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Loanword Adaptation and Phonological Theory*

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This paper examines English-based loanwords in Standard Mandarin in light of various proposals on how loanwords are adapted and processed, and discusses the implications of the findings in loanword adaptation for phonological theory. There have been three major approaches to the adaptation and processing of sound-based loanwords: the Perception Approach, the Phonology Approach, and the Perception-Phonology Approach. By examining how Standard Mandarin adapts English consonants, vowels, and stress for loanwords, I show that the combined Perception-Phonology Approach better accounts for the data. The data and processes of loanword adaptation contribute to issues related to how the interaction of phonetics and phonology can be modeled. The degree to which and how features are perceived and modified in the adaptation process suggest relative saliency and/or asymmetrical relationship between features, and thus have interesting implications for feature theory in particular and phonological theory in general.

1. Introduction

There have been three major approaches to the adaptation and processing of sound-based loanwords. The Perception Approach (Peperkamp & Dupoux 2003, Peperkamp 2005) argues that adaptation results from misperception and is processed at the phonetic level. Peperkamp, Vendelin & Nakamura (2008) show that most loanword adaptations originate in *perceptual assimilation* that maps the non-native sounds and structures at the perceptual level onto the phonetically closest native ones. In their proposed speech-sound processing model for perception/encoding, as schematized in (1), perceptual assimilation (the source of loanword adaptations) occurs at the phonetic encoding phase. Under the Perception Approach, the changes of non-native sounds in loanwords are made purely at the perceptual level without involving phonology (Peperkamp & Dupoux 2003, Peperkamp 2005, Peperkamp, Vendelin & Nakamura 2008). The role of phonological grammar is hence indirect: loanword adaptations are *influenced* rather than computed by phonological grammar in the sense that phonology "determines which sounds and sound structures are available for the non-native ones to map onto" (Peperkamp, Vendelin & Nakamura 2008:131).

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(1) Perception/encoding in speech-sound processing
(Peperkamp, Vendelin & Nakamura 2008:154)

Phonetic surface form
→ Phonetic encoding
(the process responsible for perceptual assimilation)
→ Phonological surface form
→ Underlying form

In contrast to the Perception Approach, under the Phonology Approach, the input to the adaptation process requires access to the source language's phonology, and loanword adaptation follows category preservation/proximity principles where segment matching is based on phonological categories (e.g. Paradis & LaCharité 1997, LaCharité & Paradis 2005, Paradis 2006, Rose & Demuth 2006, Uffmann 2006). The process of phonetic approximation is used only if the borrowers are not bilinguals (Paradis & LaCharité 2008). Under the Perception-Phonology Approach, the input to the adaptation process is based on how the borrowers perceive the acoustic signals of the source language, and then the perception-based input is modified/adapted by the borrowing language's phonological grammar (e.g. Silverman 1992, Yip 1993, 2002, 2006, Steriade 2001, Kang 2003, Kenstowicz 2003, Kenstowicz & Suchato 2006, Miao 2006). Other than these three major approaches, it has been shown in the literature that a variety of other factors, such as orthography, morphology, and semantics, can be involved in loanword adaptation (e.g. Adler 2006, Davis & Cho 2006, Miao 2006, Smith 2006ab, Vendelin & Peperkamp 2006); however, I will limit my discussion to the three competing approaches.

In this paper, I examine English-based loanwords in Standard Mandarin (SM) in light of the three models on how loanwords are adapted and processed and discuss the implications of the findings for phonological theory. The next section (§2) presents the data of English-based loanwords in SM, and §3 discusses which of the three models of loanword adaptation better accounts for the SM data. The concluding section (§4) offers remarks on the implications for phonological theory.

2. English-based loanwords in SM

In this section, we examine the patterns of syllable structure adjustments in loanword adaptation and the characteristics of adaptations of English consonants, vowels, and stress into SM.

2.1. Syllable structure adjustments

All loanwords conform to SM syllable structure, in which (i) the maximal syllable is CGVX, where C=consonant, G=glide, V=vowel/syllabic C, X=C or V (cf. Lin 1989, 2007b, Duanmu 2000), and (ii) the coda consonant can only be [n] and [ŋ], with the assumption that the *er* syllable [əɹ] consists of a rhotacized vowel (cf. Lee & Zee 2003, Zee 2003). Since

English syllable structure is more complex, syllable structure adjustments need to be made in loanword adaptation from English to SM (cf. Shih 2004, Miao 2006, Lin 2007b). In addition, Phonotactics and allophonic distributions are also strictly followed. Examples for epenthetic vowels/syllabic consonants to break up consonant clusters in English are given in (2a), and (2b) shows examples where some consonants in English are deleted so as to conform to SM syllable structure.

(2) a. Epenthesis

Strauss	*shǐ.tè.láo.sī*	[**ʂɹ̩.tʰɤ̯**.lɑu.**sɹ̩**]
Brook	*bù.lǔ.kè*	[**pu**.lu.**kʰɤ̯**]
Richmond	*lì.qí.méng.dé*	[li.**tɕʰi**.məŋ.**tɤ̯**]

b. Deletion

Netherlands	*ní.dé.lán*	[ni.tɤ̯.lan_]
Denmark	*dān.mài*	[tan.mai_]
Richmond	*lì.qí.méng*	[li.tɕʰi.məŋ_]

2.2. Consonant adaptation

When a consonant appears in both English and SM, the same consonant is used most of the time. When an English consonant is not part of the SM consonant system, a replacement that shares phonetic similarities with the English consonant is adopted, as the examples in (3) show.

(3)

a.	*Victoria*	[v]	*wéi.duō.lì.yà*	[**w**ei.two.li.ja]
	Steve	[v]	*shǐ,dì,fū*	[ʂɹ̩.ti.**f**u]
b.	*Arthur*	[θ]	*yǎ.sè*	[ja.**sɤ̯**]
	Samantha	[θ]	*shā.màn.shā*	[ʂa.man.**ʂ**a]
	Timothy	[θ]	*ti.mo.xi*	[tʰi.mwo.**ɕ**i]

The examples in (4) show that phonotactics/allophonic distributions are followed; for example, in SM only an alveolo-palatal can appear before a high front vowel/glide, hence the change of an English palato-alveolar to an alveolo-palatal in SM, as in (4bd).

(4)

a.	*Johnson*	[dʒ]	*zhān.sēn*	[**tʂ**an.sən]
b.	*Jim*	[dʒ]	*jí.mǔ*	[**tɕ**i.mu]
c.	*Shakespeare*	[ʃ]	*shā.shì.bǐ.yà*	[**ʂ**a.ʂɹ̩.pi.ja]
d.	*Sheraton*	[ʃ]	*xǐ.lái.dēng*	[**ɕ**i.lai.təŋ]

There are also contextual variation: for example, coda liquids in the rime delete after nonhigh back vowels in SM loanwords (Shih 2004), as in (5a). In general, as shown in (6), a limited range of context-free variation is commonly tolerated: for example, a nasal coda can be adapted as either an alveolar or velar nasal in SM (6de).

(5)	a.	*Barbara*	[ɹ]	*bā.bā.lā*	[pa_.pa.la]
		Mark	[ɹ]	*mǎ.kè*	[ma_.kʰɤ]
	b.	*Hilton*	[l]	*xī.ěr.dùn*	[çi.**əɹ**.tun]
		Blair	[ɹ]	*bù.léi.ěr*	[pu.lei.**əɹ**]

(6)	a.	*Simon*	[s]	*sài.méng*	[**s**ai.məŋ]
		Scott	[s]	*shǐ.kǎo.tè*	[**ʂ**ɻ̩.kʰɑu.tʰɤ]
				sī.kǎo.tè	[**s**ɻ̩.kʰɑu.tʰɤ]
	b.	*Peggy*	[pʰ]	*pèi.jī*	[**pʰ**ei.tɕi]
		Peter	[pʰ]	*bǐ.dé*	[**p**i.tɤ]
	c.	*Scotland*	[k]	*sū.gé.lán*	[su.**k**ɤ.lan]
		Scott	[k]	*shǐ.kǎo.tè*	[ʂɻ̩.**kʰ**au.tʰɤ]
	d.	*Harding*	[ŋ]	*hā.dìng*	[xa.tjə**ŋ**]
		Lansing	[ŋ]	*lán.xīn*	[lan.ɕi**n**]
	e.	*Johnson*	[n]	*zhān.shēng*	[tʂan.ʂə**ŋ**]
		Johnson	[n]	*zhān.sēn*	[tʂan.sə**n**]

2.3. Vowel adaptation

There is a high degree of variation in adapting English vowels SM as it is common to match the same English vowel with several different vowels. English [eɪ] can be adapted to [ei] or the less faithful [i] and [ai], as shown in (7).

(7)	*Reagan*	[eɪ]	→	*lei.gen*	[l**ei**.kən]
	Reagan	[eɪ]	→	*li.gen*	[l**i**.kən]
	Shoemaker	[eɪ]	→	*xiu.mai.ke*	[ɕjou.m**ai**.kʰɤ]

Deviation from faithful vowel adaptation can sometimes be attributed to individual users' or translators' preferences for particular characters based on semantic considerations or other factors (cf. Miao 2006). However, my recent studies have demonstrated that the seemingly chaotic variation in SM vowel adaptation has general patterns and restrictions (Lin 2007ab, 2008ab). The findings are that (i) vowel backness is more faithfully replicated than height and rounding, (ii) deviation in height is tolerated but minimal; e.g., a high-mid or mid-low match is acceptable but a high-low match is not, and (iii) central vowels behave as if they are unspecified for and/or ambiguous between front and back.

(8) Sample examples

a. Adaptations of English high vowels

Grieg	[i]	*gě.lì.gé*	[kɤ.l**i**.kɤ]	front high
Grieg	[i]	*gě.léi.gé*	[kɤ.l**ei**.kɤ]	front mid

	Judy	[u]	*zhū.dì*	[tʂ**u**.ti]	back high
	Judy	[u]	*qiú.dì*	[tɕ^{h}j**ou**.ti]	back mid
b.	Adaptations of English mid front vowels				
	Reagan	[eɪ]	*léi.gēn*	[l**ei**.kən]	front mid
	Reagan	[eɪ]	*lǐ.gēn*	[l**i**.kən]	front high
	Shoemaker	[eɪ]	*xiū.mài.kè*	[ɕjou.m**ai**.k^{h}ɤ]	front low
	Blair	[ɛ]	*bù.léi.ěr*	[pu.l**ei**.əɹ]	front mid
	Blair	[ɛ]	*bù.lái.ěr*	[pu.l**ai**.əɹ]	front low
	Clements	[ɛ]	*kè.lǐ.mén*	[k^{h}ɤ.l**i**.mən]	front high
c.	Adaptations of English mid back rounded vowels				
	Owen	[oʊ]	*ōu.wén*	[**ou**.wən]	back mid
	Dole	[oʊ]	*dù.ěr*	[t**u**.əɹ]	back high
	Gore	[ɔ]	*guō.ěr*	[k**wo**.əɹ]	back mid
	Gore	[ɔ]	*gāo.ěr*	[k**ɑu**.əɹ]	back low
	Ohio	[oʊ]	*é.hài.é*	[**ɤ**.xai.**ɤ**]	back mid unrounded
	Oregon	[ɔ]	*é.lè.gāng*	[**ɤ**.lɤ.kɑŋ]	back mid unrounded
d.	Adaptations of English low vowels				
	Gallup	[æ]	*gài.luò.pǔ*	[k**ai**.lwo.p^{h}u]	front low
	Jackson	[æ]	*jié.kè.sēn*	[tɕ**je**.k^{h}ɤ.sən]	front mid
	Harry	[æ]	*hā.lì*	[x**a$_{c}$**.li]	central low
	Johnson	[ɑ]	*qiáng.shēng*	[tɕ^{h}jɑŋ.ʂəŋ]	back low
	Carter	[ɑ]	*kǎ.tè*	[k^{h}**a$_{c}$**.t^{h}ɤ]	central low
e.	Adaptations of English mid central vowels				
	Kentucky	[ə][ʌ]	*kěn.dé.jī*	[k^{h}**ə**n.t**ɤ**.tɕi]	central/back mid
	Douglas	[ʌ][ə]	*dào.gé.lā.sī*	[t**ɑu**.kɤ.l**a$_{c}$**.sɻ]	back/central low
	Ferdinand	[ɚ]	*fěi.dí.nán*	[f**ei**.ti.nan]	front mid
	Jeremy	[ə]	*jié.lì.mǐ*	[tɕje.l**i**.mi]	front high
	Hillary	[ə]	*xī.lái.lì*	[ɕi.l**ai**.li]	front low
	Bird	[ɚ]	*bó.dé*	[p**wo**.tɤ]	back mid rounded
	Curt	[ɚ]	*kè.tè*	[k^{h}**ɤ**.t^{h}ɤ]	back mid
	Curt	[ɚ]	*kòu.tè*	[k**ou**.t^{h}ɤ]	back mid rounded
	Wordsworth	[ɚ]	*wò.zī.huá.sī*	[w**u**.tsɻ.xw**a$_{c}$**.sɻ]	back high rounded/ central low

In Lin (2008b), the generalizations based on a large corpus from 1978 *Oxford Advanced English-English and English-Chinese Dictionary* are as follows:

(9) Generalizations from the dictionary corpus
   a. In terms of the front-back dimension, English non-central high/mid vowels and diphthongs are mostly matched in backness in SM, whereas the SM matches for English central vowels and low vowels vary to a larger extent.
   b. In terms of the height dimension, English high and low vowels have a strong tendency to be retained as high and low respectively in SM, whereas matches for English mid vowels mostly vary between mid and low in SM.
   c. The match between mid and low vowels and that between mid and high vowels are tolerated to various degrees, but a match between high and low vowels rarely occurs, ranging from 0% for [æ] to 5% for [aʊ], although with a slightly higher 15% high-vowel match for [aɪ].
   d. A rounding mismatch rarely occurs for English unrounded front and low vowels in the adaptation process, whereas mid back rounded vowels, mid central vowels, and back diphthongs can be matched with an unrounded counterpart in SM.

The dictionary data demonstrate that the more peripheral the English vowel is, the less deviation/variation there is in the SM matches: (i) Tense high/mid vowels show less backness variation in SM matches than the corresponding lax ones, and the high vowels show less such variation than mid vowels; e.g., [i] is mostly faithfully matched, [ɪ] is slightly less so, [eɪ] is more variable, and [ɛ] is even more variable; (ii) high and low vowels show much less deviation in height than mid vowels; (iii) mid central vowels have most variable matches in height, backness, and/or rounding. The fact that vowels with better perceptual contrasts and saliency (e.g. peripheral vowels, tense vowels) are adapted more faithfully while vowels with relatively poor perceptual contrasts and saliency (e.g. mid central vowels, mid vowels, lax vowels) have more variable matches seems to suggest that perceptual factors play a crucial role in the variation patterns of SM loanword vowel adaptation.

2.4. Stress-to-tone adaptation

Like vowel adaptation, there is much variation in stress-to-tone adaptation, and the main restriction is that only attested syllable-tone combinations can be used. In general, English stress is most frequently adapted as the high level tone in SM but can also be matched with the falling or rising tone (Wu, C. 2006). Wu, H. (2006) shows that stress in monosyllabic words in the English source are adapted with the falling tone, as in (10), and that the initially stressed syllable of English disyllabic words tends to be adapted with the

high level or rising tone, as in (11). Wu, H. (2006) also maintains that stressed syllables with sonorant onset consonants favor the rising tone for perceptual reasons, as in (11b).

(10)	*pound*	*bàng*	falling tone
	pie	*pài*	falling tone
	ton	*dùn*	falling tone

(11)	a.	*sofa*	*shāfā*	high level tone
		poker	*pūkè*	high level tone
		soda	*sūdǎ*	high level tone
	b.	*logic*	*luójí*	rising tone
		modern	*módēng*	rising tone
		laser	*léishè*	rising tone

Moreover, when the stress of the English source word does not occur initially, tone assignment on the stressed position resorts to acoustic similarity (Wu, H. 2006), as in (12). In general, the low tone in SM is least likely to be used for adapting English stress.

(12)	*baroque*	*bāluòkè*	falling tone
	martini	*mǎtīngní*	high level tone
	romantic	*luómàndìkè*	falling tone

Since high level, rising and falling tones all contain the high pitch, represented as HH (55), MH (35), HL(51) respectively, any tone that has the H feature can then be used to match English stress, which phonetically also tends to be higher in pitch. Therefore, acoustic and perceptual factors seem play a crucial role.

2.5. Summary

In sum, the major generalizations drawn from SM loanword adaptation are that (i) SM phonotactics and allophonic distributions are strictly followed in loanwords, (ii) only attested syllable-tone combinations can be used, (iii) the loanword matches for English sounds and stress share phonetic and/or phonological features, and (iv) there is a limited range of variation in consonant adaptation but the variation in vowel adaptation and stress-to-tone adaptation is more extensive and seems to be conditioned by acoustic/perceptual factors.

3. Which theoretical model for loanword adaptation?

With regard to the Phonology Approach, the extensive variability of vowel adaptation and stress-to-tone adaptation in SM loanwords casts doubt on the strict form of phonological category preservation/proximity principles (LaCharité & Paradis 2005). For example, since stress and tone differ in phonological representation and status, it is unclear how phonological category matching can be done (cf. Wu, H. 2006), and Wu, H. (2006) has

argued that acoustics and perception play an important role in stress-to-tone adaptation. In addition, the fact that an English mid vowel can vary between high, mid and low vowels in SM cannot be accounted for in terms of phonological category matching. Since the non-peripheral or less contrastively salient vowels, such as mid and central vowels, exhibit more variation in matches and/or ambiguity for categorization whereas peripheral vowels or more contrastively salient vowels are more faithfully replicated, the input to the adaptation process is likely to be based on auditory perception. Moreover, most of the SM transliterations are done by bilinguals, countering the claim made by Paradis & LaCharité (2008) that phonetic approximation is adopted only by monolinguals.

Both the Perception and Perception-Phonology Approaches maintain that the input to the adaptation process is mostly based on auditory perception but differ in whether or not the borrowing language's phonological grammar is directly involved in the adaptation process. The extensive variation in vowel and stress-to-tone adaptations and the prioritized matching in favor of some particular aspects of the foreign inputs seem to argue against a purely perceptual account since the same vowel or stress is not expected to be perceived variably under the Perception Approach. In addition, the inviolability of SM phonotactics, allophonic distributions, and syllable-tone combinations reflects the dominant phonological force and supports theories of loanword adaptation that incorporate the borrowing language's phonological grammar. Therefore, the Perception-Phonology Approach seems to provide the best account of the SM loanword data.

In an interesting study, Peperkamp, Vendelin & Nakamura (2008) show that the coda nasal in French is adapted into Japanese as a nasal plus an epenthetic vowel but the coda nasal in English is adapted simply as a nasal coda, and argue that phonetic differences, i.e. strong coda nasal release in French vs. weak or little coda nasal release in English, contribute to different adaptations. Note that the studies of SM vowel and stress-to-tone adaptations often examine matches between English and SM vowels and between English stress and SM tone without considering all the phonetic properties and contexts in either English or SM. To support the Perception Approach, one has to show that the extensive variation in SM vowel and stress-to-tone adaptations results from differences in the phonetic properties induced by the contexts (after excluding factors such as the lack of attested syllable types, suitable written characters, semantic consideration, etc.) For example, one may be able to show that the closest SM phonetic match for an English mid vowel in a certain context is a SM vowel in a particular context. Any such support for the Perception Approach will have to await further research.

4. Theoretical implications and conclusion

The first set of implications concern the input and variation in SM loanword adaptation. The SM loanword data seem to suggest that the input to loanword adaptation and processing is perceptual in nature (for consonants, see also Shih 2004, Miao 2006). The variation patterns, however, show that only some specific properties of the foreign inputs are used for adaptation matches and processing (cf. Yip 2002, 2006): (i) The fact that, for

example, [n] can be adapted as either [n] or [ŋ] indicates that input nasality is retained and processed but place features are not, (ii) the high pitch of stress can be adapted as HH, MH, or HL tone, indicating that input high pitch is retained and processed but rime duration may not (Wu, H. 2006), and (iii) vowel frontness and backness are preserved but vowel height and roundness are not as well preserved (Lin 2007ab, 2008ab). The fact that the speakers/listeners/adaptors tend to be better attuned to some particular set of features suggests that these features are salient in perception or primary in phonology. The formal phonological analysis of SM vowel adaptation in Lin (2008a) proposes that the input is underspecified. For example, the highly variable mid central vowel is specified with only [–high] and hence can be matched with front or back and mid or low vowels. If this thinking is on the right track, then one source of variation can come from underspecified input. The variation patterns in SM loanword adaptation then have theoretical implications for issues of underspecification and how variation is modeled.

The larger theoretical questions are then: (i) How to construct a model to predict the degree of underspecification (or selective perception/representation) and which features to be underspecified/selected? (ii) What are the possible sources of variation in loanword adaptation in particular and in linguistic variation in general (cf. Coetzee 2006)? (iii) How should variation be modeled in theoretical linguistics and psycholinguistics? Empirically and experimentally, we may ask: (i) What types of data can provide the evidence for these theoretical questions? (ii) What phonetic and/or psycholinguistic experiments can be conducted to tease apart phonetic versus phonological factors, predict the degree of underspecification and which features to be underspecified, and show how and when variation occurs?

The SM loanword adaptation data also have implications for feature theory. That some features are better retained than others in the adaptation process and minimal deviation in some other features is tolerated suggests that not all features are equally salient perceptually or of the same weight phonologically. It is also interesting to note that for consonants, manner features are more faithfully retained than place and voicing features (Steriade 2001, 2002, Miao 2006), and yet for vowels, backness features (vowel place features) are more faithfully retained than other vowel features. For prosodic features, pitch height appears to be more salient. The larger theoretical questions then are: (i) Why is there asymmetrical behavior of different features? (ii) What phonetic and/or phonological factors influence the asymmetrical behavior? (iii) How can a feature theory capture the unequal relationships between features? Empirically and experimentally, the questions are: (i) What types of data can help construct such a feature theory? (ii) What phonetic and/or psycholinguistic experiments can be conducted to gain a better understanding of the underlying causes of the asymmetrical relationship/behavior among different features?

In conclusion, the data and processes of loanword adaptation showcase the interplay between phonetics and phonology and contribute to issues related to how the interaction of phonetics and phonology can be modeled. The degree to which and how features are perceived and modified in the adaptation process and the prevalence of variable adaptation

suggest relative saliency and/or asymmetrical relationship between features, and thus have interesting implications for feature theory in particular and phonological theory in general.

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