounds resyllabified as onset of an epenthetic syllable.

(13) SL	SF	MC Pinyin	IPA	Gloss
English	For<u>bes</u>	fu2- < > -<u>bu</u>4-<u>si</u>1	/fu-<u>pu</u>-<u>sz̩</u>/	fortune-cloth-this
	Bert Robe<u>rts</u>	bo2-te4-luo2- <u>bo</u>2- < > -<u>ci</u>2	/puɔ-tʰɤ-luɔ- puɔ-<u>tsʰz̩</u>/	uncle-special-net- uncle-thatch
	Tom Ha<u>nks</u>	tang1-mu3-ha<u>n</u>4 -<u>ke</u>4-<u>si</u>1	/tʰɑŋ-mu-<u>han</u>- <u>kʰɤ</u>-<u>sz̩</u>/	soup-ø-man- restrain-this
German	Neuma<u>rkt</u>	nuo4-yi1-ma3- < > -<u>ke</u>4-<u>te</u>4	/nuɔ-i-ma- <u>kʰɤ</u>-<u>tʰɤ</u>/	promise-rely-horse- restrain-special
	Wo<u>rms</u>	fu2- < > -<u>mu</u>3-<u>si</u>	/fu-<u>mu</u>-<u>sz̩</u>/	hide-ø-this
	Wi<u>ngst</u>	wen1-<u>si</u>1-<u>te</u>4	/ue<u>n</u>-<u>sz̩</u>-<u>tʰɤ</u>/	warm-this-special

The only two instances of $C_1C_2C_3C_4$ clusters, both in the coda, are given in (14). The constituent phonemes in these two clusters are adapted in a way similar to consonants in other types of coda structures. For example, in the complex coda /-rbst/ of "Ze**rbst**" (German, place name), the first segment /r/ is adapted as a rhotic vowel, and the remaining three consonants are all resyllabified through vowel epenthesis. The resultant Mandarin form is "ce4-**er**3-**pu**3-**si**1-**te**4" /tsʰɤ-**ə̃**-**pʰu**- <u>sz̩</u>-**tʰɤ**/ (*policy-you-popular-this-special*).

(14) SL	SF	MC Pinyin	IPA	Gloss
English	E<u>rnst</u> & Young[◊]	<u>an</u>1- < > -yong3- [kuai4-ji4]-shi4 -wu4- suo3]	/a<u>n</u>-yŋ-[kʰuai-tɕi] -[ʂɻ̩-u-suɔ/	safety-forever- [accounting]-[firm]
German	Ze<u>rbst</u>	ce4-<u>er</u>3-<u>pu</u>3-<u>si</u>1- <u>te</u>4	/tsʰɤ-<u>ə̃</u>-<u>pʰu</u>-<u>sz̩</u>- <u>tʰɤ</u>/	policy-you-popular- this-special

Examination of the adaptation of CCC and CCCC clusters shows that such complex clusters undergo simplification processes strategies similar to those used in the nativization of simplex codas and CC clusters. The specific processes involving consonants vary according to phoneme class, and there exist alternations between preservation and deletion.

4.6 Interaction between phonological factors and adaptation strategies (English loans)

As has been discussed earlier, variations between alternative adaptation strategies in loanword phonology are influenced by phonological and/or phonetic contexts (see §4.2). The factors that have been reported to affect the likelihood of segment preservation vs. deletion include the following: (a) quality of the preceding vowel (Kang 2003); (b) consonantal features (Kang 2003); (c) phoneme category (Silverman 1992, Yip 1993); (d) segment/cluster position (onset vs. coda) (Silverman 1992, Brasington 1997); and (e) cluster structure (Kenstowicz 2003a, Brasington 1997).

This section will examine the interaction between contextual features and the variation between adaptation strategies in Mandarin. Since deletion occurs at low frequencies in the German and Italian data (see §4.3-§4.5), only English loans, and in particular the adaptation of simplex C and C_1C_2 clusters (in both onset and coda positions), will be analyzed. The potential effects of six factors on the frequency of deletion (vs. preservation) will be investigated. The six factors include syllable stress and the five mentioned above. Stress is taken into consideration in view of the fact that segments in stressed syllables often display stronger resistance to certain phonological processes than segments in unstressed syllables (e.g. Beckman 1997).

Based on prior findings in loanword phonology, the following patterns are predicted. First, consonants are more likely to be preserved when they occur in a perceptually salient position, including: (a) in a stressed (vs. unstressed) syllable (as in Beckman 1997); (b) after a tense (vs. lax) vowel (as in Kang 2003); (c) in the onset (vs. coda) (as in Silverman 1992, Brasington 1997). Second, certain classes of sounds (e.g. fricatives) which are intrinsically more perceptible than others (e.g. plosives) are more likely to be retained (as in Silverman 1992, Yip 1993). Thirdly, a segment in an onset or a coda cluster will be more likely to be preserved when the cluster structure present strong perceptual cues for the target segment. More specifically, a cluster-final obstruent in sonorant-obstruent clusters is more likely to be preserved than in obstruent-obstruent clusters (as in Kenstowicz 2003a); and in nasal-obstruent clusters, the cluster-final obstruent is more likely to be retained when it is voiceless (rather than voiced) (as in Kenstowicz 2003a), and when it is a fricative (rather than a plosive) (as in Brasington 1997). Consonantal features (e.g. voicing and place) of simplex plosive codas, which influence Korean loan phonology (Kang 2003), will have no effect in Mandarin. This is because unlike in Korean, there are no phonological or morpho-phonemic rules in Mandarin that may affect the choice between vowel insertion and consonant deletion after stops of a particular voicing or place feature. Results from the English data are presented below.

4.6.1 Stress

The effect of stress is examined by comparing the deletion rates of English final simplex codas in stressed and unstressed syllables. Results listed in Table 4.16 show that deletion tends to occur more frequently in unstressed syllables than in stressed syllables, and this effect varies across segment categories. For obstruents, the differences between

the two contexts are not significant. Nasals are rarely deleted regardless of whether the host syllable is stressed or unstressed. Significant effects are observed in the adaptation of liquid codas, for which frequencies of deletion are much higher in unstressed syllables than in stressed ones. For example, in the case of coda /-l/, the deletion rate is 10% in stressed syllables, which is much lower than the rate in unstressed syllables (40.91%) (p < 0.02).

These results suggest that there is no uniform pattern across phoneme categories with respect to stress effects in Mandarin. Some types of simplex codas (e.g. liquids) may be more likely to undergo deletion in an unstressed syllable than in a stressed syllable, which conforms to Beckman's (1997) observation about positional faithfulness effects. However, in most categories, no significant effect is observed.

Table 4.16. Stress and consonant deletion (English simplex codas)

C class		$V_{[+stress]} C$	$V_{[-stress]} C$	p
Obstruent	Plosives	14/55 (25.45%)	27/70 (38.57%)	< 0.13
	Fricatives	3/36 (8.33%)	11/50 (22.00%)	< 0.10
	Affricates	0/7 (0%)	1/4 (25%)	N/A
Nasal	/-m/	0/6 (0%)	1/20 (5.00%)	N/A
	/-n, -ŋ/	0/24 (0%)	0/150 (0%)	N/A
Liquid	/-l/	2/20 (10.00%)	18/44 (40.91%)	< 0.02*
	/-ɹ/	4/13 (30.77%)	73/85 (85.88%)	< 0.01*

4.6.2 Vowel quality, consonant voicing and consonant place

Investigation of the interaction between the same three factors (i.e. vowel quality, consonantal voicing and place) studied by Kang (2003) and the likelihood of final coda deletion shows no obvious effect of these factors in Mandarin. Based on Small (1999), Ladefoged (2001) and Spencer (1996), English tense and lax vowels are classified in (15). This list combines the vowel sounds in the Received Pronunciation (RP) and General American English (GA). Minor inter-dialectal variations are ignored since Australian English and Canadian English are respectively more or less that same as RP and GA. (I treat the two "r-colored" vowels in GA, i.e. /ɝ/ and /ɚ/ as /ɜɹ/ and /əɹ/, in which /-ɹ/ is a coda. Hence, they are not included in the table.)

(15) English tense and lax vowels

Tense   i   e   u   o   ɔ   ɑ   ɜ   aɪ   aʊ   ɔɪ   ɪə   oʊ   ju

Lax   ɪ   ɛ   æ   ʊ   ʌ   ə

A comparison between the frequencies of coda deletion after tense and lax vowels is given in Table 4.17, which shows no distinctive preference for deletion in relation to

vowel quality. For instance, plosives appear to be more likely to undergo deletion when they come after a lax vowel (34.38%) than after a tense vowel (27.59%) (p < 0.50), but fricatives behave in the opposite manner, with a higher deletion frequency after tense vowels (17.07%) than after lax vowels (13.33%) (p < 0.85). Significant differences are only observed in the adaptation of coda /-ɹ/, which is deleted at a much higher rate when the preceding vowel is lax (82.93%) than when the vowel is tense (53.33%) (p < 0.01). For nasals and affricates, no significance tests are given because instances of deletion are either two few or not observed. Mandarin adaptation of English /-ɹ/ supports Kang's (2003) findings that deletion is more frequent in unstressed syllables, but the adaptation of other consonants does not.

Table 4.17. Vowel quality and consonant deletion (English simplex codas)

C class		$V_{[tense]}$ C	$V_{[lax]}$ C	p
Obstruent	Plosive	8/29 (27.59%)	33/96 (34.38%)	< 0.50
	Fricative	7/41 (17.07%)	7/45 (15.56%)	< 0.85
	Affricate	0/3 (0%)	1/8 (12.5%)	N/A
Nasal	/-m/	0/3 (0%)	1/23 (4.35%)	N/A
	/-n, -ŋ/	0/22 (0%)	0/152 (0%)	N/A
Liquid	/-l/	6/18 (33.33%)	14/46 (30.43%)	< 0.83
	/-ɹ/	8/15 (53.33)	69/83 (83.13%)	< 0.01*

No correlation between the voicing feature of the target segment and the likelihood of deletion is found either. As is shown in Table 4.18, voiceless and voiced obstruents do not differ significantly. In the adaptation of plosives, the proportions of deletion are about even for the two groups (i.e. 32.61% for [-voice] sounds vs. 33.33% for the [+voice] sounds) (p < 0.94). Voiced fricatives demonstrate a higher rate of deletion than voiceless ones (25.93% vs. 11.86%), but the difference is not significant (p < 0.11). For affricates, no statistical conclusion can be drawn since there are too few cases in the data.

Table 4.18. Voicing features and consonant deletion (English simplex codas)

C class	[-voice]	[+voice]	p
Plosives	30/92 (32.61%)	11/33 (33.33%)	< 0.94
Fricatives	7/59 (11.86%)	7/27 (25.93%)	< 0.11
Affricates	1/5 (20.00%)	0/6 (0%)	N/A

Similar to vowel quality and consonant voicing, consonantal place has no obvious effects on the frequencies of segment deletion. The results listed in Table 4.19 show that

there is no systematic correlation between any particular place feature and the rates of deletion. For example, although coronal plosives are deleted more frequently than labial fricatives (33.33% vs. 25.00%), the difference is only slight (p < 0.84). For fricatives and affricates, no conclusion can be drawn due to the small number of total instances.

Table 4.19. Place features and consonant deletion (English simplex codas)

C class	Labial	Coronal	Dorsal	p
Plosive	9/12 (25.00%)	19/57 (33.33%)	19/56 (33.93%)	< 0.84
Fricative	0/8 (0%)	14/78 (17.95%)	N/A	N/A
Affricate	N/A	1/11 (9.01%)	N/A	N/A

As is seen above, the three factors, namely, vowel quality, consonantal voicing and place, do not influence the variation between adaptation strategies in Mandarin loanword phonology. The prediction of higher deletion rates for codas following a lax vowel is disproved, except in the case of English coda /-ɹ/. Voicing and place features of consonants, which regulate Korean loanword phonology (Kang 2003), display no relationship with the choice of loan processes in Mandarin.

The lack of voicing and place effects as seen in Table 4.18 and Table 4.19 can be accounted for by the differences between Korean and Mandarin phonology. In Korean, the collaboration of two rules, i.e. the voicing of intervocalic plain stops and the morpho-phonemic restrictions against coronal-final words, leads to the greater likelihood of vowel epenthesis when the coda is voiced and coronal. In Mandarin phonology, however, there are no similar processes.

4.6.3 Phoneme category

Analysis of the relationship between phoneme category and deletion frequencies shows that different classes of consonants display differential likelihood of deletion. The proportions of deletion (vs. preservation) in the adaptation of final simplex codas are listed in Table 4.20. Liquid /-ɹ/ demonstrates the highest rate of deletion (78.35%), whereas nasals have the lowest (0% for /-n, -ŋ/, and 1.38% for /-m/). Obstruents and liquid /-l/ stand in the middle range. Adaptations of word-final C_1C_2 clusters show a similar hierarchy. The C_1 deletion rates and ranking scale given in Table 4.21 show that /-ɹ/ and nasals lie respectively at the top and bottom ends of the scale (94.44% for /-ɹ/, 7.14% for /-n, -ŋ/, and 0% for /-m/). Obstruents and the liquid /-l/ lie between. The pattern also holds true for processes involving C_2, as is presented in Table 4.22.

Furthermore, there exist within-class differences. Among obstruents, plosives generally have a higher rate of deletion than fricatives. For instance, in the adaptation of simplex codas as shown in Table 4.20, the deletion frequency of plosives is 32.80%, but that of fricatives is only 16.28% (p < 0.01). The two liquids also behave differently, with

/-ɹ/ deletion occurring far more frequently than /l/ deletion, e.g. 78.51% for /-ɹ/ vs. 31.25% for /-l/ in the case of simplex codas (p < 0.01).

Table 4.20. Preservation vs. deletion (English simplex codas)

C class		Preservation	Deletion	Total
Obstruents	Plosives	84 (67.20%)	41 (32.80%)	125
	Fricatives	72 (83.72%)	14 (16.28%)	86
	Affricates	10 (90.91%)	1 (9.09%)	11
Nasals	/-m/	25 (96.15%)	1 (3.85%)	26
	/-n, -ŋ/	174 (100.00%)	0 (0.00%)	174
Liquids	/-l/	44 (68.75%)	20 (31.25%)	64
	/-ɹ/	21 (21.43%)	77 (78.57%)	98
Ranking of deletion rates: **Liquid /-ɹ/ >** Plosive, Liquid /-l/ > Fricative > Affricate > ***/-m/ > /-n, -ŋ/***				

Table 4.21. Preservation vs. deletion (C_1 in English coda C_1C_2 clusters)

C_1 class		Preservation	Deletion	Total
Obstruent	Plosive	21 (67.63%)	11 (32.38%)	32
	Fricative	8 (88.89%)	1 (11.11%)	9
Nasal	/m/	4 (100.00%)	0 (0.00%)	4
	/n, ŋ/	39 (92.86%)	3 (7.14%)	42
Liquid	/l/	15 (65.22%)	8 (34.78%)	23
	/ɹ/	3 (5.56%)	51 (94.44%)	54
Ranking of deletion rates: **Liquid /-ɹ/** > Liquid /l/, Plosive > Fricative > ***/-n, -ŋ/, /-m/***				

Table 4.22. Preservation vs. deletion (C_2 in English coda C_1C_2 clusters)

C_2 class		Preservation	Deletion	Total
Obstruent	Plosive	51 (67.11%)	25 (32.89%)	76
	Fricative	62 (76.54%)	19 (23.46%)	81
	Affricate	2 (66.67%)	1 (33.33%)	3
Nasal	/m/	0	0	0
	/n, ŋ/	4 (100.00%)	0 (0.00%)	4
Liquid	/-l/	N/A	N/A	0
	/-ɹ/	N/A	N/A	N/A
Ranking of deletion rates : Liquid /l/ > Affricate > Plosive > Fricative > ***/-n, -ŋ/***				

Based on Mandarin adaptation of English coda structures as seen above, it can be concluded that consonants demonstrate differential frequencies of deletion. Liquids are more likely to be deleted than obstruents, and the latter are more likely to be deleted than nasals. Furthermore, between the two liquids, /-ɹ/ has higher deletion rates than the lateral; and among obstruents, plosives are deleted more frequently than fricatives.

4.6.4 Segment/cluster position

With respect to segment/cluster position, it is expected that in Mandarin adaptation of English C_1C_2 clusters, deletion will occur more frequently in the coda than in the onset, in view of the findings in Cantonese (Silverman 1992) and Marshallese (Brasington 1997) that vowel insertion occurs more often in the nativization of onset clusters than of coda clusters. This prediction is borne out in the adaptation of English simplex onsets and codas as well as onset and coda clusters.

First, English simplex codas are more likely to be deleted than simplex onsets. As was shown before, word-final simplex codas, most of which are illegal in Mandarin (except nasals /-n, -ŋ/), are either preserved (e.g. through vowel epenthesis) or deleted (see (124) in §4.6.3). In contrast, simplex onsets, well-formed structures in both English and Mandarin, require no phonotactic repairs and rarely undergo deletion. As is shown in Table 4.23, deletion of English simplex onsets (C Del) almost never occurs, with only one case observed. [24]

Table 4.23. Preservation vs. deletion (English simplex onsets)

C class		Preservation	C Del	σ Del	Total
Obstruents	Plosives	298	1	8	307
	Fricatives	154	0	7	161
	Affricates	42	0	7	49
Nasals	/m, n/	111	0	1	112
Liquids	/l, ɹ/	103	0	5	108
Glides	/j, w/	57	0	1	58
Total		765	1	29	795

Second, segments in English coda clusters are more likely to be deleted than segments in onset clusters. It is shown in Table 4.24 that preservation rates of C_1 and C_2 in onset C_1C_2 clusters are all above 80%. Obstruents and nasals in these clusters are rarely deleted. Although liquids and glides have relatively higher deletion rates than other consonants (i.e. 10.81% for /l/ and 18.00% for /r/ at the C_2 position), preservation is the predominant strategy. Nativization of coda clusters, however, presents a different picture. As was shown in Table 4.21 and Table 4.22 (see §4.6.3), deletion of obstruents in coda clusters ranges from 11.11% (fricatives) to 32.38% (plosives) at the C_1 position, and from 23.46%

---

[24] The same is true for simplex onsets in adaptation of German and Italian words. Among the total of 663 German instances, all are retained in the onset position except for 11 cases of syllable deletion. Of 177 Italian cases, there are three instances of consonant deletion and one syllable deletion.

(fricatives) to 33.33% (affricates) at the C_2 position. Furthermore, the same class of phonemes demonstrates higher likelihood of deletion in coda clusters than in onset clusters. For example, C_1 plosives have a deletion rate of 32.38% in coda clusters, but only 1.23% in onset clusters.

Table 4.24. Preservation vs. deletion (English onset C_1C_2 clusters)

	C class		Preservation	C Del	Total
C_1	Plosive		80 (98.77%)	1 (1.23%)	81
	Fricative		48 (100.00%)	0 (0.00%)	48
C_2	Plosive		23 (100.00%)	0 (0.00%)	23
	Nasals (/m, n/)		5 (100.00%)	0 (0.00%)	5
	Liquid	/l/	33 (89.19%)	4 (10.81%)	37
		/ɹ/	41 (82.00%)	9 (18.00%)	50
	Glide (/w/)		9 (81.82%)	2 (18.18%)	11

Comparisons between the frequencies of deletion in the onset and in the coda show that in Mandarin loan phonology, onset consonants are accorded greater priority of being preserved than coda consonants. This pattern is consistent with the findings in Cantonese (Silverman 1992) and Marshallese (Brasington 1997).

4.6.5 Cluster structure

The structure or type of consonant clusters is found to correlate with the likelihood of segment preservation vs. deletion in the loanword phonology of Cantonese (Silverman 1992, Yip 1993), Fijian (Kenstowicz 2003a) and Marshallese (Brasington 1997). According to Kenstowicz (2003a), in Fijian adaptation of English final obstruent-obstruent clusters, the second obstruent undergoes deletion more often than vowel insertion, whereas in the case of oonorant-obstruent clusters, the final obstruent undergoes vowel insertion more frequently. In addition, Kenstowicz observes that in nasal-plosive clusters, a [-voice] plosive is generally preserved by vowel epenthesis, but a [+voice] one is adapted with even likelihood of deletion and vowel insertion. Brasington (1997) finds that in Marshallese adaptations of English nasal-obstruent clusters, deletion occurs more often when the post-nasal obstruent is a stop than when it is a sibilant.

To examine the relationship between cluster structure and the frequencies of deletion (vs. preservation), Coda -C_1C_2 clusters in the English data are classified into four types, namely obstruent-obstruent (e.g. /-ft/ and /-ks/), Liquid-Obstruent (e.g. /-ld/, /-ɹz/), nasal-obstruent (/-mp/ and /-nz/) and Liquid-Nasal (e.g. /-ɹn/). (Onset C_1C_2 clusters are not discussed since deletion occurs rarely.) The results displayed in Table 4.25 show that preservation of C_2 is preferred over deletion in both obs-obs clusters and Son-Obs clusters (including liquid-obs and nasal-obs types). Comparison across these three categories does not reveal a uniform effect. The C_2 deletion rate in obs-obs (26.83%) is higher than in one type of son-obs cluster, i.e. Liquid-Obs (19.18%), but lower than in the other, i.e. nasal-obs (43.48%). If the two types of Son-Obs clusters are combined, the

preservation and deletion rates for the final obstruent are respectively 71.43% (85/119) and 28.57% (34/119), which are about the same as those in obs-obs clusters (73.17% for preservation, and 26.83% for deletion). (liquid-nasal clusters are not discussed as there are too few instances to draw any valid comparison.) These results show that in Mandarin loanword processes, there is no clear effect of cluster structure on the choice of adaptation strategy for the cluster-final segment, nor is there an overwhelming dominance of deletion over preservation for the final obstruent in C-obstruent clusters in general.

Table 4.25. Preservation vs. deletion by cluster type (English coda C_1C_2 clusters)

Position\ C_1-C_2 (n)	C1		C_2	
	Preservation	Deletion	Preservation	Deletion
A) Obs-Obs (41)	29 (70.73%)	12 (29.27%)	30 (73.17%)	11 (26.83%)
B) Liquid-Obs (73)	18 (24.66%)	55 (75.34%)	59 (80.82%)	14 (19.18%)
C) Nasal-Obs (46)	43 (93.48%)	3 (6.52%)	26 (56.52%)	20 (43.48%)
D) Liquid-Nasal (4)	0 (0.00%)	4 (100.00%)	4 (100.00%)	0 (0.00%)

Note: Obs = Obstruents

The results presented above contradict the Fijian patterns, in which C_2 in obs-obs coda clusters is more likely to be deleted than in son-obs coda clusters. Kenstowicz (2003a: 16) shows that in Fijian adaptation of English final obs-obs clusters, the frequency of C_2 deletion is 20/24 (83.33%), while vowel epenthesis makes up only 4/24 (16.67%). In the case of final Son-Obs clusters, the rates of deletion and vowel epenthesis targeted at C_2 are respectively 12/40 (30%) and 28/40 (70%).

In view of Kenstowicz's (2003) findings on the voicing effect in Fijian regarding English final Nasal-Plosive clusters, the frequencies of obstruent deletion in Mandarin adaptations of English Nasal-Obs clusters are calculated. The figures in Table 4.26 show that the rate of C_2 deletion in nasal-plosive clusters is 46.68% when the plosive is [-voice], and 66.67% when the segment is [+voice]. In the case of nasal-fricative clusters, the deletion rates of the fricative are respectively 25% for [-voice] sounds and 29.41% for [+voice] sounds. The results demonstrate a similar pattern to that in Fijian, in which the /t/ in /-nt/ coda clusters is less likely to be deleted than the /d/ in /-nd/ clusters (2/15 or 13.33% for /t/ vs. 4/7 or 57.14% for /d/) (see Kenstowicz 2003a: 16). Thus, we can say that Mandarin and Fijian show a similar preference for deletion of a [+voice] obstruent in Nasal-Obs clusters, although the pattern in Mandarin is not as strong as that in Fijian.

Table 4.26. Voicing effects on adaptation English nasal-plosive coda clusters

Cluster type (n)			C_2	
			V Epenthesis	Deletion
Nasal-Plosive	Nasal-C [-voice] (15)	/-mp/, /-nt/, /-ŋk/	8 (53.33%)	7 (46.67%)
	Nasal-C [+voice] (9)	/-nd/	3 (33.33%)	6 (66.67%)
Nasal-Fricative	Nasal-C [-voice] (4)	/-ns/	3 (75.00%)	1 (25.00%)
	Nasal-C [+voice] (17)	/-mz/, /-nz/	12 (70.59%)	5 (29.41%)
Nasal-Affricate	Nasal-C [-voice] (1)	/-ntʃ/		1 (100.00%)
	Nasal-C [+voice] (0)	/	/	/

Moreover, a comparison between Nasal-Plosive and Nasal-Fricative clusters listed in Table 4.26 shows that a post-nasal plosive is more likely to be deleted than a post-nasal fricative. Disregarding voicing differences, the frequencies of C_2 deletion are respectively 13/24 (54.17%) in Nasal-Plosive clusters and 6/21 (28.57%) in nasal-fricative clusters. This pattern is consistent with the general picture in Mandarin that plosives tend to have higher rates of deletion than fricatives (see §4.6.3). It also supports Brasington (1997), who observes that C_2 deletion is more frequent in Nasal-Stop clusters than in Nasal-Sibilant clusters.

To summarize §4.6, the findings about the relationship between various phonological/ phonetic contexts and the likelihood of segment deletion vs. preservation lead to the following conclusions:

(a) With respect to syllable stress features, deletion tends to be more frequent in unstressed syllables than in stressed syllables. The effect is significant in the adaptation of liquids.

(b) No obvious effect of vowel quality is observed (except for liquid /-ɹ/, which is more deleted more often when the preceding vowel is lax than when the vowel is tense).

(c) No effect of consonantal voicing and place features is observed.

(d) Frequencies of coda deletion vary according to phoneme class features, along a hierarchy of Liquid > Obstruent [Fricative > Plosive] > Nasals. (The symbol ">" means more likely to be deleted.)

(e) Segments in the coda are more likely to be deleted than those in the onset;

(f) No obvious effect of cluster structure is observed with respect to the likelihood of C_2 deletion in the adaptation of final obstruent-obstruent clusters and sonorant-obstruent clusters.

(g) In adaptations of English nasal-plosive clusters, a [+voice] plosive is more likely to be deleted than a [-voice] one.

(h) In the adaptation of nasal-obstruent coda clusters, a post-nasal stop is more likely to be deleted than a post-nasal fricative.

These findings suggest that Mandarin speakers pay varying degrees of attention to the phonetic details of the source pronunciation. Some contextual factors, such as stress and phoneme category, play a more important role. Other factors (e.g. vowel quality), do not have significant effects.

4.7 Quality of epenthetic vowels

As has been introduced in §4.2, cross-linguistically there are three ways in which epenthetic vowels are chosen in loanword adaptation, namely insertion of a default or unmarked vowel, a copy vowel, or a vowel sharing place features of a neighboring consonant (Uffmann 2004). In this section, the quality of inserted vowels in Mandarin loanword phonology will be analyzed. It will be shown that Mandarin speakers adopt the

third strategy, i.e. onset assimilation, in that the epenthetic vowels generally share the place features (including, but not limited to the [±labial] features) of the preceding consonant (i.e. the onset). This pattern holds across loans from all three donor languages.

The inventory of epenthetic vowels observed in the corpus data is summarized in Table 4.27. (For each class of phonemes, the epenthetic vowel of the highest frequency is marked by "*." Shaded areas are exceptional cases where the epenthetic vowel and the preceding consonant do not agree in place.) The results show that labial consonants, including plosives /p, b/, fricatives /f, v/ and nasal /m/, are mostly replaced by Mandarin labial sounds and resyllabified by insertion of a labial vowel /u/. Other labial vowels (e.g. /uɔ/ and /ɑu/) are also used, but they occur far less frequently. [25]

The data in (16) illustrate the insertion of labial vowels after labial consonants. For example, /u/ is inserted after the final coda in Gallu**p** (English, name of census agency) > "gai4-luo4-**pu**3" /kai-luɔ-**p^{h}u**/, and "Ha**mm**" (German, place name) > "ha1-**mu**3" /xa-**mu**/. (For convenience, all data given in this section involve word-final simplex codas only).

After non-labial plosives /-t, -d, -k, -g/, a back [-labial] vowel /ɤ/ is added. The epenthesis of /ɤ/ may be motivated by its status as the most neutral and variable vowel in Mandarin. According to Ramsey (1987: 44) and Norman (1988: 142), the actual production of this vowel varies greatly in the degree of height and retraction, depending on the phonetic environment. Insertion of /ɤ/ after alveolar and velar stops is illustrated in (17), e.g. "Fenbi**d**" (English, brand name of medicine) > "fen1-bi4-**de**3" /fən-pi-**tɤ**/, and Fia**t** (Italian, brand name of automobile) > "fei1-ya4-**te**" /fei-ia-**t^{h}ɤ**/.

Similarly, non-labial fricatives and affricates are resyllabified by epenthesis of a vowel that agrees with the preceding consonant in place of articulation. If the adapted form of the consonant is a sibilant or a retroflex approximant, an apical vowel /z̩/ or /ɻ̩/ (both written as "i" in Pinyin) will be inserted, with /z̩/ after dental sibilants /s, ts^h, ts/ and /ɻ̩/ after retroflex sibilants /ʂ, tʂ^h, tʂ/. The two Mandarin apical vowels, appearing only after dental and retroflex consonants, are phonetically the "vocalic prolongation" (Li 1999: 39-41) or a "syllabic" continuation of the syllable initial (Ramsey 1987: 45). Thus, insertion of an apical vowel creates a syllable whose onset and nucleus share the same place feature. Furthermore, when the output of a consonant is palatal (i.e. fricative /ɕ/ and affricate /tɕ^h, tɕ/), a high vowel /i/ will be added. The German velar fricative /x/ is generally replaced by its Mandarin correspondent and resyllabified by a homorganic vowel /ɤ/. In all these cases, the epenthetic syllable consists of an onset and a vowel that agree in articulatory place.

---

[25] The vowel / uɔ/ is represented by Pinyin "o" after labial initials and by "uo" after non-labial initials. See Norman 1988: 141 and Ramsey 1987: 44 for more details.

Table 4.27. Inventory of epenthetic vowels

	Source Phoneme	Mandarin Output	Epenthetic V Phoneme	%
Plosive	p, b (n = 78)	pʰ, p	u*	83.33
			uɔ	11.54
			ɑu	3.85
			i	1.28
	t, d (n = 195)	tʰ, t	ɤ*	97.95
			i	1.03
			uɔ	0.51
		ts	Apical V	0.51
	k, g (n = 196)	kʰ, k	ɤ*	98.98
		x	ɤ	0.51
		tɕʰ	i	0.51
Fricative	/f, v/ (n = 70)	f	u*	97.14
			ən	1.43
		To /u/	N/A	1.43
	θᴱ, s, z, ʃ, ʒᴱ (n = 271)	s, tsʰ, ts, ʂ, tʂʰ, tʂ, ɭ	Apical V*	97.05
			əŋ	0.37
			u	0.37
		ɕ	i	1.48
			yɛ	0.37
		f	u	0.37
	ɕᴳ (n = 13)	ɕ	i*	92.31
		ʂ	Apical V	7.69
	xᴳ (n = 26)	x	ɤ*	96.15
		ɕ	i	3.85
Affricate	tsᴳ (n =39)	tsʰ	Apical V*	100.00
	tʃᴱ, dʒᴱ (n = 12)	tɕ, tɕʰ	i*	83.33
		ʂ, tʂ	Apical V	16.67
Nasal	m (n = 61)	m	u*	98.39
			uɔ	1.61
	n (n = 2)	n	i	0
"l, r"	"l, "r" (n = 209)	To /ɚ/	N/A	95.22
		l, ɭ	ɤ	2.40
			u	1.44
			i	0.48
			uei	0.48

Notes: (1) Cᴱ: phonemes only exist in English;   (2) Cᴳ: phonemes only exist in German

(16) SL	SF	MC Pinyin	IPA	Gloss
English	Gallup	gai4-luo4-pu3	/kai-luɔ-pʰu/	cover-RIVER-popularity
	BobDog	ba1-bu4-dou4	/pa-pu-tou/	to cling to-cloth-bean
	Chubb◊	qiu1-bo2	/tɕʰiou-buɔ/	hill-abundant
	Davidoff	da4-wei4-du4-fu1	/ta-uei-tu-fu/	big-to protect-SUR-husband
	Dove◊	de2-fu2	/tɤ-fu/	virtue-lotus
	Dodge Ram	dao4-qi2-la1-mu3	/tɑu- tɕʰi-la1-mu/	road-wonder-to pull-housekeeer
German	Kaub	kao3-bo2-(shi4)	/kʰɑu-puɔ-(ʂɻ̩)/	exam-uncle-(city)
	Hoff	huo4-fu1	/xuɔ-fu/	suddenly-husband
	Hamm	ha1-mu3	/xa-mu/	to breathe out-housekeeper

(17) SL	SF	MC Pinyin	IPA	Gloss
English	Target	tai3-ji2-te4	/tai-tɕi-tʰɤ/	tower-fortune-special
	Fenbid◊	fen1-bi4-de3	/fən-pi-tɤ/	fragrance-must-acquire
	Modoc	mo4-duo1-ke4	/muɔ-tuɔ-kʰɤ/	silence-much-gram
	Maytag◊	mei3-tai4-ke4	/mei-tʰai-kʰɤ/	beauty-safe-gram
German	Duravit	du4-la1-wei2-te4	/tu-la-uei-tʰɤ/	SUR-to pull-to maintain-special
	Bad Ems	ba1-te4-ai1-mu3-si1	/pa-tʰɤ-ai-mu-sz̩/	to cling to-special-dust-housekeeper-this
	Waldeck	wa3-er3-de2-ke4	/ua-ɚ̃-tɤ-kʰɤ/	tile-you-virtue-gram
	Viag	wei2-er3-ge2	/uei-ɚ̃-kʰɤ/	to maintain-you-square
Italian	Fiat	fei1-ya4-te4	/fei-ia-tʰɤ/	fragrant-second-special
	Parmalat	pa4-ma3-la1-te4	/pʰa-ma-la-tʰɤ/	handkerchief-agate-to pull-special

Examples of vowel insertion to resyllabify [-labial] fricatives and affricates are given in (18). For instance, "Oti**s**" (English, brand name of elevator) and "Guta**ch**" (German, city name) are realized respectively as "ao4-di2-**si**1" /au-ti-**sz̩**/ and "gu3-ta3-he4" /ku-tʰa-**xɤ**/ in Mandarin. In the former, an apical vowel /z̩/ is added after the sibilant /s/, and in the latter a mid vowel /ɤ/ is inserted to resyllabifiy the velar fricative /x/.

The quality of epenthetic vowels in Mandarin loanword phonology as discussed above show that Mandarin speakers choose a vowel that best assimilates to the preceding consonant. The inserted vowel agrees with the onset not only in [±labial] features but also place of articulation. In this way, the inserted vowel is minimally

obtrusive (cf. Uffmann 2005) and helps maintain maximal similarity between the source pronunciation and the Mandarin output.

(18) SL	SF	MC Pinyin	IPA	Gloss
English	Wye<u>th</u>◊	hui4-<u>shi</u>4	/xuei-ʂɻ̩/	benefit-surname
	Oti<u>s</u>	ao4-di2-<u>si</u>1	/ɑu-ti-sz̩/	profound-arrow-this
	Yuppie<u>s</u>◊	ya3-pi2-<u>shi</u>4	/ia-pʰi-ʂɻ̩/	elegant-skin-gentleman
	Febree<u>ze</u>◊	fang3-bi4-<u>shi</u>4	/fɑŋ-pi-ʂɻ̩/	fabric-must-appropriate
	Mi<u>dge</u>	mi-<u>ji</u>1-[wa2-wa]	/mi-tɕi-[ua-ua]/	rice-wife-[doll]
	Ora<u>nge</u>	ao4-lan2-<u>qi</u>2	/ɑu-lan-tɕʰi/	profound-orchid-weird
German	Bo<u>ss</u>	bo1-<u>shi</u>4	/puɔ-ʂɻ̩/	wave-gentleman
	Auri<u>ch</u>	ao4-li4-<u>xi</u>1	/ɑu-li-ɕi/	profound-benefit-rare
	Zülpi<u>ch</u>	su1-er3-pi3-<u>xi</u>1	/su-ɚ-pʰi-ɕi/	to revive-you-∅-rare
	Guta<u>ch</u>	gu3-ta3-<u>he</u>4	/ku-tʰa-xɤ/	ancient-tower-prominent
	Deu<u>tz</u>	dao4-yi1-<u>ci</u>2	/tɑu-i-tsz̩/	road-rely-puncture vine
	Oscha<u>tz</u>	ao4-sha1-<u>ci</u>2	/ɑu-ʂa-tsz̩/	profound-sand-puncture -vine
Italian	Juventu<u>s</u>	you1-wen2-tu2 -<u>si</u>1	/iu-uən-tʰu-sz̩/	especially-writing-drawing -this
	Ortle<u>s</u>	ao4-er3-te4-lai2 -<u>si</u>1	/ɑu-ɚ-tʰɤ-lai- sz̩/	profound-you-special-radish -this

4.8 Perceptual similarity and constraint ranking for phonotactic adaptation

In this section, I will develop an OT analysis of the phonotactic processes in Mandarin loanword phonology. I will propose that perceptual distinctiveness of consonants as related to segmental and contextual factors triggers differential preference for the preservation (vs. deletion) of consonants in various contexts (§4.8.1). I will also argue that the choice of epenthetic vowels is governed by perceptual factors in that place agreement between an inserted vowel and the preceding consonant enhances the perceptual similarity between the source form and the loan form (§4.8.2). As for the free alternation of adaptation strategies, I will propose variable rankings of constraints that motivate the respective repair processes (§4.8.3). As in Chapter 3, I assume the input to Mandarin loanword phonology is the source pronunciation of the borrowed term in the donor language, based on the consideration that foreign words are mostly adapted into Mandarin by competent bilinguals.

4.8.1 Perceptual similarity and differential frequencies of segment deletion

To account for the differential likelihood of segment preservation vs. deletion in relation to various contextual factors, I adopt Steriade's (2002) P-map proposal and postulate that the degree of perceptual distinctiveness of a segment in a certain context determines how likely it is to be retained (vs. deleted). The more salient a segment is, the more likely it is to be preserved.

Before going into detailed analysis of the constraint rankings, I introduce in (19) the well-formedness constraints governing Mandarin syllable structures, including NoCoda (Obs), NoCoda [Labial], NoCoda (l, r), *Complex-Onset, and *Complex-Coda. Since obstruents and the bilabial nasal /-m/ are entirely banned in the coda, NoCoda (Obs), NoCoda [Labial], and NoCoda (l, r) are undominated. [26] Furthermore, that consonant clusters are impermissible in both onset and coda positions suggests that *Complex-Onset and *Complex-Coda also rank the highest. For convenience, these four top-ranking constraints will be collectively termed as "Syllable-Structure" (abbreviated as "σ-STR" in the forthcoming tableaux).

> (19) Constraints for Mandarin syllable structures (σ-STR)
>   (a) NoCoda (Obs): An [-nasal] consonant cannot be a syllable coda.
>   (b) NoCoda [Labial]: A labial consonant cannot be a syllable coda.
>   (c) NoCoda (l, r): A lateral or "r" cannot be a syllable coda.
>   (d) *Complex-Onset: No consonant clusters are allowed in syllable onset.
>   (e) *Complex-Coda: No consonant clusters are allowed in syllable coda.

In addition to the σ-STR constraints, there are two correspondence constraints active in loanword processes, which are defined in (20). MAX-IO (C) bans segment deletion, and DEP-IO (V) forbids vowel insertion. The fact that consonant deletion and vowel epenthesis take place in order to satisfy the "σ-STR" constraints provide evidence that MAX-IO (C) and DEP-IO (V) rank lower than "σ-STR." The ranking order between the two correspondence constraints is not evident in Mandarin phonology since vowel epenthesis and consonant deletion do not occur in the native vocabulary. In loanword adaptation, they are variably ranked: if MAX-IO (C) >> DEP-IO (V), vowel epenthesis will be the preferred strategy; and the reverse order will trigger consonant deletion (see §4.8.3).

> (20) Correspondence constraints
>   (i) MAX-IO (C): Any consonant in the input must have a correspondent in the output (no deletion).
>   (ii) DEP-IO (V): Any vowel in the output must have a correspondent in the input (no epenthesis).

---

[26] See Broselow, Chen & Wang (1998), for alternative definitions of constraints NoCoda (Obs), MAX-IO (C) and DEP - IO (V).

Based on findings about the effects of contextual features on the variation between segment preservation vs. deletion in Mandarin (see §4.6), I postulate that Mandarin speakers' perception of English consonants is influenced by four factors: stress, phoneme class (or category), segment/cluster position and cluster structure, the latter one involving the voicing and class features of the obstruent in nasal-obstruent clusters. The relationship between these contextual factors and the perceptibility of consonants is formulated in (21) (cf. (1) in §4.2.2). The hierarchy in (21a) states that coda consonants in stressed syllables are perceptually more distinctive than in unstressed syllables. Differential perceptibility of consonants across phoneme category is defined in (21b), in which nasal codas are more distinctive than obsturent codas, and the latter are more distinctive than liquid codas; furthermore, within obstruents, fricatives are more salient than plosives due to their intrinsic high frequency, and within liquids the lateral is more distinct than /-ɹ/. The ranking scale of (21c) states that consonants in the onset are more perceptible than those in the coda. Lastly, the effects of cluster structure are expressed in (21d): in Nasal-Obstruent clusters, the cluster-final obstruent is more distinctive when it is voiceless than when it is voiced (21d-i), and when it is a fricative than when it is a plosive (21d-ii).

(21) Perceptibility scales of English consonants
  (a) Distinctiveness by syllable stress
    $C /V_{[+stress]}$ __ $]_\sigma$ > $C /V_{[-stress]}$ __ $]_\sigma$
  (b) Distinctiveness scale by phoneme category
    Nasal /V__ $]_\sigma$ > Fricative /V__ $]_\sigma$ > Plosive /V__ $]_\sigma$ > /-l/ /V__ $]_\sigma$ >
      /-ɹ//V__ $]_\sigma$
  (c) Distinctiveness scale by segment/cluster position
    $C /_\sigma[$ __ (C) V > C /V (C) __ $]_\sigma$
  (d) Distinctiveness scale by cluster structure
    (i) $C_{[-voice]}$ / VN__ $]_\sigma$ > $C_{[+voice]}$ / VN__ $]_\sigma$
    (ii) Fricative / VN__ $]_\sigma$ > Plosive / VN__ $]_\sigma$

The perceptibility scales in (21) project the rankings of correspondence constraints in Mandarin loanword phonology. The ranking hierarchies of MAX-IO constraints in correspondence to (21) are presented in (22).

(22) Ranking of correspondence constraints
  (a) MXA-IO (C /V$_{[+stress]}$ __ $]_\sigma$) >> MAX-IO (C /V$_{[-stress]}$ __ $]_\sigma$)
  (b) MAX-IO (Nasal Coda) >> MAX-IO (Fricative Coda) >>
    MAX-IO (Plosive Coda) >> MAX-IO (/-l/ Coda) >>
    MAX-IO (/-ɹ/ Coda)
  (c) MAX-IO (Onset C) >> MAX-IO (Coda C)
  (d) (i) MAX-IO (C$_{[-voice]}$ / VN__ $]_\sigma$) >> MAX-IO (C$_{[+voice]}$ / VN__ $]_\sigma$)
    (ii) MAX-IO (Fricative/ VN__ $]_\sigma$) >> MAX-IO (Plosive / VN__ $]_\sigma$)

The position of a segment C on a distinctiveness hierarchy correlates with the position of MAX-IO (C) in the constraint hierarchy. For instance, the dominance of a coda in a stressed syllable over one in an unstressed syllable in the perceptibility scale of (21a) projects the ranking of MAX-IO (C /V$_{[+stress]}$ __]$_\sigma$) >> MAX-IO (C /V$_{[-stress]}$ __]$_\sigma$) in (22a). Hence deletion of a coda is more costly in a stressed syllable than in an unstressed syllable.

Predictions of the rankings in (22) are attested in the English data. For example, the ranking of MAX-IO for different phoneme categories as given in (22b) suggests that if deletion ever occurs in adapting an English coda cluster containing an obstruent and a liquid approximant /ɹ/, the segment that is most likely to be deleted is /ɹ/. The tableau in (23) shows that this prediction is borne out. In "Forbes" > "fu2-bu4-si1" /fu-pu-sz̩/," the ranking of MAX-IO (Fricative Coda) >> MAX-IO (Plosive Coda) >> MAX-IO (/-ɹ/ Coda) leads to the choice of candidate (a), in which only /ɹ/ in the coda cluster is deleted. (For brevity, the tableaux in this section do not include constraints involved in segmental adaptation). Candidates (b)-(d), which contain null correspondents for /b/ and /s/, violate the higher ranking MAX-IO (Fricative Coda) and MAX-IO (Plosive Coda). Candidate (e) fails due to its violation of the undominated σ-STR, in particular, *Complex-Coda. Thus the interaction between different MAX-IO constraints and DEP-IO (V) produces candidate (a) as the winner. (Constraints that are not relevant, e.g. MAX-IO (Nasal Coda), are omitted from the tableau.)

(23) "Forbes" /ˈfɔɹbz/ > "fu2-bu4-si1" /fu-pu-sz̩/

Forbes /ˈfɔɹbz/	σ-STR	MAX-IO (Fric Coda)	MAX-IO (Plos Coda)	DEP-IO (V)	MAX-IO (/ɹ/ Coda)
☞ a) /fu- <> pu-sz̩/				* *	*
b) /fu-ɚ-<> sz̩/			* !	* *	
c) /fu-ɚ-pu-<> /		* !		* *	
d) /fu-<> <> <> /		* !	*		*
e) /fu- <> bs /	* !				*

Similarly, if deletion is employed to simplify a Nasal-Obstruent cluster, the segment subject to deletion may well be the obstruent rather than the nasal. For instance, in the adaptation of "Ashland" (English, company name) > "a1-shi2-lan2 <>" /a-ʂɻ-lan/ *PREF-assorted-orchid*, the cluster-final plosive /d/ is deleted, whereas the cluster-initial /n/ is retained. The adaptation of this word falls out from the ranking of MAX-IO (Nasal Coda) >> MAX-IO (Plosive Coda). As is shown in (24), candidate (a) wins since it is formed by

(24) "Ashland" /ˈæʃlənd/ > "a1-shi2-lan2 <>" /a-ʂɻ-lan/

Ashland /ˈæʃlənd/	σ-STR	MAX-IO (N Coda)	MAX-IO (Plos Coda)	DEP-IO (V)
☞ a) /a-ʂɻ-lan<>/			*	
b) /a-ʂɻ-la-<>tɤ/		* !		*
c) /a-ʂɻ-land/	* !			

creation of an nonsalient segment (/d/) and preservation of a salient segment (/n/). Candidate (b), in which a salient segment is deleted, loses in the competition, and candidate (c) is ruled out due to fatal violation of σ-STR (i.e. *Complex-Coda).

The tableau in (25) illustrates the ranking of MAX-IO (Onset C) >> MAX-IO (Coda C) by "Kroger" (English) > /kʰɤ-luɔ-kɤ/ "ke4-luo2-ge2." This ranking motivates preservation of both segments in the onset cluster, but deletion of the simplex coda. Candidates (c)-(d), in which a constituent of the onset cluster is deleted, incur fatal violations of MAX-IO (Onset C). Furthermore, DEP-IO (V) >> MAX-IO (Coda C) triggers preference for deletion of a coda consonant (rather than vowel epenthesis). Candidate (e) is the worst-formed since it violates the undominated constraints for native syllable structures (i.e. *Complex-Onset). Thus, candidate (a), which derives from deletion of a perceptually weak segment, stands as the best adaptation for "Kroger."

(25) "Kroger" /ˈkɹoʊɡəɹ/ > "ke4-luo2-ge2" /kʰɤ-luɔ-kɤ/

Kroger /ˈkɹoʊɡəɹ/	σ-STR	MAX-IO (Onset C)	DEP-IO (V)	MAX-IO (Coda C)
☞ a) /kʰɤ̠-luɔ-kɤ <>/			*	*
b) / kʰ <> uɔ- kɤ <>/		* !		*
c) /<> luɔ-kɤ-ɚ/		* !		
d) / kʰ <> uɔ-kɤ-ɚ/		* !		
e) /kʰluɔ-kɤ <>/	* !			*

4.8.2 Perceptual similarity and quality of epenthetic vowels

The quality of epenthetic vowels in Mandarin loanword phonology can also be accounted for by perceptual factors. As was seen in §4.7, the inserted vowel usually shares the same place feature as the preceding onset consonant. After a labial plosive or fricative, a [+labial] vowel /u/ is the predominant choice (e.g. in "Gallup" > "gai4-luo4-pu" /kai-luɔ-pʰu/). After alveolar and velar plosives, a [-labial] vowel /ɤ/ is inserted (e.g. in Maytag" (English) > "mei3-tai4-ke4" /mei-tʰai-kʰɤ/). For non-labial fricatives and non-labial affricates, the epenthetic vowels are /z̩/ and /ʐ̩ /, which are respectively the syllabic prolongation of a Mandarin dental and retroflex sibilant (e.g. in "Otis" > "ao4-di2-si1" /aʊ-ti-sz̩/, and "Yuppies" > "ya3-pi2-shi4" /ia-pʰi-ʂʐ̩/). Lastly, a palatal affricate will be resyllabified by a [+palatal] high vowel /i/. Insertion of a vowel that agrees with the preceding consonant in articulatory place enhances the perceptual similarity between the source word and the adapted form.

The requirement for place agreement between an epenthetic vowel and the resyllabified coda can be formulated as a constraint in (26). Since it is rarely violated in Mandarin, this constraint stands at the top of the ranking scale, together with σ-STR. (Exceptional cases, which might result from various non-phonological factors, e.g. the influence of spelling, will not be addressed here.)

(26) DEP-IO (Place): An epenthetic segment cannot have an independent place
feature.

The mechanism of constraint ranking that regulates vowel insertion in Mandarin loan processes is shown in (27) and (28). In both tableaux, candidate (a) stands as optimal since it satisfies all constraints but the lowest one, DEP-IO (V). Candidate (b), which derives from deletion of the plosive coda in the input, is ruled out because it violates the higher ranking MAX-IO (C). Candidate (c) loses due to violation of the undominated DEP-IO (Place), although it satisfies all other constraints

(27) "Gallup" /ˈgæləp/ > "gai4-luo4-pu" /kai-luɔ-pʰu/

Gallup /ˈgæləp/	σ-STR	DEP-IO (Place)	MAX-IO (C)	DEP-IO (V)
☞ a) /kai-luɔ-pʰu̲/				*
b) /kai-luɔ <u>< ></u> /			* !	
c) /kai-luɔ-pʰi̲/		* !		

(28) "Maytag" /ˈmeɪtæg/ > "mei3-tai4-ke4" /mei-tʰai-kʰɤ/

Maytag /ˈmeɪtæg/	σ-STR	DEP-IO (Place)	MAX-IO (C)	DEP-IO (V)
☞ a) /mei-tʰai-k̲ʰɤ̲/				*
b) /mei-tʰai <u>< ></u> /			* !	
c) /mei-tʰai-k̲ʰu̲/		* !		

4.8.3 Free variation of adaptation strategies in the same context

Despite the correlation between frequencies of adaptation processes and various phonological factors, the co-existence of alternative strategies in the same context still awaits explanation. For this, I argue that constraints that are inert in the native phonology but active in loanword phonology can be variably ranked. The alternation between vowel epenthesis and consonant deletion can be accounted for by the free ranking of the two correspondence constraints, MAX-IO (C), which bans consonant deletion, and DEP-IO (V), which penalizes vowel insertion. When MAX-IO (C) ranks higher than DEP-IO (V), vowel epenthesis takes place. When DEP-IO (V) dominates MAX-IO (C), a consonant will be deleted.

The concept of variable constraint ranking is proposed by Boersma and Hayes (2001) to explain both gradual language acquisition and variations. They assume that rankings, which are sometimes stochastic, represent a range of probabilities rather than a fixed point on a ranking scale. At places where the rankings of two constraints are close enough, their ranges of probabilities overlap. Hence, a speaker may have variable productions for the same type of input. A canonical OT analysis, in which constraints are ranked in a fixed order, cannot account for this co-existence of alternative outputs. Thus,

a mechanism of variable constraint rankings captures the feature of language acquisition as a mobile and gradual process as well as allowing for the possibility of different rankings across different times.

Variable constraint ranking has been argued to be the mechanism underlying other types of loanword flexibility (e.g. Ross 1996) and second language acquisition (Broselow 2004). Ross (1996) argues that free constraint orders account for the variability of loan morphology in Tagalog. Broselow (2004) proposes that variable rankings for constraints inactive in the native grammar account for the emergence of universal unmarked structures (e.g. final devoicing) in second language acquisition.

I propose that variability of constraint ranking in Mandarin loanword adaptation results from the lack of the adaptation processes in the native vocabulary. For example, consonant deletion and vowel epenthesis do not participate in native Mandarin phonology. Mandarin speakers do not have exposure to the two processes, and hence do not acquire a fixed ranking of MAX-IO (C) and DEP-IO (V). As a result, the two constraints are randomly ordered in the loan adaptation grammar, which gives rise to the free variation between deletion and epenthesis in the nativization of foreign syllable structures that are incompatible with the native language. [27]

The tableaux in (29) and (30) illustrate the function of this hierarchy. The ranking of MAX-IO (C) >> DEP-IO (V) in (30) triggers vowel epenthesis in the adaptation of "Buick." Thus, candidate (a), /piɛ-kʰɤ/, stands as the optimal output in that it violates only the lowest constraint, DEP-IO (V). Candidate (b), /piɛ- < >/ loses due to its violation of the higher ranking MAX-IO (C). The remaining candidates are ruled out by the undominated DEP-IO (Place) and σ-STR (i.e. NoCoda (Obs)).

(29) "Bui**ck**" /ˈbuɪk/ > "bie2-**ke**4" /piɛ-**kʰɤ**/ (Vowel epenthesis)

Buick /ˈbjuɪk/	σ-STR	DEP-IO (Place)	MAX-IO (C)	DEP-IO (V)
☞ a) /piɛ-k̲ʰɤ/				*
b) / piɛ <̲ >̲/			* !	
c) / piɛ-k̲ʰu̲/		* !		
c) /piɛk̲ʰ/	* !			

---

[27] It needs to be noted that the exact working mechanism of variable constraint order in loanword adaptations (as suggested in this paper) differs somewhat from that in language acquisition (as proposed in Boersma and Hayes 2001). For instance, the motivations are different. In language borrowing, ranking variations arise from arbitrary choice of repair strategies due to the lack of relevant processes in the borrower's native language. But in language acquisition, flexible rankings are a mechanism of constant trial-and-error in the gradual language learning process.

The tableau in (30) shows that a ranking of DEP-IO (V) >> MAX-IO (C) motivates consonant deletion in the adaptation of "Ti**c** Ta**c**". Candidate (a), i.e. /ti-ta/, wins because deletion rather than vowel insertion incurs the least cost. All other candidates, however, violate constraints that dominate MAX-IO (C). [28]

(30) "Ti**c** Ta**c**" /ˈtɪk ˈtæ**k**/ > "di1-da1" /ti-ta/ (Coda deletion)

Tic Tac /ˈtɪk ˈtæk /	σ-STR	DEP-IO (Place)	DEP-IO (V)	MAX-IO (C)
☞ a) /ti <> - ta <> /				**
b) /ti-kʰɤ-ta <> /			* !	*
c) /ti-kʰɤ-ta-kʰɤ/			* ! *	
d) /ti-kʰu-ta-kʰu/		* ! *	* *	
c) /tikʰ-takʰ/	* !			

Free rankings of constraints can also account for the adaptation of /-m/ codas, which are either resyllabified through /u/ insertion or changed to a licit nasal coda /-n/ or /-ŋ/. The two constraints that are variably ranked are IDENT-IO (Place), which mandates preservation of the place feature, and DEP-IO (V), which bans vowel insertion. Since both processes results in segment preservation, MAX-IO (C) ranks higher than DEP-IO (V) and IDENT (Place). When IDENT (Place) dominates DEP-IO (V), vowel insertion will occur. A reverse of this ranking will trigger /-m/ > /-n, -ŋ/.

Variable rankings of IDENT (Place) and DEP-IO (V) in the adaptation of /-m/ codas are shown in (31) and (32). In (31), where "Dodge Ra**m**" /ˈdɑdʒ ˈɹæ**m**/) surfaces as "dao4-qi2-la1-mu3" /taʊ-tɕʰi-la-**mu**/ (*road-wonder-to pull-housekeeper*), the dominance of IDENT (Place) over DEP-IO (V) motivates /u/ epenthesis, and hence the winning of

(31) "Dodge Ra**m**" /ˈdɑdʒ ˈɹæ**m**/ > "dao4-qi2-la1-**mu**3" /taʊ-tɕʰi-la-**mu**/

Dodge Ram /ˈdɑdʒ ˈɹæm/	σ-STR	DEP-IO (Place)	MAX-IO (C)	IDENT (Place)	DEP-IO (V)
☞ a) /taʊ-tɕʰi-la-mu/					* *
b) /taʊ-tɕʰi-la <>/			* !		*
b) /taʊ-tɕʰi-la-mi./		* !			**
b) /taʊ-tɕʰi-lam./	* !				*

---

[28] Alice C. Harris (personal communication, November 30, 2005) pointed out to me that an alternative explanation for the free variations of adaptation processes in the same context might be that the two variably-ranked constraints, e.g. DEP-IO (V) and MAX-IO (C) in (28) and (29), are equally ranked, and that what crucially determines the output might be some lower-ranked constraints. At this stage, I have not been able to find factors that could predict the choice of strategy, so I leave this an issue open for future research.

(32) "Pentiu**m**" /ˈpɛntiəm/ > "ben1-te**ng**2" /pən-tʰəŋ/

Pentium /ˈpɛntiəm/	σ-STR	DEP-IO (Place)	MAX-IO (C)	DEP-IO (V)	IDENT (Place)
☞ a) /pən-tʰəŋ/					*
b) /pən-tʰi-ɤ-<u>mu</u>/				* !	
b) /pən-tʰi-ɤ < >/			* !		
b) /pən-tʰi-ɤ-<u>mi</u>/		* !			
b) /taʊ-tɕʰi-ɤ<u>m</u>./	* !				

candidate (a). In (32), where "Pentiu**m**" /ˈpɛntiəm/ is adapted as "ben1-te**ng**2" /pən-tʰəŋ/ (*to run quickly-to soar*), the ranking of DEP-IO (V) >> IDENT (Place) leads to the change of place feature (rather than vowel epenthesis) as an optimal strategy. Hence, candidate (a) wins, whereas candidate (b) is ruled out.

4.9 Summary

In this chapter, I examined the phonotactic processes in Mandarin adaptation of foreign syllable structures. It was shown that generally vowel epenthesis occurs more frequently than consonant deletion (except in the case of "l, r"). In addition, I investigated the influence of various phonological contexts on the alternation between adaptation strategies. It was found that the frequencies of segment deletion (vs. preservation) correlate with certain segmental and contextual factors.

To account for phonotactic patterns in Mandarin loanword phonology, I proposed an OT analysis from a perceptual perspective. Differential preference for segment deletion vs. preservation in various contexts is explained by the differential perceptibility of the source structures in those contexts. Place agreement between an epenthetic vowel and the preceding consonant is argued to be triggered by a constraint DEP-IO (Place), which bans epenthetic segments for having an independent place feature. For the free variations between preservation and deletion, I argued that the constraints motivating these repair processes have variable rankings.

Chapter 5
Perceptual Similarity and Online Loan
Perception and Adaptation

5.1 Introduction: Goal and design

In Chapters 3 and 4, I presented an analysis of the general patterns and variability of Mandarin loanword processes found in the corpus data. The major claim is that loanword phonology is constrained by the degree of phonological/phonetic similarity between the foreign source word and the adapted form. The borrower creates a loan that shares adequate (although not always the greatest) similarity with the source form. Perceptual similarity limits the possible distance (or variability) between the foreign origin and the Mandarin output.

To examine the validity of these claims about the role of perceptual similarity, three experiments were conducted. The goal was to investigate whether online perception and adaptation of solicited loans conform to the adaptation patterns observed in the corpus data. Two hypotheses were to be tested. One is that an adaptation process is employed for the very reason that it can create a loan that shares great perceptual similarity with the source form. The other is that the form perceived as most similar to the source word will also be the form actually produced in adaptation.

The particular phonological structure used to test the hypotheses was the English monosyllabic C_1VC_2 construction, where C_2 is an oral stop. The target of investigation was how Mandarin speakers nativize the C_2 coda. The stimuli were either existing or hypothetical English words (see Appendix VI. Table B).

To minimize the interference of semantic factors, tokens were presented to participants as English place names (see Appendix VII). This design was based on the findings in Chapters 3 and 4 that variations in both segmental and phonotactic adaptations occur less frequently with words that are less likely to be adapted with semantic associations, e.g. place names and person names as opposed to brand names and company names (see §3.3.8 and §4.3.4).

In this chapter, I will present the results of the experiments and revisit the analysis developed in Chapters 3 and 4. In §5.2, the three experiments, including methodology and results, will be discussed in detail. General discussion will be given in §5.3, which will show that the experimental results conform to the patterns observed in the corpus data and that an analysis based on perceptual similarity is a tenable approach to loanword phonology.

5.2 Experiments

The three experiments were conducted in May and June 2005. (The project was approved by IRB, State University of New York at Stony Brook, on April 6, 2005; Project ID: 20055746.) Experiment One was a perception task, in which the participants evaluated the similarity between the English tokens and candidate Mandarin renditions. Experiment Two tested online adaptation of English words, by asking the participants to produce adapted forms in Mandarin Pinyin. Experiment Three was similar to Experiment Two, except that the adapted forms were solicited in the form of Chinese characters. The experiments were divided into two sessions, which were at least one week apart, depending on the participants' schedules. In the first session, Experiment One was conducted, and in the second, Experiments Two and Three.

5.2.1 Experiment One: Perception (Similarity judgment)

The purpose of this experiment was to investigate Mandarin speakers' perception of the degree of similarity between a foreign word and its alternative Mandarin adaptations. It was expected that the similarity ranking of the different types of adapted form will conform to the relative frequency of those patterns in the corpus data. In other words, if in the corpus data an adaptation process A occurs more frequently than a process B, then in this experiment, a Mandarin candidate form created by process A is expected to be perceived as more similar to the source form than a candidate created by process B.

Findings in Chapters 3 and 4 show the dominance of faithful voice/aspiration mappings in phoneme substitution and the preference for vowel epenthesis as a strategy to repair illicit syllable structures. The faithful mappings of plosives are for a voiceless sound in the source form to be mapped to a Mandarin aspirated plosive, and for a foreign voiced sound to be replaced by a Mandarin unaspirated plosive. These mappings account for 89.74% of /-p, -t/ codas, 93.75% of /-b, -d/ codas, and 88.24% /-k/ and 66.67% /-g/ codas in the corpus data (see Table 3.1 in §3.3.1). In the adaptation of simplex plosive codas, vowel epenthesis constitutes 75.62% of all coda instances, while consonant deletion occurs less frequently (20.90%). Change of a plosive coda to a nasal coda almost never occurs (see Table 4.2 in §4.3.1).

Based on these findings, specific predictions for the experiment are the following: English C_1VC_2 forms with codas /-p, -t, -k/ will be judged most similar to candidate Mandarin forms $C_1VC_2V_\emptyset$ that contain an aspirated /p^h, t^h, k^h/ sound as C_2 and an epenthetic vowel ($V_\emptyset$) after this sound. English tokens with /-b, -d, -g/ codas will be rated most similar to Mandarin candidates that contain an unaspirated /p, t, k/ sound as C_2 followed by an epenthetic vowel.

Method

Participants. Ten adult Mandarin-English bilinguals (4 males and 6 females) volunteered to participate in the experiment. They were native Mandarin speakers born in Mainland China and with normal hearing. At the time of the experiment, the participants had lived in an English-speaking country for at least two academic or calendar years,

ranging from 2 to 7 years (mean = 3 years and 8 months). All were graduate students at the State University of New York at Stony Brook.

Stimuli. The stimuli were 88 pairs of tokens, each pair consisting of a hypothetical English place name and a candidate Mandarin adapted form (see Appendix VI. Table B). The English tokens all fit a monosyllabic C_1VC_2 template, where C_1 = /l/ or /m/, V = /i/ or /ʌ/, and C_2 = any plosive (i.e. /p, b, t, d, k, g/) (e.g. /lit/ and /mʌd/). The total of English forms was 24 (2 onsets x 2 vowels x 6 codas). Each token appeared 3 or 4 times in the stimuli to pair up with different candidate Mandarin forms. For example, the token /lip/ appeared three times in the stimuli, each time paired with a candidate Mandarin rendition, namely /lip/ ~ /li pʰu/, /lip/ ~ /li pu/, /lip/ ~ /li/.

The Mandarin tokens and the processes through which they were formed are listed in (1). The epenthetic vowel in all tokens shared place features with the preceding consonant (i.e. labial /u/ after labial stops, and non-labial /ɤ/ after alveolar and velar stops).

(1) Structures of Mandarin tokens and adaptation processes

(a) $C_1V\mathbf{C_2V_ø}$ (Faith), where C_2 is segmentally realized with <u>faithful</u> mapping from
  English voice to Mandarin aspiration features AND is resyllabified through
  vowel epenthesis.
  Process: V-Epen (Faith)
  Token forms: /$C_1V\mathbf{p}$/ > /C_1V $\mathbf{p^h}$u/, /$C_1V\mathbf{t}$/ > /C_1V $\mathbf{t^h}$ɤ/, /$C_1V\mathbf{k}$/ > /$C_1V\mathbf{k^h}$ɤ/
  /$C_1V\mathbf{b}$/ > /C_1V $\mathbf{p}$u/, /$C_1V\mathbf{d}$/ > /C_1V $\mathbf{t}$ɤ/, /$C_1V\mathbf{g}$/ > /C_1V $\mathbf{k}$ɤ/

(b) $C_1V\mathbf{C_2V_ø}$ (Dev), where C2 is segmentally realized with <u>deviant</u> mapping from
  English voice to Mandarin aspiration features AND is resyllabified
  through vowel epenthesis.
  Process: V-Epen (Dev)
  Token forms: /$C_1V\mathbf{p}$/ > C_1V $\mathbf{p}$u/, /$C_1V\mathbf{t}$/ > /C_1V $\mathbf{t}$ɤ/, /$C_1V\mathbf{k}$/ > /C_1V $\mathbf{k}$ɤ/
  /$C_1V\mathbf{b}$/ > /C_1V $\mathbf{p^h}$u/, /$C_1V\mathbf{d}$/ > /C_1V $\mathbf{t^h}$ɤ/, /$C_1V\mathbf{g}$/ > /C_1V $\mathbf{k^h}$ɤ/

(c) C_1V, where C_2 is deleted.
  Process: C-Del
  Token forms: /$C_1V\mathbf{p}$/ > /C_1V/, /$C_1V\mathbf{t}$/ > /C_1V/, /$C_1V\mathbf{k}$/ > /C_1V/
  /$C_1V\mathbf{b}$/ > /C_1V/, /$C_1V\mathbf{d}$/ > /C_1V/, /$C_1V\mathbf{g}$/ > /C_1V/

(d) $C_1V\mathbf{N}$, where a final nasal /n/ or /ŋ/ is the respective Mandarin substitute for an
  English alveolar or velar stop (/n/ for /t, d/, and /ŋ/ for /k, g/).
  Process: Nasalization
  Token forms: /$C_1V\mathbf{t}$/ > /C_1Vn/, /$C_1V\mathbf{k}$/ > /C_1Vŋ/
  /$C_1V\mathbf{d}$/ > /C_1Vn/, /$C_1V\mathbf{g}$/ > /C_1Vŋ/

English tokens ending with a bilabial stop had three candidate Mandarin renditions, i.e. in the structures of (1a) - (1c), and those ending with a final alveolar and velar stop had four Mandarin forms, i.e. in the structures of (1a) - (1d). The total number of pairs was 88, including 24 corresponding to English words ending with a bilabial stop (2 onsets x 2 vowels x 2 bilabial stops x 3 candidate Mandarin forms) and 64 corresponding to those

ending with an alveolar or velar stop (2 onsets x 2 vowels x 4 stops x 4 candidate Mandarin forms).

In addition to the 88 target pairs discussed above, there were 5 trial pairs and 24 filler pairs (see Appendix VI, Table A & C). The English forms in the trial and filler pairs were of CV, CVm and CVn structures, where C = /s, h, f, p, b, t, d, n/, and V = /aɪ, eɪ/. The Mandarin correspondents for the English fillers were respectively CV (for English CV), /CV + mu/ (for English CVm), and CVn (for English CVn). All trial and filler items occurred only once in the stimuli.

For the purpose of the experiment, the tokens were digitally recorded in a quiet room at a sampling rate of 16 kHz, by use of Computerized Speech Laboratory (CSL) Model 4300 and a Sennheiser E815-S microphone. The English tokens were read by an adult native speaker of American English, and the Mandarin tokens by an adult native speaker of Mandarin born in Mainland China. Both readers were male. The English speaker was asked to read with a falling tone and to release the final stops. The Mandarin speaker was asked to read monosyllabic tokens (e.g. /ma/) with a fourth tone, and disyllabic forms (e.g. /ma tɤ/) with a fourth tone followed by a third tone. In this way, the interference of prosodic features was minimized although it was hardly possible to eliminate it entirely.

Recorded utterances were edited and synthesized into wave files by Praat (version 4.3.02), according to the specific needs of the experimental tasks. The inter-pair interval was 7 seconds. Each pair of stimuli was cued by a serial number read by the same person who produced the English tokens.

Procedure. The participants were tested individually in a sound-attenuated chamber in the Phonetics Lab of the Department of Linguistics, State University of New York at Stony Brook. The stimuli were presented through Sony MDR-CD380 headphones. Before the experiment began, the participants were asked to read the task instructions (Appendix VII: Task One) and were trained with 5 trial pairs. The participants were asked to judge the similarity between the two words in each pair by choosing from three categories: a) Similar; b) Somewhat similar; and c) Not similar. In the practice session, they were given clarifications whenever requested. The task instructions and choice items were given on paper. The participants answered on paper as well. During the experiment, the author monitored presentation of the stimuli through Koss SB-40 headphones.

Predictions

With regard to segmental adaptations, it was predicted that a Mandarin form of type (1a), i.e. $C_1VC_2V_{\emptyset}$ (Faith), would receive a higher similarity rating than a form of (1b) type, i.e. $C_1VC_2V_{\emptyset}$ (Dev). This is based on analyses of the corpus data presented in Chapter 3, which revealed that the preferred mappings of stops is for a foreign voiceless stop to be replaced by a Mandarin aspirated stop (e.g. /t/ > /tʰ/), and a foreign voiced stop to be replaced by a Mandarin unaspirated stop (e.g. /d/ > /t/).

As for phonotactic adaptation, it was expected that the Mandarin tokens formed by vowel epenthesis, i.e. (1a) and (1b), would be perceived as more similar to the English source words than a token of type (1c), i.e. C_1V (created by C-Del). The form of (1d), i.e. C_1VN (formed by Nasalization) would be rated the least similar. These predictions are based on the findings in Chapter 4, which showed that vowel epenthesis generally is preferred over consonant deletion in resolving illicit syllable structures, and that for

plosive codas, only vowel epenthesis and consonant deletion are observed, and that nasalization of a plosive coda never occurs.

Incorporating these predictions, we can postulate a similarity ranking formulated in (2a) for the different Mandarin tokens, and a ranking of (2b) for the correspondent processes in term of their contribution to the perceived similarity between the English form and a Mandarin rendition.

(2) (a) Predicted similarity hierarchy of Mandarin tokens

$C_1VC_2V_\emptyset$ (Faith) > $C_1VC_2V_\emptyset$ (Dev) > C_1V > C_1VN

(b) Predicted similarity hierarchy of adaptation processes

V-Epen (Faith) > V-Epen (Dev) > C-Del > Nasalization

Results and discussion

To get a general picture of the subjects' answers, the three similarity categories were assigned a score of 1-3 in an ascending order of similarity, with "1" standing for "Not similar," "2" for "Somewhat similar" and "3" for "Similar." The results thus derived are displayed in Figure 1, which presents the average score of the Mandarin tokens by type of adaptation process. The higher the score a token type received, the more similar to the English source form it was perceived as.
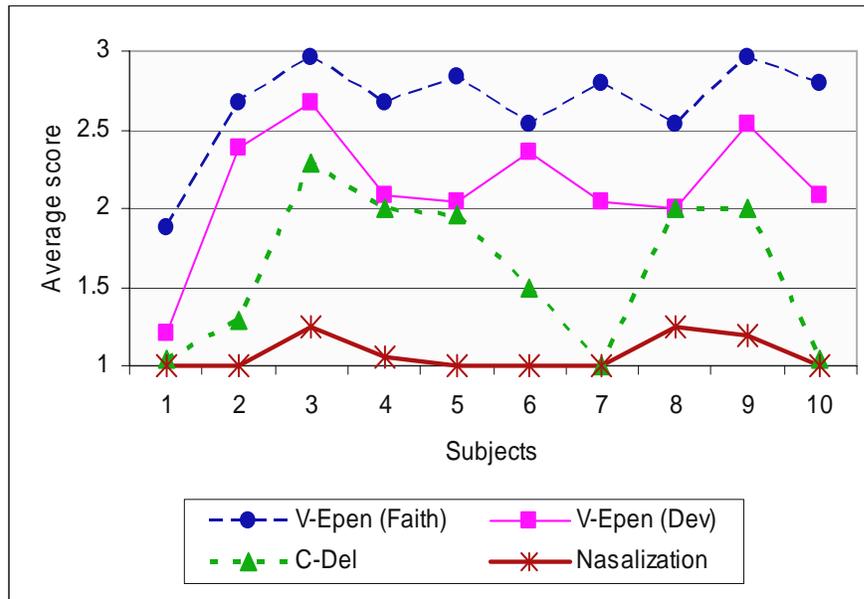

Figure 5.1. Average similarity scores of Mandarin tokens

The chart shows that for all participants, the order of similarity scores is "V-Epen (Faith) > V-Epen (Dev) > C-Del > Nasalization." This means that for an English word of C_1VC_2 structure, vowel insertion following a faithfully adapted coda consonant (in terms of voice/aspiration mapping) created the phonologically optimal (or most similar) rendition in Mandarin (e.g. /li**t**/ > /li **tʰɤ**/, and /mʌ**d**/ > /ma tɤ/). The process that

generated the second most faithful adaptation was vowel insertion following an adapted coda with deviant voice/aspiration mapping (e.g. /lit/ > /li tɤ/, and /mʌd/ > /ma tʰɤ/). The form that was perceived as the third most similar was a form deriving from consonant deletion (e.g. /lit/ > /li/, and /mʌd/ > /ma/). Loans created by nasalization of the stop coda led to the least similar adaptation (e.g. lit/ > /lin/, and /mʌd/ > /man/).

Despite differences in the absolute numerical score between participants, the order of perceived similarity holds true within the choices of each individual. For example, the average similarity scores assigned by Subject 1 to all token types were lower than the respective scores assigned by Subject 2. However, the order of the token type in terms of perceived similarity showed the same pattern, i.e. V-Epen (Faith Asp) > V-Epen (Dev Asp) > C-Del > Nasalization.

The results from this experiment are consistent with the findings from the corpus data. Firstly, Mandarin speakers demonstrate higher preference for vowel epenthesis than for consonant deletion in resolving illicit syllable structures. As is shown in Figure 5.1, the two types of Mandarin tokens formed by vowel epenthesis both received higher similarity scores than did tokens created through consonant deletion. This suggests that vowel insertion is a less costly phonotactic strategy than segment deletion. The finding conforms to the results from the corpus data, which indicate that vowel epenthesis (V-Epen) occurs much more frequently than consonant deletion (C-Del) in Mandarin adaptations of foreign simplex plosive codas (except when the coda is an "r-" sound). As was seen from Table 4.2 in §4.3.1, the frequencies of V-Epen vs. C-Del are respectively 64.12% (84/131) vs. 31.30% (41/131) for English simplex plosive codas, 97.01% (65/67) vs. 1.49% (1/67) for German ones, and 100% (3/3) vs. 0% (0/3) for Italian ones.

Secondly, voice/aspiration features are more susceptible to change than manner features like nasality. In this experiment, Mandarin tokens of the "V-Epen (Dev)" pattern contrast sharply with tokens of the "Nasalization" pattern, with the former perceived as the second closest to the English source form, and the latter perceived as the least close. Similarly, the phoneme substitution patterns examined in §3.3.1 show that unfaithfulness in voice/aspiration (along with vowel insertion) does occur, but change in nasality rarely does. It was shown in Table 3.1 that deviant voicing/aspiration realizations of simplex plosive codas constitute respectively 4.76% (4/84), 18.46% (12/65), and 0% (0/3) of the vowel insertion instances in the English, German and Italian data. In contrast, substitution of a Mandarin nasal for a foreign obstruent coda is observed in only 1/131 (0.76%) cases in English simplex plosive codas, and none in the German and Italian data (see Table 4.1 in §4.3.1). These findings suggest that deviant realizations of consonantal voicing/aspiration are more tolerable than changes in nasality, at least for plosives (also §3.4.2).

5.2.2 Experiment Two: Online adaptation (Pinyin)

If the similarity ranking of different adapted forms/processes observed in Experiment One holds, a further question to ask is whether Mandarin speakers apply this perceptual knowledge to real adaptation practice. In other words, it needs to be investigated whether the Mandarin form that is perceived as most similar to the source pronunciation will also be the form that is most frequently produced. To answer this question, Experiment Two

solicited loans adapted online in the form of Mandarin Pinyin without tonal value, e.g. "li pu" (/li pʰu/) < /lip/. In the Pinyin system, sounds and tones are represented separately. For example, in "pū" and "pǔ" the segments are identical (i.e. "pu" /pʰu/), and the diacritics indicate different tonal values. It was expected that in adapting English words into Pinyin forms without tone assignment, Mandarin speakers would have phonological closeness as the only factor to consider. Potential interference of semantic factors associated with the nature of the Chinese ideographic script could be minimized or avoided. Thus, it was predicted that the solicited loans would have a form that is rated highly similar to the source words.

Method

Participants. The participants were the same 10 Mandarin speakers who participated in Experiment One.

Stimuli. The stimuli consisted of 36 English tokens, including 24 target tokens and 12 fillers (See Appendix VI. Table E-F). The target tokens were the same as the English target tokens in Experiment One. The fillers were half of the English fillers in Experiment One. (The other half were used as fillers in Experiment Three.)

The English recordings used for Experiment One served as stimuli tokens. Recorded utterances were edited and synthesized into wave files by Praat (version 4.3.02). The interstimulus interval (ISI) was 8 seconds. Each token was cued by a serial number read by the same speaker who produced the English tokens.

Procedure. The experiment was conducted with the same equipment used in Experiment One. Before the experiment began, the participants were asked to read the task instructions (Appendix VII: Task Two) and were trained with 5 trial items (Appendix VI. Table D). The participants were asked to listen to the English stimuli and write down their own renditions for the English tokens in Pinyin. They were informed that they did not need to give tones for the Pinyin forms. In the practice session, they were given clarifications whenever requested. During the experiment, the author monitored presentation of the stimuli through Koss SB-40 headphones.

Predictions

If perceptual similarity determines phonological adaptations, it was predicted that the solicited loans in this experiment would all be in a structure that was perceived as highly similar to the source word. In view of the results from the similarity judgment task in Experiment One as well as the findings in Chapters 3 and 4, the expected form should be $C_1VC_2V_{\text{ø}}$ (Faith Asp), which is created by vowel insertion and faithful voice-aspiration mapping for C_2. For example, English tokens like /li**p**/ and /mʌ**d**/ are most likely to be adapted as /li **pʰu**/ and /ma **tɤ**/ respectively. Furthermore, if variations do occur, the alternative form is most probably $C_1VC_2V_{\text{ø}}$ (Dev Asp), which derives from vowel insertion and a deviant voice-aspiration mapping for C_2. Other process such as consonant deletion and nasalization, which respectively trigger C_1V and C_1VN forms, will not be used.

Results and discussion

    Answers from 9 out of the 10 participants served as valid data. Data from the other participant (Subject 6), who lost track of the order of the stimuli, were excluded. Results from this experiment reveal three patterns. Firstly, vowel insertion was the only phonotactic strategy used by the participants. The solicited Mandarin Pinyin forms were all of a $C_1VC_2V_\emptyset$ type, whereas consonant deletion and nasalization were never used. Secondly, the epenthetic vowels in the Mandarin forms agreed with the preceding consonant in terms of [+/- labial] place features. It can be seen in Table 5.1 that the vowel after a bilabial stop is mostly /uɔ/ ("o" in Pinyin) and sometimes /u/ ("u" in Pinyin), and that after an alveolar or velar stop, the inserted sound is uniformly /ɤ/ ("e" in Pinyin).

Table 5.1. Epenthetic vowels (Solicited loans in Pinyin)

English Coda	Mandarin Epenthetic V		Total	
			n	%
/-p, -b/	u	/u/	8	11.11%
	o	/uɔ/	64	88.89%
/-t, -d/	e	/ɤ/	72	100.00%
/-k, -g/	e	/ɤ/	72	100.00%

Thirdly, segmental nativization displayed variability in the mapping of voice-aspiration features, but never in other features (e.g. nasality). As is shown in Table 5.2, the only type of variation was that English voiceless stops were alternatively realized as Mandarin aspirated and unaspirated stops. For instance, the participants adapted 50% of English /-p/ codas as a Mandarin aspirated /pʰ/, and the other 50% as an unaspirated /p/. There was a significant place effect on the variability, with labial stops being more likely to have variant outputs than alveolar and velar stops. Such a place effect is not seen in the corpus data, and the reason for its presence this experiment is not clear. In addition, no respondent gave any alternative adaptations for the three voiced stops. (See in §5.3 for discussions on these place and voicing effects in comparison with the corpus data.)

Table 5.2. Variability of segment mapping (Solicited loans in Pinyin)

English		Mandarin Output				Total
Place	Phoneme	[+asp] Stop		[-asp] Stop		
Labial	/-p/	18	(50.00%)	18	(50.00%)	36
Coronal	/-t/	32	(88.89%)	4	(11.11%)	36
Velar	/-k/	33	(91.67%)	3	(8.33%)	36

Fisher's exact test (2-tailed): /-p/ vs. /-t/: $p < 0.001$; /-p/ vs. /-k/: $p < 0.001$;
/-t/ vs/ -k/: $p = 1.000$

    The results from this experiment confirmed the prediction that the solicited loan forms would have the same structure as the Mandarin tokens that received high similarity ratings in Experiment One. The Mandarin candidate forms that received highest similarity scores in Experiment One were those formed by vowel insertion plus a faithful

substitute for the English final coda. In this experiment, the most frequent forms produced by the participants also derive from vowel insertion along with faithful adaptation of the English plosive codas (e.g. /mʌt/ > /ma tʰɤ/). Furthermore, variations are possible, but constrained: Unfaithful realization of voice/aspiration features is tolerable, but change of manner features like sonorancy and nasality is resisted (e.g. /mʌt/

> /ma dɤ/, */man/). These results support the claim that perceptual similarity is a crucial force in loanword phonology in that the borrower adapts a foreign word into a form that is perceived as similar to the foreign pronunciation.

5.2.3 Experiment Three: Online adaptation (Chinese characters)

Since full nativization of foreign loans in Mandarin involves graphic integration into the logographic writing system of Chinese, it is necessary to investigate whether phonological adaptations based on perceptual similarity will be influenced by orthographic factors. Two types of results were predicted. One was that the solicited loans in this experiment would show the same phonological pattern as the solicited Pinyin forms in Experiment Two, that is, Mandarin speakers would create an adapted form that is perceived to be of greatest similarity to the source words. Semantic considerations as related to the choice of a particular Chinese character out of an inventory of homophones were predicted not to play a significant role in this experiment, considering that the tokens were presented to the respondents as place names, and hence the possibilities for a borrower to choose a certain character purposely for special semantic effects are much lower (as opposed to the adaptation of brand names and company names).

The other prediction is that variations in the Chinese character forms would exist even if an English token was adapted into the same phonological form (pronunciation) in Mandarin. To assign a written form to a loan inevitably commits the participants to the choice of a particular character (and meanwhile a morpheme) among an inventory of homophonous graphs, despite the presence or absence of semantic considerations. Hence, differences in the written forms were expected to occur in that participants might make different decisions on which character to use.

Method

Participants. The participants were the same 10 Mandarin speakers who were tested in Experiment One and Experiment Two.

Stimuli. The stimuli consisted of 36 English tokens, including 24 target tokens and 12 fillers (see Appendix VI. Table E-F). The target tokens were the same as the English target tokens in Experiment One and Experiment Two. The fillers were half of the English fillers in Experiment One. (The other half were used as fillers in Experiment Two.)

The English recordings used for Experiment One served as stimuli tokens. Recorded utterances were edited and synthesized into wave files by Praat (version 4.3.02). The interstimulus interval (ISI) was 11 seconds. Each token was cued by a serial number read by the same speaker who produced the English tokens.

Procedure. The experiment was conducted with the same equipment used in Experiments One and Two. Before the experiment began, the participants were asked to read the task instructions (Appendix VII: Task Three) and were trained with 5 trial items (Appendix VI. Table D). In the practice session, they were given clarifications whenever requested. The participants were asked to listen to the English stimuli and to write down their own renditions for those tokens in Chinese characters. During the experiment, the author monitored presentation of the stimuli through Koss SB-40 headphones.

Predictions

It was predicted that the solicited adaptations written in Chinese characters would demonstrate phonological patterns similar to the Pinyin forms in Experiment Two. The most frequent answers were expected to be of the $C_1VC_2V_\emptyset$ (Faith Asp) type (e.g. /mʌt/ > /ma t^hɤ/), and possible variants are of the $C_1VC_2V_\emptyset$ (Dev Asp) type (e.g. /mʌt/ > /ma tɤ/). Other processes (e.g. consonant deletion and nasalization) which would result in forms perceived as barely similar to the source forms (e.g. C_1V and C_1VN) would be rarely or never used. Furthermore, due to the abundance of homophonous characters in the Chinese writing system, variant graphic outputs for a single pronunciation were expected in the answers.

Results and discussion

The Mandarin forms produced by 9 out of the 10 participants were analyzed. (Subject 6, the same subject whose answers were excluded from discussions in Experiment Two, was also dismissed from this experiment for convenience of comparison between the two experiments.) The results bore out the predictions about the phonological structures and the graphic variability of the solicited forms. Firstly, the phonotactic and segmental adaptations demonstrated the same pattern as those in Experiment Two. All participants employed vowel epenthesis unexceptionally. The epenthetic vowels in the answers all agreed with the preceding consonant in [+/- labial] place features: a labial vowel was inserted after a labial stop, and a non-labial vowel /ɤ/ after an alveolar or velar stop (see Table 5.3).

Table 5.3. Epenthetic vowels (Solicited loans in Chinese characters)

English Coda	Mandarin Epenthetic V		Total	
			n	%
/-p, -b/	u	/u/	11	15.28%
	o	/uɔ/	61	84.72%
/-t, -d/	e	/ɤ/	72	100.00%
/-k, -g/	e	/ɤ/	72	100.00%

Segmental nativization displayed a similar type of variation as that in Experiment Two. The only feature that was susceptible to alternative mapping was voicing/aspiration in the adaptation of English voiceless stops (see Table 5.4). For instance, English coda /p/ was sometimes replaced by Mandarin aspirated stop /p^h/ (36.11%) and other times by

unaspirated /p/ (63.89%). Place has a significant effect on the variability of segmental substitution in that bilabial /-p/ displayed a much higher frequency of variation than alveolar and velar stops. Furthermore, no variant mappings for voiced codas were observed.[29] (See in §5.3 for discussions on the place and voicing effects in comparison with the corpus data.)

Table 5.4. Variability of segment mapping (Solicited loans in Chinese characters)

English		Mandarin Output				Total
Place	Phoneme	[+asp] Stop		[-asp] Stop		
Labial	/-p/	13	(36.11%)	23	(63.89%)	36
Coronal	/-t/	31	(86.11%)	5	(13.89%)	36
Velar	/-k/	34	(94.44%)	2	(5.56%)	36

Fisher's exact test (2-tailed): /-p/ vs. /-t/: $p < 0.001$; /-p/ vs. /-k/: $p < 0.001$;
/-t/ vs/ -k/: $p = 0.429$

Secondly, the prediction that a single loan may be assigned different written forms was confirmed. As is shown in Table 5.5, the participants chose different Chinese characters although they produced the same Mandarin syllable in the solicited loan forms. For example, an English bilabial stop /b/ was sometimes adapted as "bo" /puɔ/, through vowel epenthesis and a mapping of English [-voice] feature to Mandarin [-aspirated] feature for /b/. The graphic form for this particular syllable, however, demonstrated great flexibility. A total of five different characters were observed in the answers, including 勃 "bo2" *vigorous*, 卜 "bo0" *raddish*, "bo2" 博 *abundant*, 波 "bo1" *wave*, and "bo2" 伯 *uncle*. Since this study focuses on phonological processes in loan adaptation, the mechanism of the graphic adaptation of loanwords in Mandarin will not be investigated in detail, but rather left for future research.

---

[29] There is one instance of English /g/ being adapted into Mandarin /tʰ/. The reason for this is not clear. It is possibly due to a slip of the pen. Since this mapping occurs only once and in one subject only (Subject 7), it is treated as an exception.

Table 5.5. Graphic variability of phonemic loans

English Coda	Mandarin			
	Pinyin		Character	Gloss
/-p, -b/	pu	pu3	普	universal
		pu3	浦	water bond
		pu2	仆	servant
	po	po1	坡	slope
		po4	破	broken
		po2	婆	old woman
	bu	bu4	布	cloth
	bo	bo2	勃	vigorous
		bo0	卜	radish
		bo2	博	abundant
		bo1	波	wave
		bo2	伯	uncle
/-t, -d/	te	te4	特	special
	de	de2	德	virtue
		de2	得	get
		de0	的	POSSESSIVE
/-k, -g/	ke	ke4	克	conquer
		ke1	科	branch of study
		ke3	可	feasible
	ge	ge2	格	square
		ge4	各	each
		ge1	哥	elder brother
		ge4	个	MEASUER WORD
		ge2	葛	plant name

5.3 General discussion

In general, results from the three experiments are consistent with the analysis of the corpus data. First, the preference for vowel insertion over consonant deletion as a phonotactic process to resolve illicit codas is observed in both the corpus loans and in the experiments. Analysis of the corpus data shows that V-Epen and C-Del account for 64.12% and 31.30% of simplex plosive codas, respectively, in the English loans (see Table 4.1 in §4.3.1). In the three experiments discussed above, Mandarin tokens of V-Epen type (i.e. $C_1VC_2V_{\emptyset}$) were either rated as most similar to English C_1VC_2 forms (Experiment One) or uniformly produced by all participants in the production tests

(Experiments Two and Three). These findings support the ranking of MAX >> DEP, which renders vowel insertion more tolerable than coda deletion. Second, place agreement between epenthetic vowels and the preceding consonant in both online adaptations (Experiment Two and Experiment Three) and the corpus data corroborate the proposal in Chapter 4 that DEP (V-Place) is undominated in Mandarin loan adaptations. Lastly, the experimental results support the claim in Chapter 3 that faithful realization of a manner feature is of greater importance than faithfulness to a voice/aspiration feature. This confirms the ranking of IDENT (Manner) >> IDENT (Voice/aspiration), which renders change in voice/aspiration more tolerable than change in nasality (e.g. / mʌd/ >

/ma tɤ/ or /ma tʰɤ/, */man/).

The same constraint rankings proposed in Chapters 3 and 4 can account for the online adaptation patterns shown in the experiments. Tableaux in (3) and (4) illustrate how the interaction between well-formedness constraints and faithfulness constraints functions to nativize an English word into Mandarin. In both examples, candidate (a), which violates only the lowest ranking constraint DEP (V), stands as the optimal output. Candidate (b), which fails to satisfy DEP-IO (V) and IDENT (Voice/Asp), is the second best form. This suggests that it will occur less frequently than (a) as the adapted form for the English input. Furthermore, candidate (b), although not as good as form (a), fares much better than other candidates. Thus, it is predicted that when variant adaptations arise, (a) and (b) are better alternative outputs than the rest.

(3) /lip/ > /li pʰu/, /li pu/

/lip/	σ-STR	DEP-IO (Place)	IDENT (Manner)	MAX-IO (C)	DEP-IO (V)	IDENT (Voice/Asp)
☞ a) li pʰu					*	
👆 b) li pu					*	*
c) li < >				* !		
d) li mu			* !		*	
e) li pʰi		* !			*	
f) lim	* !		* !			

(4) /mʌt/ > /ma tʰɤ/, /ma tɤ/

/mʌp/	σ-STR	DEP-IO (Place)	IDENT (Manner)	MAX-IO (C)	DEP-IO (V)	IDENT (Voice/Asp)
☞ a) ma tʰɤ/					*	
👆 b) ma tɤ/					*	*
c) ma < >				* !		
d) man			* !			
e) ma tʰi		* !			*	

In addition to phonological adaptations, graphic variability for a single loan as seen in Experiment Three is also consistent with the multiple adaptations in the corpus data (see discussions in §2.2.5). The participants in the experiment used variant characters to

represent the same syllable. For example, the syllable "ge" /kɤ/ was written alternatively as five different characters, i.e. 格 "ge2" *square*, 各 "ge4" *each*, and 哥 "ge1" *elder brother*, 个 "ge4" *MEASURE WORD*, 葛 ge2" *plant name*. Similarly, the corpus data contain some words that have variant written forms as well (Appendix IV). For instance, the English word "Aids" (name of a disease) has two alternative forms of the same pronunciation, i.e. ai-zi1-bing4" (/ai-tsz̩-piŋ/), written either as 爱滋病 (love-develop-[disease]) or as 艾滋病 (plant name-develop-[disease]). [30]

The experimental results differ from the corpus data in several respects. One is that in the experiments, vowel epenthesis was employed as the only phonotactic strategy. In the corpus data, however, English obstruent codas undergo either vowel epenthesis or consonant deletion (e.g. 64.12% for vowel epenthesis vs. 31.30% for consonant deletion in the case of simplex plosive codas). This difference may be due to the design of the experiment. The experiment stimuli were all read in careful citation form and with clear release of the final stop. Thus, the participants in the experiments could hear each stimulus clearly, which led to the uniform choice of vowel insertion. Loans in the corpus, however, are adapted in real life situations, where diverse factors may interfere with the borrower's perception of the source form. Moreover, all experimental tokens were hypothetical place names, for which deletion is less likely to occur than in other types of words (e.g. brand names and company names) (§4.3.4).

The other difference between the experimental results and the corpus data lies in the relative frequencies of /u/ and /uɔ/ as epenthetic vowels used to resyllabify labial codas. In both Experiment Two and Experiment Three, the Mandarin participants used /uɔ/ much more frequently than /u/, i.e. 88.89% vs. 11.11% in Experiment 2, and 84.72% vs. 15.28% in Experiment 3) (see §5.2). In the corpus loans, however, /u/ constitutes a much higher proportion (81.48%) than /uɔ/ (11.11%) (see Table 4.27 in §4.7). What underlies this difference may also be the design of the experiments, in which the stimuli were read with careful release of the final stop. Stop release, if strong enough, is perceptually very similar to a vowel (e.g. Parker 1977). In particular, it may sound like a mid or mid-high vowel. Thus, the insertion of /uɔ/, a less rounded and lower vowel than /u/, rendered greater similarity between the source pronunciation and the adapted form. In contrast, the loans in the collected corpus are existing words adapted under various conditions. The source forms (either written or oral) that serve as the basis for adaptation could not be controlled.

Lastly, variations in segmental mapping displayed significant effects of voicing and place. In Experiments Two and Three, only voiceless stops were adapted alternatively into Mandarin as [+asp] and [-asp] stops, but none of the voiced stops were. Moreover, among the three voiceless stops, bilabial /-p/ was adapted with variant outputs more frequently than were alveolar /t/ and velar /k/ (see §5.2). In the corpus data, the English loans do not demonstrate clear voice and place effects. Variations occur in adaptations of both voiceless and voiced coda stops, although the frequencies of deviant voice-aspiration mapping are very low (2/62 or 3.23% for voiceless stops, and 2/22 or 9.09% for voiced stops; p > 0.27). Furthermore, in the corpus loans, bilabial coda stops /-p, -b/

---

[30] Since this research is mainly concerned with the phonological adaptations of loanwords, graphic adaptations will not be given a formal analysis.

are uniformly replaced by their faithful Mandarin correspondents, whereas alveolar and velar coda stops are realized with a deviant voicing/aspiration feature in a small number of cases, including 2/27 for /-t/ and 2/6 for /-g/ (p > 0.14). No voicing/aspiration deviation is observed in the adaptation of /-d/ (0/11) and /-k/ (0/31).

The greater variability of voiceless stops than voiced stops can be explained from a phonetic-perceptual perspective. English voiceless stops at coda positions are not aspirated, which makes it possible for them to be mapped into the unaspirated sounds in Mandarin. In the corpus data, adaptations might be influenced to a certain degree by spelling of the English source form (e.g. in the treatment of the aspirated and unaspirated allophones of foreign plosives, see §3.3.1), thus the role of perceptual similarity may be somewhat diminished. The contrast between existence of a significant place effect in the experimental data and absence of this effect in the corpus data is not clear. I will leave this for future research.

Despite the differences between the solicited loans and the corpus loans as discussed above, the general adaptation patterns observed in the two types of data are the same. In both situations, perceptual similarity plays a decisive role.

Chapter 6
Conclusion

6.1 Summary

This dissertation provides a study of loanword adaptations into modern Mandarin Chinese, based on a corpus of borrowings from three languages, namely, English, German and Italian. The research focuses on the phonological processes through which foreign consonants and syllable structures are adapted into Mandarin. Examination of the phoneme mapping patterns revealed that the articulatory features of consonants display differential changeability, with manner features (e.g. sonorancy and nasality) more likely to be maintained than other features (e.g. place and voice/aspiration). Phonotactic adaptations of illicit syllable structures demonstrate variation between consonant preservation (e.g. through vowel epenthesis) and deletion, and the likelihood of retention vs. deletion is related to various phonological factors (e.g. syllable stress). In addition, the study examined the effects of sociolinguistic and socio-cultural factors, showing that extra-phonological factors, e.g. the medium of borrowing and the meaning categories of the borrowed term, interact with the phonetic and phonological processes of loan nativization in Mandarin.

To account for the adaptation patterns observed in the corpus data, I argued that the recipient language speakers' perceptual knowledge plays a crucial role in loanword phonology. Following Steriade's (2002) P-map concept, I proposed an OT analysis, in which rankings of various correspondence constraints are projected by the perceptual similarity between the source form and the adapted form. For phoneme substitution, it was postulated that consonantal features (e.g. manner and place) have differential perceptibility, which triggers the ranking of the respective identity constraints for these manners. For phonotactic repairs of foreign syllable structures, I posited that the varying perceptibility of contrasts in certain phonological contexts motivates the ranking of the respective correspondence constraints (e.g. MAX-IO) for different classes of sounds (e.g. plosives vs. nasals).

The hypothesis about the role of perceptual similarity in loanword adaptations was further tested in online perception and adaptation experiments. The results conform to the findings from the existent loans, proving that manner features are more resistant to change than other features (e.g. voicing/aspiration), and that vowel epenthesis is preferred to consonant deletion in adapting English plosive codas. This supports the OT analysis proposed for the adaptation patterns in the corpus data.

6.2 Contributions

This research contributes to the theories of Mandarin phonology and loanword phonology as well as phonological theories in general. First of all, it leads to insights into the native Mandarin grammar, which can be seen from two respects. Findings about loanword adaptation provide evidence for constraints that are not active in native processes yet play a crucial role in language contact situations. For example, the substitution of lateral /l-/ (rather than rhotic /ɻ-/) for foreign "r-" sounds in onset positions reveals that the lateral is a less marked onset than /ɻ-/. Furthermore, the study offers a more comprehensive perspective on the interaction between phonological and extra-phonological factors in Mandarin loanword phonology. For instance, the proposal that the variability of segmental mapping is constrained by the innate perceptibility of consonantal features suggests that Mandarin speakers' semantic efforts in the creation of phonemic-semantic loans are phonologically constrained rather than randomly free. In contrast to previous research on loan adaptation in Mandarin (e.g. Yáo 1998, Chen 1999, Liú 1986, Masini 1993), which mainly gave etymological and sociolinguistic descriptions, this study focuses on construction of formal phonological explanations.

Secondly, this research shows that loanword adaptation can be better accounted for by a perceptual-similarity approach, which integrates the borrower's perceptual knowledge into the production grammar, than by approaches that treat loanword processes as either solely phonetic or solely phonological. On the one hand, phoneme substitutions in Mandarin loanword phonology are carried out mostly in a phoneme-to-phoneme manner, with non-contrastive phonetic details in the source language ignored. This provides counter-evidence against a perception-only approach as advanced by Peperkamp (2002) and Peperkamp & Dupoux (2003), who argue that loan adaptation is a function of perception only. On the other hand, the variability of segment mapping in Mandarin shows that sometimes the phonetic details of the source pronunciation are taken into consideration (e.g. co-articulation between a velar plosive onset and a high front vowel), and hence perception does play a role in the adaptation process. This suggests that a production-only approach as proposed by Paradis (1996) and Jacobs & Gussenhoven (2000) is not adequate either. In this research, the variability of segmental and phonotactic adaptation in Mandarin loanword phonology is analyzed from a perspective of perceptual salience and perceptual similarity. Thus, the functions of both perception and production are successfully formulated into the loan adaptation grammar.

Thirdly, this study enhances our understanding of the variability of loanword adaptation. For one thing, it lends support to the cross-linguistic findings that segmental features of consonants display differential changeability, and more specifically that faithfulness to manner features enjoys higher priority than faithfulness to other features like place and voicing (e.g. Broselow 1999, Steriade 2002, Kenstowicz 2003a). Hence, it instantiates a universal ranking of featural identity constraints, i.e. IDENT (Manner) dominates IDENT (Place) and IDENT (Voicing/Aspiration). For another thing, it supports the claim that segment preservation (e.g. through vowel epenthesis) is preferred over segment deletion in the adaptation of foreign syllable structures (Paradis 1996, Paradis & LaCharité 1997, Uffmann 2001, 2004). Furthermore, analysis of the loan data

in Mandarin shows that vowel insertion is not always the default strategy. Instead, the likelihood of retention vs. deletion varies across phonological/phonetic contexts. For instance, nasal codas are retained more frequently than plosives, and codas in stressed syllables are more likely to be preserved than codas in unstressed syllables. The differential preference for repair strategies in relation to contextual features as observed in Mandarin as well as in other languages such as Cantonese (Silverman 1992) and Korean (Kang 2003) reveals a more comprehensive picture of the mechanism of loan adaptations.

Lastly, from a broader perspective, this research supports the view that phonology is phonetically grounded (Hayes 1999, Steriade 2002). It contributes to our understanding of the role of perception in phonology and its relationship to constraint ranking. In view of prior studies which show that perceptual salience and perceptual similarity underlie a variety of phonological phenomena such as onset reduplication (Fleischhacker 2002) and speech errors (Walker 2003) in addition to loanword adaptation, we may construct a general theory of phonology based on the universal perceptibility of linguistic structures, and a perceptual perspective on constraint organization as proposed by Steriade (2002) may well be a promising direction for this enterprise.

6.3 Directions for future research

This study investigated only Mandarin adaptation of foreign consonants and consonant clusters, but it did not address the mapping of vowels between the donor language(s) and the recipient language. A more comprehensive understanding of Mandarin loanword phonology will require research on the adaptation of vowels. For example, in view of the differential faithfulness requirement for consonant features (e.g. manner vs. voice/aspiration), it would be interesting to examine whether different articulatory features of vowels (e.g. height and roundedness) have a differential or equal role in constructing perceptual similarity in loanword adaptation as well as in phonological processes in general. It was observed by Zwicky & Zwicky (1986) that height and tenseness are two vocalic features most frequently employed in imperfect puns. For example, "etch" can be used to pun "itch," despite the different heights of the initial vowels. Bond (1999: 9-24) reports that vowel perception errors in English casual speech involve vowel height (e.g. "kings" $\rightarrow$ "kangs"), tenseness (e.g. "fical" $\rightarrow$ "feckle") and frontness (e.g. "Johnson" $\rightarrow$ "Jensen"), and he observes that errors distribute unevenly between front vowels and other vowels (i.e. central and back vowels) in that front vowels are more likely to be misperceived. These findings may suggest that certain vocalic features (e.g. height) are perceptually less salient, and hence have lower faithfulness priority, than other features (e.g. roundedness). In addition, it is commonly agreed in the field of historical linguistics that consonants have greater stability than vowels (e.g. Coetsem 1988). In view of this, we may predict that consonant faithfulness is of greater importance than vowel faithfulness. Whether loanword nativization displays similar patterns awaits further research into the role of perceptual similarity in universal grammar.

Furthermore, this study focuses on adaptations of word-initial and word-final consonantal structures. One particular area that calls for research is whether phonological domain (e.g. syllable vs. word) will influence the perceptibility of contrasts induced by a particular phonological process (e.g. segment deletion). In the case of loanword adaptation, for example, it is possible that once an adequate number (although not all) of the total constituents of a certain word are faithfully nativized, the rest might enjoy greater freedom in adaptation. If this is indeed the case, we may need to construct a concept of holistic or global similarity on the word level. For instance, in the adaptation of English "Cigna" /ˈsɪɡnə/ (name of a U.S insurance company) into Mandarin "xin4-nuo4" /ɕin-nuɔ/ "*trust-promise*," it seems that the only clear pairs of correspondence are /s/ > /ɕ/ and /n/ > /n/, while other segments are adapted with much greater freedom, e.g. the final vowel /ə/ > /uɔ/. Through cooperation of faithful adaptation of some constituents and deviant realization of others, the resultant Mandarin form both retains sufficient similarity and conveys desirable meaning links to the source word. The other potential direction of research is to investigate whether word length exerts any effect on the variation of segment preservation and deletion. Since the native vocabulary of Mandarin consists of mostly bi-syllabic and tri-syllabic words, it is possible that deletion will be more likely if the source term is multisyllabic or contains consonant clusters, simplification of which through segment preservation would create multisyllabic loans. Broselow, Chen & Wang (1998) propose that the preference for bisyllabic words in the native vocabulary of Mandarin plays a role in Mandarin speakers' acquisition of English obstruent codas. Although no clear effects of word length are observed in the corpus data of this research due to the limited number of short (e.g. monosyllabic) source terms, a more systematic study is needed in order to attain a comprehensive understanding of the relationship between word length and the alternation between preservation and deletion. Future studies to explore loanword adaptation from a broader perspective that goes beyond segmental and syllabic structures may enhance our understanding of the full mechanism of perceptual similarity in phonology.

Lastly, it should be noted that influences from differences among Chinese dialects, although minimized in the data, might not have been entirely avoided, especially in the case of the Italian loans. Most of the Italian loans in the corpus were taken from a published Italian-Chinese dictionary (see §1.5), and no etymological information is available in the dictionary. Thus, the exact time when these terms were introduced into Mandarin is not clear. If a word was borrowed before Mandarin became widely used as the official language of China, it might have entered Mandarin through some other dialect. As is pointed out by Chen (1999: 104-105), dialectal influence was indeed quite evident in certain periods of Chinese history. For instance, in the early to mid 19th century, many English words were first borrowed into Cantonese, and later entered Mandarin. The results in this study, however, will not be affected in significant ways since the Italian data constitute a very small portion of the corpus data. As for loans from the other two languages (i.e. English and German), dialectal influence is minimal since terms collected in the corpus are limited to those that were borrowed after the 1950s when Mandarin had gained considerable popularity in Mainland China.

It is hoped that future research will provide further insights into the function of language perception in the universal grammar of phonology. Research in loanword

adaptations, by its very inter-disciplinary nature, can enhance our understanding of not only the linguistic mechanism of word borrowing but also various other language phenomena such as language contact and intercultural communications. This study contributes to this direction of research, by investigating both the phonological processes and the interaction between phonological/perceptual considerations and other factors (e.g. semantic considerations) in Mandarin loanword phonology.

Bibliography

Adler. Allison N. (2004). Faithfulness and perception in loanword adaptation: A case study from Hawaiian. Phonology generals paper. MIT.

Akinlabi, Akinbiyi. (1993). Underspecification and the phonology of Yoruba /r/. *Linguistic Inquiry,* 24, 139-160.

Alleton, Viviane. (2001). Chinese terminologies: On preconceptions. In Michael Lackner, Iwo Amelung, and Joachim Kurtz (eds.), pp. 15-34.

Amelung, Iwo, Joachim Kurtz, and Michael Lackner. (2001). Introduction. In Michael Lackner, Iwo Amelung, and Joachim Kurtz (eds.), pp. 1-12.

Anderson, Janet I. (1983). The difficulties of English syllable structures for Chinese ESL learners. *Language Learning and Communication,* 2, 53-61.

Batibo, Herman M. (1996). Loanword clusters nativization rules in Tswana and Swahili: A comparative study. *South African Journal of African Languages,* 16 (2), 33-41.

Bauer, Robert S., and Paul K. Benedict. (1997). *Modern Cantonese Phonology*. Berlin: Mouton de Gruyter.

Beckman, Jill N. (1997). Positional faithfulness, positional neutralization and Shona vowel harmony. *Phonology,* 14, 1-46.

Benware, Wilbur A. (1986). *Phonetics and phonology of modern German: An introduction.* Washington DC: Georgetown University Press.

Best, Catherine T., and Winifred Strange. (1992). Effects of phonological and phonetic factors on cross-language perception of approximants. *Journal of Phonetics,* 20, 305-330.

Bjarkman, Peter C. (1982). Process versus feature analysis and the notion of linguistically "closer" sounds. In Kevin Tuite, Robinson Schneider, and Robert Chametzky (eds), *Papers from the 18th Regional Meeting. Chicago Linguistic Society*, pp.14-28b.

Blevins, Juliette. (1995). The syllable in phonological theory. In John A. Goldsmith (ed.), *Handbook of phonological theory*, pp. 206-244. Oxford: Blackwell.

Boersma, Paul. (1999). On the need for a separate perception grammar. ROA-358. Retrieved September 6, 2005, from http://roa.rutgers.edu/files/358-1099/roa-358-boersma-2.pdf

Boersma, Paul, and Bruce Hayes. (2001). Empirical tests of the gradual learning algorithm. *Linguistics Inquiry,* 32, 45-86.

Bond, Zinny S. (1999). *Slip of the ear: Errors in the perception of conversation*. San Diego, CA: Academic Press.

Brannen, Kathleen. (2002). The role of perception in differential substitution. *Canadian Journal of Linguistics,* 47, 1-46.

Brasington, Ron. (1997). Cost and benefit in loanword adaptation. In Yan Huang, Richard Ingham, Paul Kerswill, and Linda Shockey (eds.), *Reading Working Papers in Linguistics* 3, pp. 1-19. Department of Linguistic Science, The University of Reading. Retrieved August 11, 2005, from http://www.personal.rdg.ac.uk/~llsling1/papers/Cost.of.a.loan.pdf

Broselow, Ellen. (1992). Loan Phonology. In W. Bright (ed.), *International Encyclopedia of Linguistics* Vol. I, pp. 200-201. New York: Oxford University Press.

Broselow, Ellen. (1999). Stress, epenthesis, and segment transformation in Selayarese loans. In Steve S. Chang, Lily Liaw and Josef Ruppenhofer (eds.). *Proceedings of the twenty-fifth annual meeting of the Berkeley Linguistic Society*, pp. 311-325. Berkeley, CA: Berkeley Linguistics Society.

Broselow, Ellen. (2001). Perceptual and grammatical factors in phoneme substitution. Paper presented at Phonological Similarity Workshop, LSA annual meeting 2001. Washington DC, January 4-7, 2001.

Broselow, Ellen. (2004). Unmarked structures and emergent rankings in second language phonology. *International Journal of Bilingualism,* 8, 51-65

Broselow, Ellen. (2005). Stress adaptation in loanword phonology: Perception and learnability. Paper presented in the Workshop of "speech perception within or outside phonology?" Cologne, Germany, Feb. 23-25, 2005.

Broselow, Ellen, Su-I Chen, and Chilin Wang. (1998). The emergence of the unmarked in second language phonology. *Studies in Second Language Acquisition,* 20, 261-280.

Burenhult, Niclas. (2001). Loanword phonology in Jahai. *Lund University, Dept. of Linguistics Working Papers,* 48, 5-14. Lund, Sweden.

Broselow, Ellen, and Zheng Xu. (2004). Differential difficulty in the acquisition of second language phonology. *International Journal of English Studies,* 4, 135-163.

Campbell, Lyle. 1998. *Historical linguistics: An introduction*. Cambridge, MA: The MIT Press.

Castiglione, Pierina Borrani. (1957). *Italian phonetics, diction and intonation*. New York: S. F. Vanni Publishers & Booksellers.

Chan, Mimi, and Helen Kwok. (1985). *A study of lexical borrowing from Chinese into English with special reference to Hong Kong*. Hong Kong: University of Hong Kong.

Chan, Mimi, and Helen Kwok. (1990). *A study of lexical borrowing from English in Hong Kong Chinese*. Hong Kong: University of Hong Kong.

Chen, Ping. (1999). *Modern Chinese: History and sociolinguistics*. Cambridge: Cambridge University Press.

Cheng, Chin-Chuan. (1973). *A synchronic phonology of Mandarin Chinese*. Monographs on Linguistic Analysis No. 4. The Hague: Mouton.

Cheng, Robert L. (1985). Group interest in treating words borrowed into Mandarin and Taiwanese. In Bjorn H. Jernudd (ed.), *Chinese language contact. Anthropological Linguistics,* 27 (2), 177-189. Bloomington: Indiana University.

Clark, Eve V. (1986). On the acquisition of final stops. In Joshua A. Fishman et al. (eds.). *The Fergusonian impact: In honor of Charles A. Ferguson on the occasion of his 65th birthday*, pp. 51-68. Berlin: Mouton de Gruyter.

Coetsmem, Frans van. (1988). *Loan phonology and two transfer types in language contact.* Dordrecht: Foris Publications.

Dai, Qingsha 戴庆厦, and Yan Dong 董艳. 1999. *Zhongguo guoqing yu shuangyu jiaoyu* 中国国情与双语教育 [The reality of China and bilingual education]. In Enquan Chen 陈恩泉, Yuxian Fu 傅雨贤, Jin'an Miao 缪锦安, and Guanyun Liao 廖官云 (eds.) *Shuangyu shuangfangyan yu xiandai zhongguo* 双语双方言与现代中国 [Diglossia, bidialectalism and modern China], pp. 57-72. Beijing 北京: Yuyan wenhua daxue chubanshe 语言文化大学出版社.

Danesi, Marcel. (1985). *Loanwords and phonological methodology*. Ottawa: Didier.

Davidson, Lisa. (2001). Hidden rankings in the final state of the English grammar. *Proceedings from HUMDRUM* 1, Rutgers University.

Davidson, Lisa, and Rolf Noyer. (1997). Loan phonology in Huave: Nativization and the ranking of faithfulness constraints. In Brian Agbayani, and Sze-Wing Tang (Eds.), *The Proceedings of the 15th West Coast Conference on Formal Linguistics*, pp. 65-79. Stanford, CA: Center Study Language & Information.

DeFrancis, John. (1984). *The Chinese language: Fact and fantasy*. Honolulu, HA: University of Hawaii Press.

Duanmu, San. (2000). *The phonology of Standard Chinese*. New York: Oxford University Press.

Dupoux, Emmanuel, Kazuhiko Kakehi, Yuki Hirose, Christophe Pallier, and Jacques Mehler. (1999). Epenthetic vowels in Japanese: A perceptual illusion? *Journal of Experimental Psychology: Human Perception and Performance,* 25, 1568-1578.

Doupoux, Emmanuel, and Sharon Pepekamp. (2002). The phonetic filter hypothesis: How phonology impacts speech perception (and vice versa). Paper presented at the Second International Conference on Contrast in Phonology. University of Toronto, May 3-5, 2002. Retrieved September 6, 2005, from http://www.chass.utoronto.ca/ ~contrast/dupouxpeperkamp.ppt#1

Eckman, Fred R. (1981). On the naturalness of interlanguage phonological rules. *Language Learning,* 31, 195-216.

Espy-Wilson, Carol Y. (1992). Acoustic measures for linguistic features distinguishing the semivowels /w j r l/ in American English. *Journal of the Acoustical Society of America,* 92, 736-757.

Fei, Huiru 费慧茹, Huanbao Wang 王焕宝, Heng Shen 沈珩, Baotai Ke 柯宝太, Emei Shen 沈萼梅. (2003). *Yihan cidan* 意汉词典 [An Italian-Chinese dictionary]. Beijing 北京: Shangwu Yinshuguan 商务印书馆.

Flege, James Emil, and Chipin Wang. (1989). Native-language phonotactic constraints affect how well Chinese subjects perceive the word-final English /t/-/d/ contrast. *Journal of Phonetics,* 17, 299-315.

Fleischhacker, Heidi. (2001). Cluster-dependent epenthesis asymmetries. In Adam Albright, and Taehong Cho (eds.), *UCLA Working Papers in Linguistics* 7, *Papers in Phonology* 5, pp. 71-116.

Fleischhaker, Heidi. (2002). Onset transfer in reduplication. Paper presented at LSA annual meeting. San Francisco: January 3-6, 2002. Retrieved September 6, 2005, from http://www.linguistics.ucla. edu/people/grads/fleischhacker/ 2002lsapaper.pdf

Fox, Anthony. (1990). *The structure of German.* Oxford: Clarendon Press.

Fries, Charles C., and Kenneth L. Pike. (1949). Coexistent phonemic systems. *Language,* 25, 29-50.

Gao, Ding-Guo, and Henry S. R. Kao. (2002). Psycho-geometric analysis of commonly used Chinese characters. In Henry S. R. Kao, Che-Kan Leong, and Ding-Guo Gao (eds.), *Cognitive neuroscience studies of the Chinese language*, pp. 195-206. Hong Kong: Hong Kong University Press.

Gao, Minkai 高名凯, and Zhengtan Liu 刘正琰. (1958). *Xiandai Hanyu wailaici yanjiu* 现代汉语外来词研究 [Foreign loans in Modern Chinese]. Beijing 北京：Wenzi

Gaige Chubanshe 文字改革出版社.

Gao, Mingkai 高名凯, Zhengtan Liu 刘正琰, Yongqian Mai 麦永乾, and Youwei Shi 史有为. (1984). *Haiyu wailiaci cidian* 汉语外来词词典 [Dictionary of loan words and hybrid words in Chinese]. Shanghai 上海: Shanghai Cishu Chubanshe 上海辞书出版社.

Garnes, Sara, and Zinny S. Bond. (1980). A slip of the ear: A snip of the ear? A slip of the year? In Victoria A. Fromkin (ed.), *Errors in linguistic performance*, pp. 231-239. New York: Academic Press.

Grosjean, François. (1982). *Life with two languages: An introduction to bilingualism.* Cambridge, MA: Harvard University Press.

Hall, Christopher. (1992). *Modern German pronunciation: An introduction for speakers of English.* Manchester & New York: Manchester University Press.

Hancin-Bhatt, Barbara. (1994). Segment transfer: A consequence of a dynamic system. *Second Language Research,* 10, 241-269.

Hancin-Bhatt, Barbara, and Rakesh M. Bhatt. (1997). Optimal L2 syllables: Interactions of transfer and developmental effects. *Studies in Second Language Acquisition,* 19, 331-378.

Haugen, Einar. (1950). The analysis of linguistic borrowing. *Language* 26: 210-231.

Haunz, Christine. (2002). The role of speech perception in the adaptation of loanwords. Unpublished manuscript, University of Edinburgh. Retrieved August 11, 2005, from http://www.ling.ed.ac.uk/ ~pgc/archive/2002/proc02/haunz02.pdf

Haunz, Christine. (2003). Grammatical and non-grammatical factors in loanword adaptation. Unpublished manuscript, TAAL, University of Edinburgh. Retrieved August 11, 2005, from http://www.ling.ed.ac.uk/~christin/presentations/pgc2003.pdf

Hayes, Bruce P. (1999). Phonetically driven phonology: The role of Optimality Theory and inductive grounding. In Michael Darnell, Edith Moravscik, Michael Noonan, Frederick Newmeyer, and Kathleen Wheatly (eds.), *Functionalism and formalism in linguistics*, Vol. I: General Papers, pp. 243-285. Amsterdam: John Benjamins.

Hirano, Hideyuki. (1994). A constraint-based approach to Korean loanwords. *Language Research,* 30, 707-739.

Hock, Hans Henrich, and Brian D. Joseph. (1996). *Language history, language change, and language relationship: An introduction to historical and comparative linguistics.* Berlin: Mouton de Gruyter.

Holden, Kyril. (1976). Assimilation rates of borrowings and phonological productivity. *Language,* 52, 131-147.

Hong, Wei. (1995). An analysis of language changes in China since the 1980s. *Linguistische Berichte,* 156, 143-154.

Hoosain, Rumjahn. (1991). *Psycholinguistic implications for linguistics relativity: A case study of Chinese*. Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Hualde, José Ignacio. (1999). Patterns of correspondence in the adaptation of Spanish borrowings in Basque. In Steve S. Chang, Lily Liaw, and Josef Ruppenhofer (eds.), *Proceedings of the twenty-fifth annual meeting of the Berkeley Linguistic Society*, pp. 348-358. Berkeley, CA: Berkeley Linguistics Society.

Itô, Junko, and Armin Mester. (1994). Japanese phonology. In John. Goldsmith (Ed.), *The handbook of phonological theory*: 817-838. Oxford: Blackwell.

Itô, Junko, and Armin Mester. (1995). The core-periphery structure of the lexicon and constraints on reranking. In Jill Beckman, Laura Walsh Dickey, and Suzanne Urbanczyk (eds.), *Papers in Optimality Theory. University of Massachusetts Occasional Papers in Linguistics* 18: 181-210. Amherst, UMASS: Graduate Linguistic Student Association

Jacobs, Haike, and Carlos Gussenhoven. (2000). Loan phonology: Perception, salience, the lexicon and OT. In Joost Dekkers, Frank van der Leeuw, and Jeroen van de Weijer (eds.), *Optimality Theory: Phonology, syntax and acquisition,* pp. 193-210. Oxford: Oxford University Press.

Janker, Peter M., and Hans Georg Piroth. (1999). On the perception of voicing in word-final stops in German. *Proceedings of the 14th International Congress on Phonetic Sciences (ICPhS), San Francisco*, pp. 2219-2222. Retrieved August 11, 2005, from http:// www.zas.gwz-berlin.de/mitarb/homepage/janker/pdfs/99icphsp.pdf

Jia, Zhongshan 贾中山, and Zhang Hui 张卉. (2001). Zuixin hanzi tongji jiexiao 最新汉字统计揭晓 [Latest statistics on Chinese characters]. *Beijing Wanbao* 北京晚报 [Beijing Evening Papers] September 26, 2001. Retrieved Aug. 11, 2005, from www. kanhan.com/webpage/chi/news.php?news=35

Kabak, Baris. (2003). The perceptual processing of second language consonant clusters. Doctoral dissertation, University of Delaware.

Kager, René. (1999). *Optimality theory*. Cambridge: Cambridge University Press.

Kang, Yoonjung. (2003). Perceptual similarity in loanword adaptation: English post-vocalic word-final stops in Korean. *Phonology,* 20, 219-273.

Kaye, Jonathan, and Barbara Nykiel. (1979). Loan words and abstract phonotactic constraints. *Canadian Journal of Linguistics,* 24, 71-93.

Kenstowicz, Michael. (2003a). Salience and similarity in loanword adaptation: A case study from Fijian. Unpublished manuscript, MIT. Retrieved August 11, 2005, from http://web.mit.edu/ linguistics/www/ kenstowicz/kenstowicz-'03.pdf

Kenstowicz, Michael. (2003b). The role of perception in loanword phonology. A review of *Les emprunts linguisiques d'origine europénne en Fon* by Flavien Gbéto, Köln: Rüdiger Köppe Verlag, 2000. *Studies in African Linguistics,* 32, 95-112.

Kuiper, Koos. (1993). Dutch loan-words and loan-translations in modern Chinese: An example of successful sinification by Way of Japan. In Lloyd Haft (ed.), *Words from the West: Western texts in Chinese literary context: Essays to honor Erik Zürcher on his sixty-fifth birthday*, pp. 116-144. Leiden: Centre of Non-Western Studies.

Kurtz, Joachim. (2001). Coming to terms with logic: The naturalization of an Occidental notion in China. In Michael Lackner, Iwo Amelung, and Joachim Kurtz (eds.), pp. 147-175.

Lackner, Michael, Iwo Amelung, and Joachim Kurtz. (eds.). (2001). *New terms for new ideas: Western knowledge and lexical change in late imperial China.* Sinica Leidensia 52. Leiden: Brill.

Ladefoged, Peter. (2001). *A course in phonetics* (4th ed.). Fort Worth, TX: Harcourt College Publishers.

Li, Wen-Chao. (1999). *A diachronically-motivated segmental phonology of Mandarin Chinese*. Berkeley Insights into Linguistics and Semiotics Vol. 37. New York: Peter Lang.

Lippert, Wolfgang. (2001). Language in the modernization process: The integration of Western concepts and terms into Chinese and Japanese in the nineteenth century. In Michael Lackner, Iwo Amelung, and Joachim Kurtz (eds.), 57-66.

Liu, Yongquan. (1986). Terminological development and organization in China. *International Journal of the Sociology of Language,* 59, 33-46.

Liu, Yongquan 刘涌泉. (1994). Tantan Zimuci 谈谈字母词 [On alphabetic words in Chinese]. In Liu Yongquan 刘涌泉 (ed.). 2001. Appendix III, pp. 266-270.

Liu, Yongquan. (2001). New development of Chinese lexicon. *Journal of Asian Pacific Communication,* 11, 255-262.

Liu, Yongquan 刘涌泉. (ed.). (2001). *Zimuci cidian* 字母词词典 [A dictionary of alphabetic words]. Shanghai 上海: Shanghai Cishu Chubanshe 上海辞书出版社.

Lockwood, William Burley. (1987). *German today: The advanced learner's guide*. Oxford: Clarendon Press.

Lou, Chengzhao. (1992). Transliterating non-Chinese proper nouns into Chinese: A comparative study of usage in Mainland China, Taiwan and Hong Kong. *International Journal of the Sociology of Language,* 97, 121-133.

Lǚ, Jiping 吕冀平, and Zhaoming Dai 戴昭铭. (eds.). (2000). *Dangqian woguo yuyan wenzi de guifanhua wenti* 当前我国语言文字的规范化问题 [Current issues on language and script standardization in China]. Shanghai 上海: Shanghai jiaoyu chubanshe 上海教育出版社.

Malecot, Andre. (1958). The role of releases in the identification of released final stops. *Language,* 34, 370-380.

Masini, Federico. (1993). *The formation of modern Chinese lexicon and its evolution towards a national language: The period from 1840 to 1898.* Journal of Chinese Linguistics, Monograph Series. No. 6.

Mattews, John, and Cynthia Brown. (2004). When intake exceeds input; Language specific perceptual illusions induced by L1 prosodic constraints. *International Journal of Bilingualism,* 8, 5-27.

McCarthy, John, and Alan Prince. (1993). *Prosodic morphology: Constraint interaction and satisfaction.* Rutgers University Center for Cognitive Science Technical Report 3. ROA-482.

McCarthy, John, and Alan Prince. (1994). The emergence of the unmarked: Optimality in prosodic morphology. In Merce Gonzalez (ed.), *Proceedings of the 24th North East Linguistics Society,* pp. 333-379.

McCarthy, John, and Alan Prince. (1995). Faithfulness and reduplicative identity. In Jill Beckman, Laura Walsh Dickey, and Suzanne Urbanczyk (eds.), *University of Massachusetts Occasional Papers in Linguistics 18: Papers in Optimality Theory,* pp. 249-384. Amherst, MA: Graduate Linguistic Student Association.

Norman, Jerry.1988. *Chinese*. Cambridge: Cambridge University Press.

Pan, Zaiping, et al. 潘再平等. (2000). Xin dehan cidian 新德汉词典 [A new German-Chinese dictionary]. Shanghai 上海: Shanghai Yiwen Chubanshe 上海译文出版社.

Paradis, Carole. (1996). The inadequacy of filters and faithfulness in loanword adaptation. In Jacques Durand, and Bernard Laks (eds.), *Current trends in phonology: Models and methods,* pp. 509-534. Salford: University of Salford Publications. Retrieved September 6, 2005, from http://www.fl.ulaval.ca/lli/caparadis/articles/Paradis_1996.pdf

Paradis, Carole, and Darlene LaCharité. (1997). Preservation and minimality in loanword adaptation. *Journal of Linguistics,* 33, 379-430.

Paradis, Carole, and Jean-François Prunet. (2000). Nasal vowels as two segments: Evidence from borrowings. *Language,* 76, 324-357.

Parker, Frank. 1977. Perceptual cues and phonological change. *Journal of Phonetics,* 5, 97-105.

Parker, Frank, and Thomas Walsh. (1981). Voicing cues as a function of the tense/lax distinction in vowels. *Journal of Phonetics,* 9, 353-358.

Peperkamp, Sharon. (2002). On the learnability of loanword adaptations. Unpublished manuscript, Laboratoire de Sciences Cognitives et Pscyholinguistique, Paris & Universite de Paris 8. Retrieved August 11, 2005 from http://www.ehess.fr/centres/lscp/ persons/peperkamp/learnability.pdf

Peperkamp, Sharon. (2003). Towards a new theory of loanword adaptations. Unpublished manuscript, Laboratoire de Sciences Cognitives et Psycholinguistique, Paris, & Université de Paris 8.

Peperkamp, Sharon, and Emmanuel Dupoux. (2001). Loanword adaptations: three problems for phonology (and a psycholinguistic solution). Unpublished manuscript, Laboratoire de Sciences Cognitives et Pscyholinguistique, Paris & Universite de Paris 8.

Peperkamp, Sharon, and Emmanuel Dupoux. (2003). Reinterpreting loanword adaptations: The role of perception. *Proceedings of the 15th International Congress of Phonetic Sciences*, pp. 367-370. Retrieved August 11, 2005, from http://www.ehess.fr/centres/ lscp/persons/peperkamp/ICPhS.pdf

Pitt, Mark A. (1998). Phonological processes and the perception of phonotactically illegal consonant clusters. *Perception and Psychophysics,* 60, 941-951.

Plag, Ingo, and Christian Uffmann. (2000). Phonological restructuring in creole: The development of paragoge in Sranan. In Ingrid Neumann-Holzschuh, and Edgar Schneider (eds.), *Degrees of restructuring in creole languages*, pp. 309-336. Amsterdam: Benjamins.

Poplack, Shana, and David Sankoff. (1984). Borrowing: the synchrony of integration. *Linguistics,* 22, 99-135.

Poplack, Shana, David Sankoff, and Christopher Miller. (1988). The social correlates and linguistic processes of lexical borrowing and assimilation. *Linguistics,* 26, 47-104.

Prince, Allan, and Paul Smolensky. (1993). Optimality theory: Constraint interaction in generative grammar. Rutgers University Center for Cognitive Science Technical Report 2. ROA 537-0802.

Ramsey, S. Robert. (1987). *The languages of China*. Princeton, NJ: Princeton University Press.

Repetti, Lori. (2001). Italian. In Jane Garry, and Carl Rubion (eds.), *Facts about the world's languages: An encyclopedia of the word's major languages, past and present*, pp. 341-344. New York & Dublin: New England Publishing Associates.

Rose, Yvan. (1999a). A structural account of root note deletion in loanword phonology. *Canadian Journal of Linguistics,* 44, 359-404.

Rose. Yvan. (1999b). Perception, representation and correspondence relations in loanword phonology. In Steve S. Chang, Lily Liaw, and Josef Ruppenhofer (Eds.), *Proceedings of the twenty-fifth annual meeting of the Berkeley Linguistic Society,* pp. 383-394. Berkeley, CA: Berkeley Linguistics Society.

Ross, Kie. (1996). Floating phonotactics: Variability in infixation and reduplication of Tagalog loanwords. Master's thesis, UCLA. Retrieved August 11, 2005, from http://www.linguistics.ucla.edu/people/zuraw/dnldpprs/FlPhono.pdf

Russ, Charles V. J. (1987). *Historical German phonology and morphology*. Oxford, Great Britain: Clarendon Press.

Sato, Charlene J. (1984). Phonological processes in second language acquisition: Another look at interlanguage syllable structure. *Language Learning,* 34 (4), 43-57.

Schütz, Albert J. (1970). Phonological patterning of English loanwords inTongan. In S.A. Wurm, and D. C. Laycock (eds.), *Pacific Linguistics Studies in hornour of Authur Capell,* 409-428. Pacific Linguistics C-13, Australian National University.

Sheldon, Amy, and Winifred Strange. (1982). The acquisition of /r/ and /l/ by Japanese learners of English: Evidence that speech production can precede speech perception. *Applied Psycholinguistics,* 3, 243-261.

Shen, Mengying et al. 沈孟璎等 (eds.). (2002). *Shiyong zimuci cidian* 实用字母词词典 [A useful dictionary of alphabetic words]. Beijing 北京：Hanyu Dacidian Chubanshe 汉语大词典出版社.

Shi, Youwei 史有为. (2000). *Hanyu wailici* 汉语外来词 [Loanwords in Chinese]. Beijing 北京: Shangwu Yinshuguan 商务印书馆.

Shi, Youwei 史有为. (2004). *Wailaici: Yiwenhua de shizhe* 外来词: 异文化的使者 [Loanwords as envoys of foreign cultures]. Shanghai 上海: Shanghai Cishu Chubanshe 上海辞书出版社.

Shinohara, Shigeko. (1997). *Analyse phonologique de l'adaptation japonaise de mots étrangers.* Unpublished doctoral dissertation. Université de la Sorbonne Nouvelle.

Shinohara, Shigeko. (2000). Default accentuation and foot structure in Japanese: Evidence from adaptations of French words. *Journal of East Asian Linguistics,* 9, 55-96.

Shinohara, Shigeko. (2004). Emergence of universal grammar in foreign word adaptations. In René Kager, Joe Pater, and Wim Zonneveld (Eds.), *Fixing priorities: Constraints in phonological acquisition*, pp. 292-320. Cambridge: Cambridge University Press.

Singh, Rajendra. (1995). Rethinking the relationship between phonology and loan phonology. *Folia Linguistica,* 29, 395-405.

Silverman, Daniel. (1992). Multiple scansions in loanword phonology: Evidence form Cantonese. *Phonology,* 9, 289-328.

Small, Larry H. (1999). *Fundamentals of phonetics: A practical guide for students.* Boston: Allyn & Bacon.

Smith. Jennifer L. (to appear). Loanword adaptation is not just perception: Evidence from Japanese loan doublets. In Timothy J. Vance (ed.), *Japanese/Korean Linguistics 14.* Stanford: CSLI. Retrieved September 6, 2005, from http://www.unc.edu/~jlsmith/home/ pdf/jk14.pdf

Spencer, Andrew. (1996). *Phonology.* Malden: Blackwell Publishers.

Steriade, Donca. (1999). Alternatives to syllable-based accounts of consonantal phonotactics. In Osamu Fujimura, Brian Joseph, and B. Palek (eds.), *Proceedings of the 1998 Linguistics and Phonetics Conference,* pp. 205-245. Prague: The Karolinum Press. Retrieved Sep 6, 2005, from http://www.linguistics.ucla.edu/people/steriade/papers/Alternatives _to_Syllables.pdf

Steriade, Donca. (2002). The phonology of perceptibility effects: The P-map and its consequences for constraint organization. Unpublished manuscript, UCLA. Retrieved September 6, 2005, from http://www.linguistics.ucla.edu/people/steriade/papers/P-mapfor_phonology.doc

Takagi, Naoyuki, and Virginia Mann. (1994). A perceptual basis for the systematic phonological correspondences between Japanese loan words and their English source words. *Journal of Phonetics,* 22, 343-356.

Tarone, Elaine E. (1980). Some influences on the syllable structure of interlanguage phonology. *International Review of Applied Linguistics,* 18, 139-152.

Tseng, Pao-chien. (1985). Language and national unity: China. In William R. Beer, and James E. Jacob (eds.). *Language policy and national unity,* pp. 178-97. Totowa, NJ: Rowman & Allanheld.

T'sou, Benjamin K. (2001). Language contact and lexical innovation. In Michael Lackner, Iwo Amelung, and Joachim Kurtz (eds.), pp. 35-56.

Tsuchida, Ayako. (1995). English loans in Japanese: Constraints in loanword phonology. *Working Papers of the Cornell Phonetics Laboratory,* 10, 145-164

Uffmann, Christian. (1999). Vowel epenthesis in loanword adaptation. Unpublished manuscript, Toronto Workshop on Phonology 1999. Retrieved August 11, 2005, from http://staff-www.uni-marburg.de/~uffmann/docs/montreal.pdf

Uffmann, Christian. (2001). Patterns of vowels epenthesis (not only) in Shona loanwords. In Caroline Féry, Anthony Dubach Green, and Ruben van de Vijver (eds.), *Proceedings of HILP 5,* pp. 193-211. Potsdam: University of Potsdam. Retrieved August 11, 2005, from http://staff-www.uni-marburg.de/~uffmann/docs/hilp.pdf

Uffmann, Christian. (2002). A typology of epenthetic vowels in loanwords. Ms, Philipps-Universität Marburg. Retrieved August 11, 2005, from http://www.staff.uni-marburg.de/~uffmann/dukoma.pdf

Uffmann, Christian. (2004). Vowel Epenthesis in Loanword Phonology. Doctoral dissertation, Philipps-Universität Marburg, Germany.

Uffmann, Christian. (2005). Epenthetic vowel quality in loanwords: Empirical and formal issues. Unpublished manuscript, Philipps-Universität Marburg. Retrieved November 10, 2005, from http://www.staff.uni-marburg.de/~uffmann/lingua-uffmann-final.pdf

Ulrich, Charles H. (1997). Loanword adaptation in Lama: Testing the TCRS model. *Canadian Journal of Linguistics,* 42, 415-463.

Ussishkin, Adam, and Andrew Wedel. (2003). Gestural motor programs and the nature of phonotactic restrictions: Evidence from loanword phonology. In Minu Tsujimura, and Gina Garding (eds.), *WCCFL Proceedings 22,* pp. 505-518. Somerville, MA: Cascadilla Press.

Vendelin, Inga, and Sharon Peperkamp. (in press). The influence of orthography on loanword adaptations. *Lingua*.

Walker, Rachel, Narineh Hacopian, and Mariko Taki. (2002). Nasal consonant speech errors: Implications for "similarity" and nasal harmony at a distance. In *Collected Papers: First Pan-American/Iberian Meeting on Acoustics*, Mexican Institute of Acoustics. Retrieved August 11, 2005, from http://www-rcf.usc.edu/~rwalker/ Errors. pdf

Walker. Rachel. (2003). Nasal and oral consonant similarity in speech errors: Exploring parallels with long-distance nasal agreement. Retrieved August 11, 2005, from http://www-rcf.usc.edu/~rwalker/SLIPS.pdf

Wang, Hongyuan 王宏源. (1997). *Hanzi ziyuan rumen* 汉字字源入门 [The origin of Chinese characters]. Beijing 北京: Sinolingua 华语教育出版社.

Weinreich, Uriel. 1968. *Languages in contact*. The Hague: Mouton Publishers.

Yao, Hanming 姚汉铭. (1998). *Xin ciyu shehui wenhua* 新词语·社会·文化 [New terms, society and culture]. Shanghai 上海: Shanghai cishu chubanshe 上海辞书出版社.

Yip, Moira. (1993). Cantonese loanword phonology and optimality theory. *Journal of Eastern Asian Linguistics,* 2, 261-291.

Zhōnghuá Rénmín Gònghéguó Guójiā Tǒngjìjú 中华人民共和国国家统计局 [National Bureau of Statistics of China]. (2000). Hànzú hé gè shǎoshù mínzú rénkǒu (2000 nián) 汉族和各少数民族人口 (2000 年) [Population of the Han nationality and ethnic minority nationalities in year 2000]. Retrieved October 16, 2005, from http://www.stats.gov.cn/was40/detail?record= 3&channelid=52984

Zhōngguó shèhuì kēxuéyuan yǔyán yánjiūsuǒ cídiǎn biānjí shì 中国社会科学院语言研究所词典编辑室 [Lexicographic Department of the Institute of Linguistics, Chinese Academy of Social Sciences] (2001). *Xiàndài hànyǔ cídiǎn (Xiūdìngběn)* 现代汉语词典 (修订本) [Modern Chinese Dictionary] (Rev. ed.). Beijing 北京: Shangwu yinshu guan 商务印书馆.

Zhou, Zhenhe 周振鹤, and Rujie You 游汝杰. (1986). *Fangyan yu Zhongguo wenhua (Xiudingben)* 方言与中国文化 (修订本) [Dialects and Chinese culture] (Rev. ed.) Shanghai 上海：Shanghai Renmin Chubanshe 上海人民出版社.

Zwicky, Arnold M. (1976). Well, this rock and roll has got to stop. Junior's head is hard as a rock. In Salikoko S. Mufwene, Carol A. Walker, and Sanford B. Steever (eds.), *Papers from the 12th Regional Meeting, Chicago Linguistic Society,* pp. 676-697.

Zwicky, Arnold M., and Elizabeth D. Zwicky. (1986). Imperfect puns, markedness and phonological similarity: With Fronds like these, who needs anemones? *Folia Linguistica,* 20, 493-503.

Appendixes (Omitted)