Loanword Phonology and Enhancement

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1. Introduction

With the development of a "constraints and repair" approach to phonological computation, the field has seen a renewed interest in loanword adaptation. The task of the adapter is to make the loan conform to the segmental, phonotactic, and prosodic structure of the recipient (L1) language while preserving as much information as possible from the donor (L2) language. The balance between these often conflicting demands is insightfully expressed by a constraint-based model of phonology such as Optimality Theory (Prince and Smolensky 1993, 2004) with its key notions of markedness and faithfulness constraints.

Over the past decade three models of loanword adaptation have emerged in the generative literature. The Phonological stance of Paradis and LaCharité (1997, 2005) claims that in their initial stages of adaptation loanwords are transmitted by bilinguals who draw on their knowledge of the donor and recipient languages to discern structural equivalences at a phonemic level that abstract away from the details of phonetic realization in both grammars. In effect, the adapters employ Sapir's (1933) phonological hearing in the transmission of a word from one language to the other. The Phonetic model of Peperkamp and Dupoux (2003) (see also Silverman 1992 for an early precursor and Peperkamp et al. 2008 for a recent restatement) sees the initial stages of loanword adaptation as the product of an extra-grammatical, speech perception module that assigns an acoustic output of L2 with the closest acoustic match that can be generated by the L1 grammar. A third approach, typically couched in the Optimality Model, agrees with second that the input is the surface representation of the donor language but argues that adaptation also takes into account the phonological categories and constraints of the native system as well as possible orthographic effects to achieve the best match. Proponents of this approach include Kenstowicz (2006), Yip (2006), and Boersma and Hamann (2009). In order to achieve some predictive power it is important for the third approach to develop principles that constrain the range of repairs that shape the loanword. Our

research over the past ten years has uncovered a number of cases in which the relative saliency of a sound is a decisive factor. In particular, Keyser and Steven's (1989, 2006) notion of Enhancement plays a critical role. Their idea is that a grammar designates certain features as the building blocks for forming phonological contrasts that encode the lexicon while other redundant features can be introduced in the course of the input-output mapping to reinforce a lexical contrast. Such enhancing features may take over the primary burden of signaling the contrast when the lexical features are challenged by the context in which they are to be realized. More generally on this view, speech perception not a passive matching process proceeding segment by segment across the speech stream but a dynamic one where top-down information about enhancing relations and phonotactics guide the identification. In particular, certain redundant features can signal downstream phonemes, which may themselves weaken or disappear. A well-known example is English vowel length, which enhances the voicing contrast in a following stop so that *cap* /kæp/ and *cab* /kæb/ are distinguished phonetically by the vowel when the stops are pronounced with no release (Reetz and Jongman (2008): [kʰæp] vs. [kʰæ:b].

In this paper we review three case studies that have demonstrated that enhancing features play a critical role in resolving the choice between conflicting strategies of faithfulness in loanword transmission. In each case we see that faithfulness to the phonetically more salient enhancing feature in a vowel overrides faithfulness to the consonant that it enhances in the L1 native grammar. The first involves the adaptation of nasal codas in English loans to Mandarin, the second involves the adaptation of French mid and low, back vowels in Moroccan Arabic, and the third the adaptation of Mandarin unaspirated stops into Yanbian Korean. The paper ends with a short summary and conclusion.

2. Mandarin

Mandarin has five vowel phonemes: /i/, /y/, /u/, /ə/, /a/. The maximal syllable has the shape CGVC where the coda C may contain a glide [w] or [j] or a nasal [n] or [ŋ]. The mid and low vowels do not contrast for [back]. Their value for this feature depends on the surrounding consonants. In particular, the low vowel has a relatively front allophone [a] when the coda contains the coronal nasal [n] and a back vowel [ɑ] when the coda contains the velar nasal [ŋ]. Thus, a process Duanmu (2000) terms Rhyme Harmony limits low-vowel-plus-nasal codas to either [an] or [ɑŋ]. Hsieh et al. (2009) constructed a corpus of some 600 words containing a nasal coda from a dictionary of Western (principally English) loanwords that were borrowed into Mandarin during the early half of the last century. Four possible combinations among front vs. back low vowels and coronal vs. velar nasal codas are possible in the loan source. In order to conform to the Rhyme Harmony phonotactic constraint and thus sound like a well-formed word of Mandarin, the loans have to be reduced to either [an] or [ɑŋ]. Hsieh et al. (2009) find that in cases where the input combinations conform to

Rhyme Harmony, the expected correspondences obtain in the vast majority of cases. These are sampled in (1). (Mandarin words are transcribed according to the Pinyin transliteration.)

(1)   [æn]   [an]
         anchovy   an.chou   26/31
         cotanjent   kou.tan.jin
         romance   luo.man.si
         Sudan   su.dan

         Congo   gɑng.guo   5/7
         franc   fa.lɑng

But when the rhyme in the source word contains conflicting combinations of a back vowel plus coronal nasal or front vowel plus velar nasal then the loans are adapted by changing the phonologically distinctive nasal coda in order to remain faithful to the redundant but enhancing vowel. The examples in (2) illustrate this generalization.

(2)   [ɑn]   [ɑŋ]   24/24
         ergon   er.gɑng
         monsoon   mɑng.xun
         pound   bɑng
         Oregon   e.le.gɑng

         [æŋ]   [an]   9/13
         bank   ban.ke
         Franklin   fu.lan
         Langley   lan.le
         tank   tan.ke

This adaptation is unexpected under the Phonological model according to which redundant phonetic details such as the [+/−back] difference between [ɑ] and [a] should be ignored in favor of distinctive differences like the place distinction in the coda nasal. But if loanword adaptation runs off the phonetic surface of the donor language and the goal is to make the loan sound as much as possible like the source word while still satisfying native language phonotactic constraints then the relative saliency of different phonetic features can play a role, particularly ones that enhance an underlying contrast. Hsieh et al. (2009) account for this case as follows. Consistent with the OT

premise of Richness of the Base, in the native Mandarin grammar faithfulness for the place feature of the coda nasal dominates the constraint Id-[back] for the vowel. The result is that four possible input combinations are reduced to two by Rhyme Harmony with the choice determined by preservation of the nasal place feature. This ranking formalizes the idea that the nasal coda is the site of the lexical contrast while the [+/–back] difference in the low vowel is a redundant property which is distributed by Rhyme Harmony to reinforce the /n/ vs. /ŋ/ contrast. This point is illustrated by the tableaux in (3).

(3)

/ɑn/	RH	Id-CPl-Coda	Id-[back]
☞ [an]			*
[ɑn]	*!		
[ɑŋ]		*!	
/aŋ/			
☞ [ɑŋ]			*
[aŋ]	*!		
[an]		*!	

On the other hand, in the English-Mandarin loanword grammar an Output-Output faithfulness constraint Id-[back]$_{E-M}$ for the more phonetically salient and enhancing [back] feature in the vowel is cloned and ranked above faithfulness for the nasal coda (4). It is assumed that the L1 grammar mapping native inputs to outputs and the loanword grammar transmitting words from English to Mandarin share the same ranking of markedness constraints but can differ in the ranking of faithfulness constraints through the action of constraint cloning. After the initial stage of adaptation modeled here the source of the loan may be forgotten or no longer available through reduced language contact in which case the loanwords may form a special stratum of the overall lexicon. See Kenstowicz (2005) for further discussion.

(4) Rhyme Harm, Id-[back]$_{E-M}$ » Id-CPl-Coda » Id-[back]
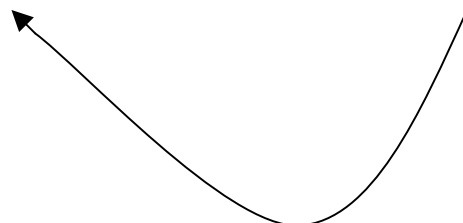
The result of the ranking in (4) is that the competition to respect to Rhyme Harmony is resolved in favor of preservation of the vowel for words that derive from English. This makes sense if the role of

such redundant features is to reinforce the lexical consonantal feature, especially in contexts like the nasal coda where the internal phonetic cues to place of articulation are relatively weak and the site of frequent cross-linguistic and dialectal neutralization. The tableau in (5) shows how disharmonic inputs from English such as those in (2) are now adapted with faithfulness to the vowel.

(5)

/ɑn/	RH	Id-[back]$_{E-M}$	Id-CPl-Coda	Id-[back]
[an]		*!		
[ɑn]	*!			
☞ [ɑŋ]			*	
/aŋ/				
[ɑŋ]		*!		
[aŋ]	*!			
☞ [an]			*	

In order to support the key premise that backness in the vowel enhances the place distinction in the nasal coda and thus motivates the reranking seen in (4), Hsieh et al. (2009) point to gating experiments by Mou (2006) showing that Mandarin subjects can reliably guess the identity of the upcoming coda nasal after hearing just the first half of the low-vowel nucleus. These experimental results support the idea that perception is involved in loanword adaptation. However, native grammar constraints like Rhyme Harmony as well as the enhancing relation between vowel backness and the place of articulation of the coda nasal are crucial in explaining why the vowel is preserved in preference to the nasal consonant. A segment-by-segment matching of L2 acoustic outputs with their L1 counterparts would faithfully map English [æ] vs. [ɑ] and [n] vs. [ŋ] to Mandarin [a] vs. [ɑ] and [n] vs. [ŋ]. Native grammar would then incorrectly resolve the conflict with respect to Rhyme Harmony in favor of the distinctive nasal. Only an approach that allows speech perception factors as well as native grammar constraints to jointly and simultaneously shape the loan can account for this example.

3. Moroccan Arabic

Our second example is based on the findings of Kenstowicz and Louriz (2009) concerning the adaptation of French (and Spanish) loanwords into Moroccan Arabic (MA). Like other Arabic dialects, MA has three vowel phonemes (/i/, /u/, /a/) as well as a contrast between plain and emphatic (pharyngealized) consonants (transcribed here with upper case letters). The vowels are realized with lowered and retracted allophones in the context of a tautosyllabic emphatic consonant.

Following Heath (1989), we transcribe these vowels as [e], [o], and [ɑ]. Finally, in contrast to most other Arabic dialects including the standard, MA has eliminated the opposition between long and short vowels. The phenomenon of interest here is the vowel correspondences found in loans. As first observed in Heath (1989) and documented in detail in Kenstowicz and Louriz (2009), French [o], [ɔ], and [a] are regularly adapted by introducing pharyngealization on the adjacent consonant. For loans with [e] and [ɛ] the outcome is more variable, ranging among [i] and [a] with plain consonants and [e] with an emphatic. Some examples appear in (6).

(6)   French   MA
        [i] style   [i] stil   'style'
        [u] couche   [u] la-kuʃ   'diaper'
        [a] salle   [ɑ] SɑL-ɑ   'Moroccan style room'
        [a] stage   [ɑ] STɑʒ   'training'
        [a] glace   [ɑ] Lɑ-gLɑS   'ice-cream'
        [ɔ] port   [o] PPoR   'port'
        [o] tôle   [o] ToL-ɑ   'sheet iron'
        [ɛ] veste   [i] fist-a   'suit jacket'
        [ɛ] hôtel   [e] wTeL   'hotel'
                              LoTeL
        [ɛ] chèque   [a] ʃʃak   'cheque'

The pattern here is similar to Mandarin. The tongue body features of [–high] for nonlow vowels [+back] for low vowels enhance the [+constricted pharynx] feature that marks tautosyllabic emphatic consonants by an analogue of Mandarin Rhyme Harmony that prohibits a combination of [i,u,a] and a pharyngealized (emphatic) consonant in the same syllable. For the native grammar mapping inputs to outputs, faithfulness to the distinctive [constricted pharynx] in the consonant dominates faithfulness to the features of [–high] and [+back] in the vowel. So if an [e,o,ɑ] were to appear in the input in a nonemphatic context under Richness of the Base, it would change to an [i,u,a] by faithfulness to the distinctive [constricted pharynx] feature in the consonant as well as markedness constraints restricting the vowel inventory to the canonical [i,u,a]. This is illustrated by the tableaux in (7).

(7)

/tɑ/	RH	Id-[constr ph]	Id-[back]
☞ [ta]			*
[tɑ]	*!		
[Tɑ]		*!	
/Ta/			

☞ [Tɑ]			*
[Ta]	*!		
[ta]		*!	

But in the French-MA loanword grammar, due to the enhancing relation between backness in low vowels and emphatic consonants, faithfulness to [back] will dominate faithfulness to [constricted pharynx]. The result is that a French loan with a low back vowel such as *salle* will be adapted as [SɑL-ɑ] with the introduction of pharyngealization on the consonant. (Like other Arabic dialects, MA has emphasis harmony that spreads the [constricted pharynx] feature to other consonants of the stem such as the lateral in [SɑL-ɑ]. See Kenstowicz and Louriz 2009 for details.)

(8)	/sɑ/	RH	Id-[back]$_{F-MA}$	Id-[constr ph]	Id-[back]
	[sa]		*!		
	[sɑ]	*!			
	☞[Sɑ]			*	

It is clear that the pharyngeal consonants are the seat of the lexical contrast in MA for when loans are integrated into the language's templating morphology the vowels may change but the pharyngealization introduced on the consonant remains: cf. *boîte* 'tin can' > *bwaT* but *bwiyT-a* 'diminutive'. As in Mandarin, the reranking of faithfulness for [back] in the vowel above faithfulness for [constricted pharynx] in the consonant is motivated by the enhancing relation between these features. Experimental evidence exists that supports this relation. Shoul (2008) conducted perception experiments in which the formant structure of the vowels in [ti], [tu], and [ta] stimuli were systematically altered. He found that increasing F1 in [ta] altered the perception of MA subjects to [Tɑ] while decreasing F2 changed [tu] to [To]. Both formant changes were active in changing the perception of [ti] to [Te].

In sum, in both Mandarin and Moroccan Arabic the loanword adaptation strategies are guided by the enhancing relation that exists between the redundant but salient vocalic features and the lexically distinctive consonantal features. The consonantal features become the site of the lexical contrast when the word is integrated into the native lexicon, as shown by the *boîte* 'tin can' > *bwaT* but *bwiyT-a* example from MA.

4. Yanbian Korean

Ito and Kenstowicz (2008) study the segmental correspondences in a corpus of c. 240 recent loans from Mandarin into the Yanbian dialect of Korean spoken in Northeast China, focusing on how the Mandarin binary aspirated-unaspirated contrast is reflected in Korean's ternary aspirated-tense-lax distinction. They find that Mandarin aspirated stops are adapted as Yanbian aspirates in both word-initial and word-medial positions while Mandarin unaspirated stops are adapted primarily as Yanbian tense stops word-initially but as lax stops word-medially. Our discussion here focuses on the correspondences in word-initial position. Some examples appear in (9) below, transcribed in the Pinyin transliteration where *p,t,k* indicate voiceless aspirated stops and *b,d,g* indicate voiceless unaspirated stops. The numbers in parentheses show the frequency of each correspondence in the corpus. The Mandarin tones are indicated with the Chao numbering.

(9)

Ma	YB-initial	YB-medial	Examples
p	p* (27), p (1)	p (19)	bing4-du2病毒 'virus' → p*íŋ.tu
pʰ	pʰ (5), p (1)	pʰ (13)	pei4-yin1 配音 'voice artist' → pʰei.ín
t	t* (23), t (2)	t (9), t* (8)	dian4-chi2 电池 'battery' → t*ɛ́n.chɨ
tʰ	tʰ (17)	tʰ (12)	tong2-ju1 同居 'live together' → tʰuŋ.cwí
k	k* (9), k (1)	k (13), k* (6)	guo4-min3 过敏 'allergy' → k*wɔ́.min
kʰ	kʰ (9)	kʰ (17)	kong1-tiao2 空调 'air-conditioner' → kʰúŋ.thjo

The question here is why the Mandarin unaspirated stops are adapted with the marked tense series rather than with the unmarked lax one. This is especially puzzling since while the voiceless aspirated initial stops of English are adapted as aspirated in the Seoul dialect, the (minimally) voiced initial stops are adapted as lax—not tense as in Yanbian. Ito and Kenstowicz (2008) show that the phonetic correlates of the Yanbian (and Mandarin) stops are crucial to understanding this correspondence. In the extensive phonetic literature on these contrasts, the phonetic correlates have been found to include VOT, closure duration, as well as F0 and voice quality in the following vowel. In (10) below we review the findings of several earlier studies along with the results of Ito and Kenstowicz' (2008) analysis of their Yanbian consultant. The first important point is that VOT fails to distinguish the tense from lax stops in word-initial position. In this regard Yanbian differs from most other Korean dialects, though Silva (2006) finds that the lax stops have fallen together with the aspirated for the youngest generation of Seoul speakers.

(10) VOT (ms)

YB	Labial	Coronal	Velar	Ave	L & A	C-Seoul	C-Cheju	K & P	S & J	S-Y
Aspirated	55	55	71	60	104	120	105	81	80-120	**75**
Lax	8	9	20	**12**	30	**70**	45	50	30-50	**70**
Tense	8	9	19	**11**	12	**20**	20	22	10-20	10

As far as F0 in the following vowel is concerned, Cho et al. (2002) find that the lower values for the lax stops are a reliable correlate distinguishing them from the tense and aspirated stops. But the speech of the Yanbian consultant reveals no reliable difference for this factor as well. It is rather in the voice quality of the following vowel that the tense and lax consonants are distinguished in Yanbian. The lax consonants are associated with breathy voice while the tense ones are associated with creaky/pressed voice. The measures reported in (11) compare the Yanbian values for the difference in the first two harmonics (H1-H2, the standard measure of voice quality) at the onset of the vowel. We see that Yanbian disperses the three-way contrast across this dimension quite broadly.

(11)   Voice quality: breathy vs. creaky (H1-H2)

	Ch	C	C*
Seoul (older speakers: Cho et al. 2002)			
H1-H2 (V onset, dB)	2	5	-3
Seoul (younger speaker: Kim et al. 2002)			
H1-H2 (V onset, dB)	3.9	4.2	-4.8
YB word-initial position: mean			
H1-H2 (V onset, dB)	6.3	-2.8	-7.1

Ito and Kenstowicz (2008) also replicated the perception experiment of Kim et al. (2001) for Yanbian in which [Cʰa], [C*a], and [Ca] stimuli were spliced at the zero-crossing point and systematically interchanged to yield nine combinations, which their Yanbian consultant was asked to categorize. The results reproduced in (12) show that the presence of a VOT lag suffices to trigger an aspirated stop judgment. But when this cue is lacking and the consonant is ambiguous between tense and lax then the voice quality in the following vowel ([t*a] vs. [ta*]) determines the judgment. Finally, when a relatively breathy vowel [aʰ] characteristic of aspiration is combined with an onset [t*] or [t] that lacks substantial VOT then the cues conflict. Here the judgment is predominantly lax suggesting that when the acoustic cues are ambiguous the grammar assigns a default (unmarked) categorization, which of course is lax in Korean.

(12)   Cross-splicing experiment in YB: word initial

Target Stimulus	Subject Judgment
ta	lax
ta*	tense

taʰ	lax, lax ≈ aspirated
t*a*	tense
t*a	lax
t*aʰ	lax
tʰaʰ	aspirated
tʰa	aspirated
tʰa*	aspirated

In sum, these experimental findings indicate that the tense stops are distinguished from the corresponding lax ones primarily by F0 in Seoul but by voice quality in Yanbian. This difference makes sense in terms of Enhancement Theory. Yanbian has preserved the lexical pitch contrasts of Middle Korean and so F0 is unavailable to supplement the consonantal laryngeal contrasts. The Seoul dialect on the other hand has lost the pitch contrasts and so can recruit F0 as an additional cue. Moreover Jun (1993) finds that the %LH intonational melody for the Accentual Phrase has taken on a %HH variant after aspirated and tense consonants, suggesting that the enhanced F0 for the Seoul dialect has been phonologized into the phrasal intonational phonology. Thus, in both contemporary Seoul and Yanbian speech an earlier ternary VOT distinction has been traded for two binary distinctions: VOT and F0 vs. voice quality.

Returning to the loanword correspondences, Ito and Kenstowicz (2008) report the values listed in (13) for the speech of their bilingual consultant concerning the phonetic correlates of the binary laryngeal contrast in Mandarin and the ternary contrast in Yanbian.

(13) Phonetic correlates in initial position

Aspirated	Ma	YB	Unaspirated	Ma	YB-lax	YB-tense
VOT (ms)	63	60	VOT (ms)	11	12	11
F0 (Hz)	277	268	F0 (Hz)	268	249	255
H1-H2 (dB)	3	6.3	H1-H2 (dB)	-5.6	-2.8	-7.1

The Mandarin (Ma) and Yanbian (YB) aspirated stops align well on the perceptually decisive VOT dimension as well as F0 and H1-H2. (The F0 values were averaged over all four Mandarin tones as well as Yanbian high and low pitches.) As far as the unaspirated stops are concerned neither VOT nor F0 decide between a tense vs. lax adaptation. However, the data indicate that Mandarin unaspirated stops are associated with relatively creaky voice in the following vowel and hence provide a good basis for deciding the Yanbian adaptation in favour of the marked tense stops over the unmarked lax ones. We recall that the evidence from the perception experiment indicated that when VOT was not decisive then voice quality determined the judgment of the stimulus. The loanword correspondences, the perceptual evidence, and the phonetic correlates thus all point to the voice quality in the

following vowel as the crucial factor. This is a classic case of enhancement since the segment-internal cues to the tense vs. lax contrast such as closure duration and passive voicing are unavailable in word/phrase-initial position. The enhancing cues in the following vowel then become crucial in distinguishing tense from lax stops and they guide the loanword adapter in deciding between these two categories when a word is transmitted from Mandarin to Yanbian.

5. Summary and Conclusion

This paper reviewed the results of several case studies of loanword adaptation in the light of the three models of loanword adaptation that have arisen in the recent literature. The findings suggest that the phonetic details of the realization of a sound in the donor language play a critical role in how the loan is adapted. As such they are beyond the grasp of the Phonological stance proposed in LaCharité and Paradis (2005). But equally importantly, they demonstrate that the phonotactic constraints and the enhancement relations linking redundant and distinctive features are crucial in shaping the loan. Hence our results are incompatible with a model that relies solely on extra-grammatical acoustic matching such as that proposed by Peperkamp and Dupoux (2003). The Optimality model with its key insight of faithfulness constraints allows both the phonetic details of the donor language as well as the phonotactic constraints of native grammar to interact in shaping the loan and hence we argue offers the most comprehensive and insightful approach to the topic. However, in order to raise this approach above the descriptive level (a necessary precursor to any serious study of a complicated phenomenon), it is important to seek generalizations as to the adaptation strategies that are deployed in the face of different options. The case studies reviewed here (as well as others—see Kenstowicz 2003) suggest that the features that stand in an enhancing relation in the native grammar can help to narrow the analytic options. In each of the three cases reviewed in this paper, it is the phonetically more salient features in the vowel that enhance a contrast in the adjacent consonant that determine the outcome.

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