The Adaptation of Japanese Loanwords into Korean*

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This study reports the results of an analysis of some 1,300 Japanese loanwords into Korean and considers their implications for theories of loanword adaptation. It is argued that adaptation runs off the systematic phonetic level of representation of the donor language, taking into account the phonetic cues to phonological categories as well as the relative location of segments in a system of surface phonetic contrasts.

1. Introduction

Both the Korean and Japanese lexicons are marked by extensive loanwords. Within the generative framework the adaptation of loans from western languages (especially English) into these two languages has been intensively studied over the past decade. There is also a rich literature on Chinese loans in traditional Korean and Japanese linguistics. But as far as we are aware, this is the first generative study on the adaptation of loans from Japanese into Korean.[1] We report the results of an analysis of c. 1,300 loanwords from Japanese words of native or Sino-Japanese origin. Most of the loans we study here were transmitted during a period of massive borrowing that spans the late 19th century until the end of World War II (c. 1880-1945), although Japanese words have continued to enter the language since then, particularly after the normalization of diplomacy in 1965 (Song 1989). Since most native Japanese words are written in kanji (Chinese characters), the interference of orthography can be minimized in comparison to most other loanword adaptations studied in

* Earlier versions of the paper were presented at the Workshop on East Asian Linguistics (University of Toronto, April 2006), at the Annual Meeting of Phonology-Morphology Circle of Korea (Cheju University, May 2006), at the North American Phonology Conference (Concordia University, May 2006) and the Linguistics Colloquium at University of California Santa Cruz. We would like to thank Peter Avery, Yukari Hirata, Bill Idsardi, Keren Rice, Hyangsook Sohn and the audiences at these meetings for helpful discussion and comments.

[1] This topic has also been addressed by Kang, S-H. (1991) and Kim, K-H. (2002). See also contributions by Hsieh (2006) and Takahashi (2006) in this volume for studies of Japanese loans into Taiwanese and Palaun, respectively.

MIT Working Papers in Linguistics 52, 65-104

the recent generative literature. However, the influence of orthography cannot be totally excluded given the existence of bilingual dictionaries where Japanese words are often represented in the native hiragana and katakana syllabaries.

2. The Corpus[2]

The words in our corpus are drawn from the 1,312-page *Ulimal Ewen Sacen* (Korean Etymological Dictionary) edited by Kim, Min-Swu (1997).[3] We chose to use the dictionary as our source because the transcription seems to be minimally affected by normative conventions and faithfully reflects the actual pronunciation as far as words of Japanese origin are concerned. We have excluded from the corpus Sino-Korean lexical items such as *c^{h}wikip* 'treatment' (< J. *toriatukai*) as well as words such as *kintɛ* 'modern' (<J. *kindai*) that were coined in Japanese and transmitted to Korean but pronounced according to the Korean rendering of the corresponding hanca (Chinese characters). Our corpus also contains around 200 western loans that were transmitted to Korean via Japanese. These items are of special interest since some have been either subsequently modified or replaced by new borrowings taken directly from the relevant western language (again typically English) (Ito et al. in preparation). For the present paper, we will focus on the loans stemming from the native and Sino-Japanese strata of the Japanese lexicon. The loanwords in our corpus are drawn from several major lexical fields: construction (J. *kugi* > K. *kuki* 'nail'), cuisine (J. *udoN* > K. *utoŋ* 'noodle'), publishing (J. *paareN* > K. *p*aren* 'parenthesis'), recreation (J. *hineri* > K. *hineri* 'twist' (billiards)), fashion (J. *uwagi* > K. *uwaki* 'jacket') and beauty (J. *kote* > K. *kote* 'curling iron'). Our data is cited in phonemic notation unless otherwise indicated. For Korean the tense series of consonants is denoted as /p*/, the aspirated as /p^{h}/, and the lax as /p/. Long vowels are transcribed as geminates. The paper discusses first the adaptation of vowels and then consonants.

3. Vowels

3.1 Vowel quality

The commonly accepted phonemic vowel inventories of the two languages are given in (1).[4]

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[2] The data base for our study was constructed by the first author. It will become available at the website of the Research Institute for Languages and Cultures of Asia and Africa, Tokyo University of Foreign Studies URL: http://joao-roiz.jp/KRLOAN.

[3] We express our sincere gratitude to Prof. Choe, Hocheol for providing us with a copy of this out-of-print dictionary.

[4] In the speech of the younger generation of contemporary Seoul Korean, several changes are underway, namely merger of /ɛ/ and /e/ to /e/, diphthongization of /ö/ to /we/, raising of /o/ closer to /u/ and retraction of /ʌ/ (Hong 1991) leading to a simpler vowel system that more closely

(1)

	i	u	i	ɨ	u
	e	o	e, ö	ʌ	o
		a	ɛ	a	
	Japanese			**Korean**	

The Japanese vowels are a subset of the Korean inventory. Given their different sizes, the vowels of the two systems might be expected to partition articulatory-acoustic space differently. But when we examine the loanword correspondences, we find that they pick out exactly the phonologically matching Korean vowels.[5]

(2)

Japanese	Korean	
beNtoo	pent*oo	'boxed lunch'
azi	aci	'horse mackerel'
hako	hak*o	'box'
kagami	kakami	'mirror'
sebiro	sepiro	'suit'
teNpura	tenp*ura, temp*ura	'tempura'

There is one systematic exception. Japanese /u/ is adapted with the Korean central vowel /ɨ/ when it appears after the coronal sibilants [tˢ], [s], and [(d)ᶻ]. Elsewhere it is adapted as /u/.

(3)

	Japanese	Korean	
a.	baNg**u**mi	paŋk**u**mi	'program'
	unagi	**u**naki	'eel'
	j**u**r**u**mi	j**u**r**u**mi	'relaxed'
	gak**u**	kak*-**u**	'frame'
b.	[tˢ]**u**mi	s*-**ɨ**mi	'stack, pile'
	jaki[tˢ]**u**ke	jak*is*-**ɨ**k*e	'glazing, baking'
	ko[tˢ]**u**zai	kos*-**ɨ**cai	'iron bar'
	s**u**si	s**ɨ**si	'sushi'
	s**u**imono	s**ɨ**imono	'type of soup'
	miz**u**age	mic**ɨ**ake	'unloading catch of fish'
	kaz**u**noko	kac**ɨ**nok*o	'herring roe'

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approximates Japanese. However, most of the loans we study here were adapted in the first half of the last century when the system in (1) was still in effect.

i	ɨ	u
e		o
	ʌ	
	a	

5 There are 11 examples in our corpus that show Japanese /e/ variably adapted as Korean /i/. For example, *maekak*e~maikak*e* 'apron' (< J. *maekake*). Kang, S-H. (1991) makes the same observation. The cause of this variation is unclear but may be relevant to the raising of /e/ to /i/ attested in long vowels and in certain short vowels in many central dialects of Korean (for example, *se:saŋ* > *si:saŋ* 'world', *pekɛ* > *pikɛ* 'pillow') (Kwak, C-K. 2003). Kang, S-H. also reports occasional adaptations of /o/ as /u/ and /u/ as /o/, which is not attested in our corpus except for an English loan K. *nampho* < J. *rampu* < E 'lamp'.

This apparent exception is readily explained. Japanese /u/, frequently transcribed as the unrounded high back vowel [ɯ], is realized as centralized [ɯ̈] after [tˢ], [s], and [z] (Homma 1973: 352-3, Fitzgerald 1996). Since this allophone is not likely to be represented in any bilingual learner's dictionary, we can be reasonably confident that it has been matched with the Korean vowel that most closely approximates it phonetically. This is another example where a nondistinctive variant in the source language coincides with a phoneme in the borrowing language (Iverson and Lee 2004).

Study of bilingual texts published in Korea allows the Japanese affrication process and the change in vowel quality to be dated (Hamada 1970). In the text *I-lo-pha* (*Iroha*) (1492) Japanese /ti/ and /tu/ were transcribed as Korean /ti/ and /tu/. But less than two centuries later, Japanese /ti/ and /tu/ appear as Korean /ci/ and /cu/ in *Chep-hay-sin-e (Syookai singo)* (1676). In the next century, the updated version of the same text (1781) and another bilingual text, *Way-e-ryu-hay (Wago ruikai)* (1786), transcribe Japanese /ti/ as Korean /ci/, while Japanese /u/ appears as /ɨ/ after /s/, /z/, /t/, and /d/, and as /u/ elsewhere.[6]

The loanword adaptations and bilingual equivalences leads us to ask how the two allophones of Japanese /u/—[ɯ̈] in post-sibilant position and [ɯ] elsewhere—compare with Korean /ɨ/ and /u/ in acoustic space. We are not aware of any phonetic studies that address this question directly. We have tried to make a rough comparison by examining the formant values for male and female speakers from two recent studies by Lee, J-K (1997, 1998), which are two parts of a larger study. For female speakers, we also include Homma (1973), which separately reports the formant values of /u/ in post-coronal consonant position and other contexts separately (marked as [ɯ̈] and [ɯ], respectively in the figure). In Lee, J-K. (1997, 1998), the vowels are word-initial and embedded in a carrier sentence read in each study by three female and three male speakers of the Seoul and Tokyo dialects. In Homma (1973), the vowels are either in the first or second syllable with a varied preceding consonantal context, read by a single female speaker of the Kyoto dialect, the author. Figure 1 shows a plot of the vowels for female speakers and Figure 2 for male speakers in terms of the format suggested in Ladefoged (1993), where the vertical axis is first formant and the horizontal axis is F2-F1.

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[6] It is unclear whether the change in the Korean transcription of Japanese post-sibilant /u/ from 'u' to 'ɨ' around the 18th century is a reflection of a change in Japanese or in Korean. While Hamada (1970) interprets this change as a reflection of fronting of the Japanese vowel in post-sibilant position, Kim, W-J. (1971) and Kim, B-K. (2003) analyze the change in transcription as evidence that the Korean vowel corresponding to the present day /ɨ/ used to be a mid vowel but raised to a high vowel position around the 18th century—part of the Korean Great Vowel Shift—thereby making itself available for transcription of the fronted /u/ of Japanese in post-sibilant position.

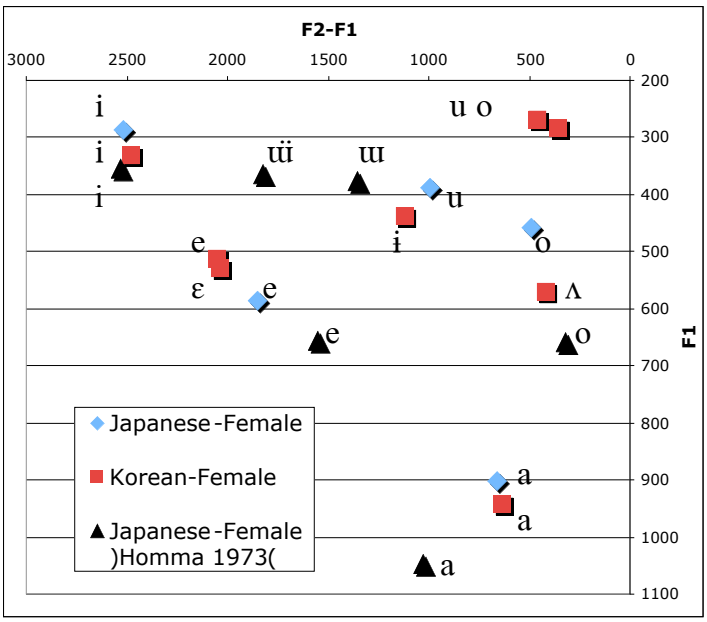

Figure 1: Japanese and Korean Vowel Formants (Female): Based on Lee, J-K. (1997, 1998) and Homma (1973)

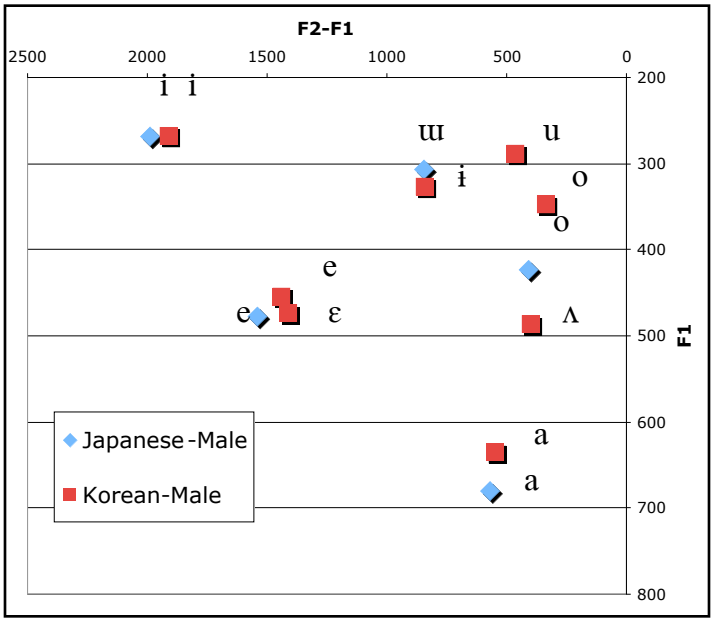

Figure 2: Japanese and Korean Vowel Formants (Male): Based on Lee, J-K. (1997, 1998)

These plots reflect the vowel mergers and subsequent shifts found in the younger generation of Seoul speakers noted in footnote 4. In particular /o/ has raised to nearly merge with /u/ and the mid unround vowel /ʌ/ has evidently retracted to the position formerly occupied by /o/. If we undo the effects of these mergers to recover the vowel system of (1) then we see that the loanword correspondences assign the Japanese vowels to the phonetically closest Korean vowels—except in one case. Japanese /u/ is normally adapted as Korean /u/ even though a visual examination of the vowel plots suggests that Korean /ɨ/ provides a closer phonetic match. Japanese /u/ is frequently described as unrounded ([ɯ]) and therefore different from French or Korean /u/. Also the tongue body is considered to be further forward than the /u/ of French and Korean (Akamatsu 1997). Lack of lip rounding and fronting of the tongue body in back vowels both have the acoustic effect of raising F2 (Stevens 1998), bringing the Japanese vowel closer to Korean /ɨ/ than to /u/ in its F2 value.

However, we might still consider Korean /ɨ/ to be a better match for Japanese /u/ on the grounds that although the Japanese /u/ lacks lip rounding, it is articulated with vertical lip compression (a gesture for which there is no IPA symbol—Vance 1987, Ladefoged and Maddieson 1996, Okada 1999). In other words, the Japanese high back vowel is produced with narrowing of the lip opening but without lip protrusion. The allophonic realization of /h/ as a bilabial fricative [ɸ] before /u/ is indicative of this labial component. If we assume that Korean adapters perceive and categorize the Japanese vowels in terms of features that are contrastive in the Korean vowel inventory, then they can reasonably be expected to equate Japanese lip compression with Korean lip protrusion as two different articulatory realizations of the same feature [labial]. For this explanation to go through, however, it must be assumed that either the post-sibilant [ɯ̈] allophone is [-labial] or that it lacks a sufficient degree of lip compression so as to inhibit the straightforward Japanese /u/ → Korean /u/ mapping. This is in line with the impressionistic description of the post-sibilant variety of Japanese /u/ found in the Korean literature—namely, the weak labiality found in the Japanese /u/ vowel is further weakened when the vowel follows sibilants (Kim, W-J. 1971).[7] It is notable that in the Yonaguni dialect of Okinawa (Joo 1977, p.125) where the Japanese mid vowels have raised to high (/e/ > /i/ and /o/ > /u/), /u/ after /s/, /z/, /t/ and /d/ has merged with /i/ suggesting that the post-sibilant /u/ is sufficiently advanced and the labial gesture is extremely weakened.

These data are problematic for two of the three major models of loanword adaptation that have been proposed in the recent theoretical literature. The phonological model of LaCharité and Paradis (2005) holds that loanwords are adapted primarily by bilinguals who draw on their linguistic competence in both the donor (L2) and the native (L1) grammars to discern equivalences at a phonological/phonemic level that abstracts away from the details of allophonic and phonetic realization. They call attention to a comparable asymmetry in the

[7] While the sources agree on the fronting of /u/ after sibilants, they differ on whether this change is extended to other coronals including [n], [j] and [r] (Akamatsu 1997: 284, note 88). The fact that Japanese /u/ is adapted as Korean /u/ after these non-sibilant coronal consonants suggests that whatever fronting there might be in this context, it is less stable and salient than after sibilants and/or the labial gesture is not as weak as following sibilants.

adaptation of English loans into French where the English lax high vowels /ɪ/ and /ʊ/ are mapped to French /i/ and /u/ instead of to the acoustically closer /e/ and /o/. If loanwords are adapted in terms of distinctive features then the [+high] of English /ɪ/ and /ʊ/ will trump [tense] or [long] (features which are not operative in French phonology) to make the French high vowels /i/ and /u/ better matches than the mid /e/ and /o/—regardless of the acoustic differences that enter later in the phonetic realization component. In order to apply their model to the case at hand, we must assume that the otherwise redundant [+labial] component of the Japanese /u/ is present at the phonemic level in order to make Korean /u/ a better match than Korean /ɨ/. More problematic is the fact that the Korean adaptation takes account of the Japanese [ɯ̈] allophone. This segment would not be expected to be present at the phonemic level, where the loanword equivalences are defined under LaCharité and Paradis (2005)'s model. Yet it is precisely in the post-sibilant context that Japanese /u/ is adapted as Korean /ɨ/, strongly suggesting that the adaptation is taking account of this predictable allophone. Finally, /u/ readily occurs after the sibilants in Korean (*e.g., supak* 'water melon'), precluding appeal to a parallel /u/ -> [ɨ] postsibilant mapping in the grammar of Korean.

A model of loanword adaptation that assumes that mapping is strictly based on phonetic similarity between the outputs of the donor and recipient languages (Silverman 1992; cf. Peperkamp 2002, Peperkamp and Dupoux 2003) also fails to explain the adaptation of Japanese /u/ in a straightforward manner. According to Peperkamp and Dupoux (2003), the equivalences in loanword adaptation are based on phonetic similarity, defined as "acoustic proximity or proximity in the sense of fine-grained articulatory gestures." The phonology of native language plays no direct role in this matching process.

When we examine the acoustic properties of these vowels, given the close proximity of the Japanese /i/, /e/, /a/, and /o/ and their Korean counterparts in acoustic space (Figures 1 and 2), the adaptation of these vowels need not implicate recourse to distinctive features or other grammatical categories. However, this model would seem to incorrectly predict that Japanese [ɯ] should be adapted as Korean /ɨ/ since they are most similar in the acoustic map of Figures 1 and 2. It is conceivable that the lip compression associated with Japanese [ɯ] might have an acoustic reflex that outweighs its F2 proximity to Korean /ɨ/. According to Stevens (1998), labial constriction in high back vowels lowers not only F2 but higher formants as well. We might thus wonder whether Japanese [ɯ] will appear closer to Korean /u/ than to Korean /ɨ/ along this acoustic dimension. We are aware of two studies that provide F3 measures for the vowels of Japanese and Korean. Keating and Huffman (1984) report the formant values for seven Japanese male speakers. In their study the surrounding consonantal context was limited to /h/ and /b/, a non-post-sibilant context. Their data can be compared with the formant values reported by Yang (1990) for twenty Korean male speakers, where the vowels were produced in an /h_do/ context.

(4) Japanese

	i	e	a	o	ɯ
F1	359	475	630	480	405
F2	1954	1720	1383	1136	1419
F3	2765	2512	2389	2399	2310

Korean

	i	e	a	o	u	ɨ
F1	341	490	738	453	369	405
F2	2219	1968	1372	945	981	1488
F3	3047	2644	2573	2674	2565	2497

In these data as well Japanese [ɯ] continues to have relatively high F2 (1419) making Korean /ɨ/ (1488) a closer match than Korean /u/ (981). And while Japanese [ɯ] has the lowest reading for F3 (2310), this value is still closer to Korean /ɨ/ (2497) than to Korean /u/ (2565). Finally, for F1 as well Japanese [ɯ] (405) is best matched by Korean /ɨ/ (405). Thus, at least for these data, no matter how the various formants are weighted, Japanese [ɯ] is best matched by Korean /ɨ/ in purely acoustic terms, as schematically represented in (5). Nevertheless, in loanword adaptation Japanese [ɯ] is adapted as Korean /u/ except after sibilants.

(5) Vowel alignment based on acoustic similarity

Japanese	i	ɯ̈	ɯ
Korean	i		ɨ u

On the articulatory side, the Japanese [ɯ] contains a positive labial gesture—lip compression—but it differs from the labial gesture found in Korean /u/, which includes lip protrusion. Even if one grants that the articulatory similarity matches Japanese [ɯ] to Korean /u/ on the grounds that they both contain a labial gesture while /ɨ/ does not, it is unclear why the articulatory similarity should override the acoustic similarity under Peperkamp and Dupoux (2003)'s model.

It thus appears that we need a third model of loanword adaptation that accesses enough phonetic detail of the donor language to distinguish the two allophonic variants of Japanese /u/, while certain other aspects of the phonetic details are ignored, such as differences in the specific labial gesture or the acoustic distance in formant values to a degree (Kenstowicz 2005, Yip 2006). Specifically, we propose that the equivalence with the recipient language crucially refers to the phonology of the native language, giving priority to the phonetic dimension that defines the basic phonological contrast of the recipient language (i.e., the presence or absence of a labial gesture in Korean /u ɨ/) over other, redundant phonetic properties (i.e., specific details in the labial gesture or central vs. back position of tongue body) (cf. Herd 2005, Arsenault 2006). With this ranking of phonetic parameters, Korean speakers assign the feature specification to the Japanese vowels as shown in (6) in the face of the acoustic misalignment noted in (5).

(6) Feature assignment based on contrastive features of Korean

Japanese	i	ʉ̈	ɯ
Korean	i	ɨ	u
[back]	-	+	+
[labial]	-	-	+

The question of just what aspects of the phonetic signal count as the basic contrast while others count as redundant or resulting from enhancements (cf. Keyser and Stevens 2006) and how speakers can acquire this knowledge is a topic of current research. So we cannot assert with confidence that the learnability problem that motivated Peperkamp and Dupoux (2003)'s phonetic adaptation model can be solved under this approach. For the case at hand, however, there is phonological evidence from the native phonology that allows Korean learners to posit [labial] as a phonologically active feature. So we can conjecture that there is no acute learnability problem. For example, there is a co-occurrence restriction against a labial glide and a labial vowel (*wo, *wu) and there is a diachronic and synchronic process of consonant to vowel [labial] assimilation: *mɨl* > *mul* 'water', *pap*ɨta* ~ *pap*uta* 'busy'. On the other hand, there is no phonological evidence to warrant a phonological feature ([central]) distinguishing back and central vowels of Korean.

Another possibility is that the adapters are bilinguals whose grammars organize the acoustic space into a network of phonetically contrasting categories along such dimensions as F1 and F2 in such a way as to permit isomorphic mapping between the two systems so that the three Japanese high vowels [i] > [ʉ̈] > [ɯ] are aligned with the corresponding Korean [i] > [ɨ] > [u]. On this view, it is neither acoustic nor phonological identity per se that is relevant but rather the placement of the segments relative to one another along the appropriate phonetic dimensions.

3.2 Vowel length

Japanese distinguishes long vs. short vowels in all positions in the word. In contemporary Korean vowel length is not reliably contrastive. But in the speech of earlier generations vowel length was distinctive, primarily in the first syllable of the word. Both Ahn (1998:68) and Lee & Ramsey (2000:66) cite such well-known minimal pairs as *mal* 'horse' vs. *maal* 'speech', *nun* 'eye' vs. *nuun* 'snow' (cf. *cʰʌs-nun* 'first snow'). Our etymological dictionary source marks vowel length in its Korean transcriptions. We report the vowel length adaptation patterns, relying on the transcriptions in the dictionary.

In our corpus of loans from the native or Sino-Japanese strata of the Japanese lexicon we find that vowel length is fairly reliably preserved.[8] First of all, a Japanese short vowel is never assigned to a Korean long vowel. As for the

[8] In the Western loanword stratum of the Japanese lexicon, there are more instances of long vowels (cf. Kubozono 2006) including /ii/ and /aa/ and they tend to show less consistent adaptation to Korean. See Ito et al. (in preparation) for discussion of such hybrid loans, i.e., Western words transmitted to Korean through Japanese.

long vowels, there are no instances of long /ii/ or /aa/ in the corpus.[9] The adaptation patterns of the other long vowels are summarized in (7).

(7)	Japanese	Korean	Japanese	Korean	
	/uu/: 19	/uu/: 18	tjuudama	cuutama	'middle sized (ball)'
		/uu/~/u/: 1	rjuubee	rjuubee~rube	'cubic meter'
	/oo/: 92	/oo/: 81	beNtoo	pent*oo	'boxed lunch'
		/o/: 9	ooiri	oiri	'sold out'
		/oo/~/o/: 1	ge[n]noo	gennoo, ginno	'big hammer'
		/oo/ ~ /ou/: 1	sirooto	sirooto, sirouto	'novice'
	/ee/: 24	/e.i/: 22	ke[n]see	kense.i	'check'
		/e.i/~/ee/: 1	heebee	heepee, he.i.pe.i	'square meter'

Interestingly, Japanese /ee/ is adapted predominantly as /e.i/. One may be inclined to explain away this adaptation as orthographic influence since Japanese long vowel /ee/ is written as 'e.i' in hiragana. However, it is notable that /oo/, which is similarly often written as 'o.u' is rarely adapted as /o.u/. The only such example listed in our source is K. *sirouto~sirooto* < J. *sirooto* 'a novice'. Although in the standard pronunciation, Japanese /ee/ is pronounced as a monophthongal long vowel, when Japanese words are pronounced mora by mora, literate speakers render long /ee/ as [e.i], mimicking the kana syllabary. For example, *kiree* 'pretty, clean' is pronounced [ki.re.i] in this speech style. Also there seems to be a fair amount of individual, lexical, and dialectal variation in pronunciation of /ee/ as [e:] or [e.i] (cf. Vance (1987), Akamatsu (1997) and sources cited therein). Therefore, adaptation of Japanese /ee/ as Korean /e.i/ is not totally detached from the actual pronunciation of the vowel in Japanese. On the other hand, /oo/ does not show such variation and is almost never pronounced as [o.u] in Japanese. Therefore, the asymmetrical adaptation of /ee/ and /oo/ owes somewhat to the phonetic realization of these vowels in Japanese. Another factor is that Japanese /oo/ has two different lexically determined representations in hiragana: 'oo' in words such as *ookii* 'big', *koori* 'ice', *toori* 'street' vs. 'ou' in words such as *ouzi* 'prince', *kouzi* 'construction', and *touzi* 'winter solstice'. The 'oo' words arose from the loss of an intervocalic h.

4. Consonants

The table of consonantal phonemes for the two languages appears in (8).

[9] The only potential case of long /aa/ is *aburaage ~ aburage* 'deep-fried tofu' which is adapted into Korean with a short /a/ *apurake ~ apuraki*.

(8)

Japanese			Korean (Ahn 1998)			
p	t	k	p	t	c	k
b	d	g	p*	t*	c*	k*
	s	h	p^h	t^h	c^h	k^h
	z			s		h
				s*		
m	n	ɴ	m	n		ŋ
	r			r/l		
w	j		w	j		

The phonemes have various positional realizations as a function of regular phonological processes. The Japanese stops /t/ and /d/ are affricated before the high vowels, appearing as [t^s] and [d^z] before /u/ and as the palatals [tʃ] and [dʒ] before /i/ and /j/. /s/ is palatalized before /i/ and /j/ while /h/ is labialized to [ɸ] before /u/. In Korean the stops are unreleased in syllable codas, neutralizing the three-way laryngeal contrast. The so-called lax consonants /p t k c/ are voiceless and slightly aspirated in phrase-initial position but variably voiced in intersonorant position. The velar nasal is restricted to the coda and the liquid phoneme is realized as a flap intervocalically and as a lateral in syllable codas. The liquid is barred from initial position except in recent western loans where it appears as [r]. Finally in both languages consonants are palatalized before the high front vowels and glides.

Comparison of the tables in (8) shows that at the phonemic level every Japanese consonant has a feature-wise correspondent in Korean. But disparities arise in the realization of these consonants at the systematic phonetic level. Once again we can ask whether loanword adaptation will abstract away from these positional variations or instead will strive to maintain them in order to achieve the best phonetic match. To preview, we find some evidence for the latter position.

Before turning to this evidence we note that for the most part the loanword correspondences are straightforward with the Japanese consonant seeking out its Korean counterpart with remarkable consistency. Thus, the sonorant consonants /m/, /n/, and /r/ are regularly adapted as /m/, /n/, and /r/ in Korean. In the latter case, the ban on initial liquids that holds over the native vocabulary is suspended.[10] In this respect Japanese loans parallel later English loanwords. (See Kenstowicz 2005 for recent discussion).

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[10] A couple of exceptions are found in Western loanwords borrowed through Japanese, where /n/ is substituted instead (J. *rampu* > K. *namp^{h}o* 'lamp', J. *rjukkusakku* > K. *nik*usak*u* 'rucksack', J. *raɴniɴgu* > K. *nanniŋku* 'undershirt (literally, 'running (shirt)'). Initial laterals are reflected orthographically in Sino-Korean loanwords in the Middle Korean period. They are retained in Northern dialects but have been eliminated in most Southern dialects including the standard Seoul (Sohn 1999:65).

(9)

Japanese	Korean	
maguro	**m**akuro	‘tuna’
ko**m**a	ko**m**a	‘scene’
nagare	**n**akare	‘draw’
ka**n**a	ka**n**a	‘written character’
reemee	**r**eimei	‘dawn’
jogo**r**e	joko**r**e	‘dirt’
hako	**h**ak*o	‘box’
ma**h**oo (biɴ)	ma**h**oo (pjʌŋ)	‘thermos’

In the rest of this section we examine adaptations in which either there is no exactly corresponding segment in Korean, forcing the adapter to make a choice among nonmatching alternatives, or where the corresponding segment does exist but is nevertheless not selected. In part, the high degree of regular correspondence may be due to the fact that Japanese consonants are always followed by a vowel except for the mora nasal and first half of a geminate. Prevocalic position is an optimal location for the realization of the acoustic cues that identify the place of articulation of the consonant. When we look at the one case of Japanese consonantal codas we find considerable variation, perhaps reflecting perceptual difficulties.

4.1 Nasal codas

The adaptation of Japanese nasal codas presents some interesting patterns. In Japanese the nasal is the only consonant to occupy the coda of the syllable (aside from geminates). Furthermore, there is no contrast in place of articulation. The consonant counts as a mora. Prepausally, it is realized with dorsal uvular closure [ɴ] (Akamatsu 1997). It is a homorganic nasal consonant before a stop. Before a fricative it is realized as a nasalized vowel. A nasalized vowel is also the realization when a final nasal is followed by a vowel across a juncture. The place of articulation of the Japanese coda nasal is thus determined by the context. Korean distinguishes three nasal phonemes: /m/, /n/, and /ŋ/. /ŋ/ is restricted to the coda while /m/ and /n/ occupy both the onset and the coda.

When we look at loanword adaptation of Japanese coda nasals into Korean, two strategies are employed with roughly the same frequency. The choice among the Korean /m n ŋ/ phonemes is either determined by the context or by default. Let us start with word-final position, which would be equivalent to prepausal position if the loan is adapted from the citation form. Examples are cited in (10).

(10)

Japanese	Korean	
toppaɴ	top*a**n**, top*a**ŋ**	‘letterpress’
soomeɴ	soome**n**, soome**ŋ**	‘vermicelli’
geɴkaɴ	kenk*a**n**	‘entrance’
tekkiɴ	tek*i**n**	‘reinforcing bar’
dokaɴ	tok*a**ŋ**, nok*a**ŋ**	‘earthenware pipe’
udoɴ	uto**ŋ**	‘noodle’
kobuɴ	k*opu**ŋ**	‘adherent’
odeɴ	ote**ŋ**	‘skewered boiled fish paste’

The adaptation of Japanese [N] in word-final position fluctuates between the velar and the coronal nasals with many words listed with both options in our corpus (11).[11]

(11)

Japanese	Korean			
	m	n	ŋ	n~ŋ
N (98)	.01	.36	.54	.10

We see the /ŋ/ adaptation as selection from among the Korean /m n ŋ/ options of the phonetically closest element to the Japanese dorsal uvular [N] because it preserves the dorsal articulator. The coronal nasal is the one supplied by the native L1 Korean grammar as a default under the commonly accepted *DORSAL >> *LABIAL >> *CORONAL oral place ranking (Jun, J. 1995, Kang, Y. 2000, de Lacy 2002).[12] Thus, the adaptations can be formalized as fluctuation between faithfulness to the Japanese input place of articulation on the one hand, and penalization by the initial constraint in the following markedness preference hierarchy for oral place on the other: IDENT-PLACE ≈ {*DORSAL >> *LABIAL >> *CORONAL}. As shown in (12) below, if IDENT-PLACE dominates the markedness hierarchy, *DORSAL in particular, then /ŋ/ is selected. But if the markedness hierarchy dominates IDENT-PLACE, as shown in (13), then /n/ is selected. Under this analysis a mapping from [N] to /m/ is impossible.

(12)

	toppaN	IDENT-PLACE	*DORSAL	*LABIAL	*CORONAL
a.	top*am	*!		*	
b.	top*an	*!			*
c. ☞	top*aŋ		*		

(13)

	toppaN	*DORSAL	*LABIAL	*CORONAL	IDENT-PLACE
a.	top*am		*!		*
b. ☞	top*an			*	*
c.	top*aŋ	*!			

[11] It is the second author's intuition that the /ŋ/ adaptation is a more general pattern with the /n/ adaptation sounding more artificial.

[12] Another possibility is that /n/ adaptation of Japanese /N/ may be an influence of the Korean pronunciation of the Chinese character (hanca): for example, the hanca-based reading of *soomen~soomeŋ, top*an~top*aŋ,tek*in,* and *kenk*an*in (10) are *somjʌ**n**, jop^{h}a**n**, c^{h}ʌlkin,* and *hjʌnkwan,* respectively, all of which have some currency in Korean. Under this alternative hypothesis, we can replace the place markedness hierarchy with a type of Output-to-Output faithfulness that forces identity to the hanca-based pronunciation of the same Japanese word.

Viewing the coronal nasal /n/ as the default supplied by the native grammar *DORSAL >> *LABIAL >> *CORONAL ranking for oral place features helps us to understand the variation found in the adaptation of preconsonantal coda nasals. Illustrative loans are shown in (14) and the frequencies of these adaptations in our corpus are tabulated in (15).

(14)

	Japanese	Korean	
a.	mo[**m**]pe	mo**m**p*e	'a type of casual pants'
	do[**m**]buri	do**m**puri	'rice topped with main dish'
	bu[**m**]pai	pu**n**p*ai	'distribution'
	ge[**m**]pee	ke**n**p*ei, ke**n**p^{h}ei	'schism'
	te[**m**]pura	te**n**p*ura	'tempura'
		te**m**p*ura	
	se[**m**]bee	se**n**bei	'pancake cracker'
		se**m**bei	
b.	ba[**ŋ**]gumi	pa**ŋ**kumi	'program'
	a[**ŋ**]ko	a**ŋ**k*o	'red bean filling'
	ge[**ŋ**]kaN	ke**n**k*an	'entrance'
	e[**ŋ**]ko	e**n**k*o	'arc'
	te[**ŋ**]kaN	t*e**n**k*aŋ	'epilepsy'
		t*e**ŋ**k*aŋ	
	ta[**ŋ**]ka	ta**n**k*a	'stretcher'
		ta**ŋ**k*a	
c.	da[**n**]dori	ta**n**tori	'management'
	ko[**n**]zjoo	ko**n**co	'disposition'
	ke[**n**]see	ke**n**sei	'check'

(15)

Japanese	Korean				
	m	n	ŋ	m~n	n~ŋ
labial (47)	**.26**	**.55**	.02	**.17**	.00
coronal (87)	.00	**.98**	.02	.00	.00
dorsal (40)	.00	**.60**	**.30**	.00	**.10**

When the following onset consonant is a labial, the Japanese nasal is adapted as /m/ at a rate of 26% and as a coronal 55%, with 17% showing both labial and coronal adaptations. But it is adapted as a dorsal /ŋ/ only 2%. When the following consonant is a dorsal then the frequencies invert with /ŋ/ promoted to 30% and /m/ reduced to zero. In both cases, the percentage of choices for the default /n/ hovers around the mid point (55% vs. 60%) or higher if we include the words showing coronal adaptation variably (72% and 70%). However, when

the following consonant is coronal then the homorganic and default factors sum together to converge on /n/, with a rate of 98%.[13]

This variation can be formalized as faithfulness to the place of articulation of the Japanese nasal coda fluctuating with the same *DORSAL >> *LABIAL >> *CORONAL markedness hierarchy.[14] In these tableaux * LABIAL counts the number of segments that have the [labial] feature specification.

(16)

	te[m]pura	IDENT-PLACE	*DORSAL	*LABIAL	*CORONAL
a. ☞	temp*ura			**	
b.	tenp*ura	*!		*	*
c.	teŋp*ura	*!	*	*	

(17)

	te[m]pura	*DORSAL	*LABIAL	*CORONAL	IDENT-PLACE
a.	temp*ura		**!		
b. ☞	tenp*ura		*	*	*
c.	teŋp*ura	*!	*		*

4.2 Japanese /s/ vs. Korean /s/ and /s*/

We now turn to the adaptation of Japanese /s/. As mentioned above, Korean has two *s*-like phonemes: the tense /s*/ and the "lax" /s/. Paralleling the characteristics of other tense obstruents (see section 4.5.), /s*/ is marked by a sharper F3 and F4 and raised F0 on the following vowel as well as longer duration than /s/ (Kang, H. 2005). On the other hand, a proper categorization of /s/ is controversial since its phonological and phonetic behavior is ambiguous between lax and aspirated categories. It patterns with other lax obstruents in that it undergoes post-obstruent tensification (/siksa/ → [siks*a] 'meal'). On the other hand, /s/ has a significantly wide glottal opening comparable to aspirated

[13] The given name of the Korean film star Pae, Yongcun has been clipped and combined with the Japanese honorific suffix: *joŋcun* > *joŋ-sama*. The latter has been borrowed back into Korean where it appears with a coronal nasal: *jonsama*. Under our analysis *joŋsama* would be highly disfavored since [ŋ] before [s] is neither the default nor homorganic with the following consonant. The two exceptional words where a nasal preceding a coronal is adapted with a dorsal nasal are morphologically complex words (K. *t*eŋ-t*eŋ-i* ('i' diminutive marker) < J. teN-teN 'polka-dot pattern', K. *utoŋ-tama* < J. *udoN-dama* 'a separate order of noodles'), where additional factors such as Base-Reduplicant Faithfulness or Output-Output faithfulness can account for the unexpected [ŋ] adaptation.

[14] The alternative possibility offered in footnote 12—faithfulness to hanca pronunciation—similarly applies to the word-medial realization of Japanese N as /n/ in Korean. Also, in the case of word-medial /n/ adaptation, a hyper-corrective bias may be relevant. In Korean, /n/ assimilates to the place of articulation of the following consonant and therefore, given a surface form of dorsal or labial homorganic clusters (*mm*, *mp*, *ŋk*, etc.), it is always possible that the underlying sequence begins with /n/.

stops (Kagaya 1974, Iverson 1983) and also patterns with other aspirated obstruents of Korean in raising the Accentual Phrase-initial boundary tone from L to H (Kagaya 1974, Jun, S-A. 1993). Also, unlike other lax obstruents, /s/ fails to undergo intersonorant voicing (Iverson 1983).[15]

As shown below, Japanese /s/ is consistently adapted as the Korean /s/ in both initial and medial positions. But Japanese geminate /ss/ is adapted as Korean tense /s*/, following the treatment of geminate obstruents in general.

(18)		Japanese	Korean	
	a.	**s**akura	**s**ak*ura	'cherry blossom'
		sebiro	**s**epiro	'suit'
		wa**s**abi	wa**s**api	'horse reddish'
		susi	**si**si	'sushi'
	b.	a**ss**ari	a**s*** ari	'simply'
		ga**ss**jo	ka**s***jo	'hands placed together in prayer'
		issuN	**is*** ~~i~~n	'one sun' (3.03 cm.)

The adaptation of Japanese /s/ as Korean /s/ is unremarkable in itself. But it takes on some significance when it is compared with the adaptation of /s/ from English. As documented by various researchers (Kim, S. 1999, Oh 2002), English /s/ is adapted as lax /s/ when drawn from a cluster but as tense /s*/ when it is not adjacent to a consonant in the English source word. The following examples are from Kim and Curtis (2002).[16]

(19)		Korean adaptation
	a.	**s**ize, **s**olo	/s*/
	b.	ga**s**, bu**s**, pea**ce**	/s*/
	c.	**s**mog, **s**nack	/s/
	d.	te**s**t, di**s**k	/s/

Kim and Curtis (2002) see this adaptation as reflecting the duration of the English /s/, which is shorter in a cluster (see Davis and Cho 2006 for an alternative interpretation). Specifically, they report an experiment in which eight English speakers read sentences with relevant words (*seek*, *sick*, *sack* vs. *stick* , *stack,* etc.) embedded. The average duration of *sV* words was 170 milliseconds while that of *sC* was 133 milliseconds. They also report a perception experiment in which Korean subjects categorize /s/-stimuli of differing durations as tense /s*/ vs. lax /s/, with a crossover point between 100 and 140 milliseconds that roughly coincides with the 133ms average duration of /s/ in English clusters. If this interpretation is correct it shows sensitivity to a noncontrastive feature in the donor language (English) as well as possibly to a noncontrastive feature in the

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[15] Cho et al (2002), however, found intervocalic voicing in a significant portion of /s/'s in their data.

[16] Kim and Curtis (2002) note that while the words in (19b) can be spelled with a lax [s], native speakers agree that this is only an orthographic convention and that tense [s*] is the appropriate adaptation.

L1 grammar, depending on which features of the Korean [s*] vs. [s] are distinctive and which are redundant and enhancements.

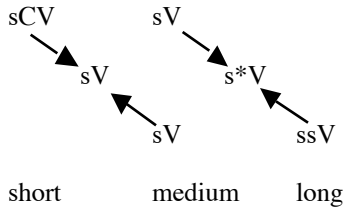
Japanese loans do not contain consonant clusters (aside from medial NC and geminates). A preliminary measurement indicates that the duration of the word-initial singleton /s/ of Japanese is comparable to that of English, if not longer. Also, in a study of the duration of medial consonants in English, Japanese, and Korean, Sato (1998) reports the following average durations and ratios of long to short /s/ in medial position.

(20)				
	English	Miss Seaton	Miss Eaton	Ratio
		202 ms.	111 ms.	1.82: 1
	Japanese	sessoo 'constancy'	sesoo 'social conditions'	
		184 ms.	101 ms.	1.82: 1
	Korean	cossok 'bed material'	cosok 'government subordinates'	
		133 ms.	86 ms.	1.68: 1

The /s/'s of Japanese and English are comparable in duration and somewhat longer than Korean. Therefore, we might expect them to be adapted with tense /s*/.

But in fact, as we have seen, Japanese /s/ is consistently adapted as Korean lax /s/. Assuming that Kim and Curtis's finding that duration is the relevant factor in determining the adaptation is correct, then we are once again faced with a dilemma for the phonological and acoustic based models of loanword adaptation. At the phonemic level, Japanese and English /s/ and Korean lax /s/ are identical feature-wise. The English durational difference only arises later, in the post-lexical phonology or in the phonetics and hence cannot be taken into account by a feature-based adaptation that runs off of the phonemic level—a point explicitly made by Kim and Curtis (2002). On the other hand, given that English and Japanese prevocalic and intervocalic /s/ have comparable duration, the model that bases loanword adaptation on finding the closest acoustic match will draw the wrong equivalences as well. But if the adaptation is based on the relative positions of the two *s*-like categories on the dimension of duration, as schematically represented in (21), then a mapping that respects the relative positions of the consonants along this dimension (i.e. $x > y$ iff $f(x) > f(y)$) will draw exactly the correct distinctions.

(21)



The implications are that sound adaptations are not executed in isolation but as part of a system of surface phonetic contrasts. More generally, adapters are not passive recipients of whatever perception/acoustics transmits to them but rather exercise active control over their grammars to fashion loans that satisfy native

grammar constraints while simultaneously remaining as faithful as possible to the source language's system of phonetic contrasts.

Another possibility is that there are other differences between Japanese and English /s/ in acoustic properties, such as intensity of frication noise, the degree of aspiration and breathiness of the following vowel, which may all affect Korean speaker's perception of the coronal fricatives of foreign languages (cf. Cho et al 2002). Further phonetic and perception study is necessary to explore this possibility.

4.3 Dental stops

As mentioned earlier, Japanese dental stops are realized as the alveopalatal affricates [tʃ] and [dʒ] before /i/ and /j/ and as the alveolar affricates [t^s] and [d^z] before /u/. Due to merger with the jod, the [tʃ] affricate can appear before any back vowel on the surface. In other words, [tʃa], [tʃo], and [tʃu] (as in *tʃa* 'tea', *tʃoosi* 'tune', and *tʃuui* 'attention') are customarily phonemicized as /tja/, /tjo/, and /tju/, respectively. This makes sense phonologically since while jod is contrastive before the back vowels (cf. *abunai* 'dangerous' vs. *jabu* 'bush'; *obi* 'kimono sash' vs. *jobi* 'call'; *ubu* 'naïve' vs. *jubi* 'finger'), jod does not occur before the front vowels /i/ and /e/. This distributional gap is matched by the absence of the palatal affricate before /e/: *[tʃe]. This sequence is found in Western loans, e.g. *tʃesu* 'chess', *tʃeeN* 'chain'. While [t^s] is restricted to appear before /u/ in the native vocabulary, it is found before other vowels in loans. Akamatsu (1997) cites *[t^s]aa* 'czar', *kan[t^s]oone* 'canzone', *[t^s]uiido* 'tweed'. Also, while the affrication of the dental stops before /i/ and /u/ is automatic in the native vocabulary, it can be inhibited in recent loans: *[t]unaito* 'tonight' and *[t]iitʃiŋgu* 'teaching'. These factors suggest that the affricates have taken on the status of "semi-phonemes" (Jakobson 1948)—largely but not entirely predictable segments that may rise to the level of linguistic consciousness for the native speaker. Korean has affricates at just a single point of articulation: alveopalatal. So a priori we might expect that if loanword adaptation occurs at the phonological level then it should abstract away from one or both affricate realizations of Japanese /t/ in favor of adaptation with Korean /t/. But in fact the loanword data indicate that Korean consistently distinguishes the three surface variants of the Japanese coronal stop. The adaptations are summarized in table (22a). Examples appear in (22b).

(22) a.

Japanese	Korean
t	t
tʃ	c (initial), c*(medial)
t^s	s*

b.	**t**a**t**ami	**t**a**t**ami	'Japanese straw floor covering'
	tama	**t**ama	'ball'
	si**t**a	si**t**a	'subordinate'
	[**tʃ**]iri	**c**iri	'fish soup'
	[tʃ]irasi	**c**irasi	'a type of sushi'
	den**[tʃ**]i	ten**c*** i	'battery'
	mo**[tʃ**]i	mo**c*** i	'rice cake'
	[**t^s**]umi	**s*i**mi	'stack, pile'
	[**t^s**]umekiri	**s*i**mek*iri	'nail clipper'
	ka[**t^s**]uo	ka**s*i**o	'bonito'
	ma[**t^s**]uri	ma**s*i**ri	'festival'

The adaptations of [t] and [tʃ] are straightforward in linking up feature-wise equivalent segments as far as the place of articulation and manner features are concerned.[17] (We transcribe the Korean alveopalatal affricate as c.) Since Korean lacks a [+anterior] affricate, there is no mapping that can maintain both the place and manner feature of the Japanese input. The adaptation of Japanese [t^s] involves making a choice among the existing Korean phonemes: /c/, /t/, /s/, and /s*/. The choice of /s*/ over /c/ indicates that faithfulness for place ([anterior]) is ranked over faithfulness for continuancy.[18] Adaptation of [t ^{s}] as either /t/ or as /s/ or /s*/ each involves a change of continuancy and so faithfulness to this feature is not decisive. But if the affricate is represented as a combination of closure and release phases, as suggested in Steriade (1993), then adaptation with Korean /s*/ can be interpreted as faithfulness to the release phase—perhaps because it is more salient phonetically (the closure phase being silence). In order to explain the choice of /s*/ over /s/, we conjecture that the closure phase is still taken into account. The tableau in (23) sketches the [t^s] > /s*/ adaptation.

(23)

	ma[t^s]uri	IDENT-[anterior]	IDENT-DURATION	IDENT-RELEASE	IDENT-CLOSURE
a.	ma<u>c</u>uri	*!			
b.	mature			*!	
c.	ma<u>s</u>uri		*!		*
d. ☞	mas*uri				*

[17] We will discuss the laryngeal adaptation of [t] in section 3.4.

[18] The normative orthographic convention of South Korea dictates (in line with the actual usage, in this case) that Japanese [t^s] be transcribed as /s*/. On the other hand, in North Korea, where the standard Pyongyang dialect has not undergone the palatalization of affricates (Lee, K-M. 1972) and therefore the affricates are still [+anterior], Japanese [t^s] is transcribed as /c/ word-initially and /c*/ word-medially.

It is puzzling, however, that the /s*/ adaptation of the voiceless dental affricate is found not only in word-medial but in word-initial position as well, where presumably the durational cue from the closure portion of the affricate is not reliably available. It is possible that in addition to the durational characteristics, other phonetic properties of the Japanese affricate, such as the degree of aspiration and the quality of the following vowel, make Korean /s*/ a better match than /s/.

4.4 Adaptation of /z/

In our discussion of /s/ adaptation (section 4.2) we saw how the same sound is treated differently depending on the system of contrasts from the source language. The Korean adaptation of /z/ is comparable between English and Japanese sources even though the phonetics is different. Japanese /z/ is realized as an affricate word-initially and as a fricative intervocalically. In word-initial position it is adapted as the Korean palatal affricate /c/.

(24)	Japanese	Korean	
	[**d^z**]arusoba	**c**arusopa	'buckwheat noodles cooled in water'
	[**d^z**]en**z**ai	**c**en**c**ai	'sweet azuki-bean soup'
	[**d^z**]agane	**c**akane	'a (metal) washer'

This substitution might be viewed as faithfulness to the Japanese affricate realization. But there are strong reasons to doubt this conclusion. First, the voiceless Japanese affricate [t^s] is realized as /s*/, preserving the place of articulation over aperture (i.e., continuancy). So we might expect the same behavior for Japanese [d^z]. But we find Korean /c/ instead of the /s*/ or /s/ that would be predicted by the loanword grammar in (23). Most importantly we find the same preference for /c/ in intervocalic position even though here Japanese /z/ is realized as a fricative.

(25)	Japanese	Korean	
	ka**z**ari	ka**c**ari	'ornament'
	take**z**ao	tak*e**c**ao	'bamboo pole'
	mi**z**o	mi**c**o	'defect'

In fact, the asymmetry in adaptation of voiced and voiceless coronal fricatives found in Japanese loanwords (J. /z/ → K. /c/; J. /s/ → K. /s/) is also found in English loans (Oh 2002).

(26)	English	Korean
	zero	**c**ero
	ro**s**e	ro**c**i

One possible explanation is proposed by Kim, H. (this volume) (cf. Oh 2002). Assuming that Korean lax consonants are underlyingly [+voice] with allophonic devoicing in phrase-initial position (Kim and Duanmu 2004), the choice of the /z/ →/c/ mapping over /z/ → /s/ is interpreted as a maneuver of the loanword phonology to remain faithful to [+voice]. The Korean lax affricate /c/ is

normally realized as voiced in intervocalic/intersonorant position. So, mapping of /z/ to /c/ in intervocalic position indicates the ranking of IDENT-[voice] over IDENT-[anterior] and IDENT-CLOSURE. The Korean fricatives /s/ and /s*/ are not subject to intervocalic voicing (Kagaya 1974)[19] and so the adaptation of /z/ to /s/ or /s*/ fails the IDENT-[voice] constraint.

(27)

	ka[z]ari	IDENT-[voice]	IDENT-[anterior]	IDENT-RELEASE	IDENT-CLOSURE
a. ☞	ka[dʒ]ari[20]		*		*
b.	kas̲ari	*!			
c.	kas̲*ari	*!			

However, the fact that the Korean lax stops are devoiced in phrase-initial position now poses a problem. Since all obstruents are voiceless in this position (unviolated *%%[+voice]), IDENT-[voice] is not relevant and we falsely predict adaptation with /s/ to occur.

(28) (💣 represents an incorrectly selected candidate.)

	[dᶻ]akane	*%%[+voice]	IDENT-[voice]	IDENT-[anterior]	IDENT-RELEASE	IDENT-CLOSURE
a.	[dʒ]akane	*!		*		
b. ☞	c̲akane		*	*!		
c. 💣	s̲akane		*			*

Kim, H. (this volume) assumes that Korean adapters extend the affricate adaptation based on the phrase-medial position to phrase-initial position choosing faithfulness to the underlying voicing specification of the Korean consonants over phonetic faithfulness. Our data show that in this respect the adaptation of English and Japanese loans with /z/ are the same.

An alternative possibility is to assume that it is the overall laryngeal characteristics of Korean /s/ and /s*/ that make them a poor match for Japanese or English /z/. As mentioned above, Korean /s/ is not simply voiceless but is also aspirated phonetically and patterns with other aspirated obstruents in inducing high tone on the following vowel in Accentual Phrase-initial position. The same F0 raising is found for /s*/. But no such laryngeal characteristics are present in /c/. Japanese /z/ is a voiced consonant and if anything, is expected to cause lowering of F0 on the following vowels (cf. Kingston and Diehl 1994). Therefore, /c/ is a better match than /s/ or /s*/ in this respect. For the moment, we will use IDENT-LARYNGEAL as a cover constraint for various laryngeal

[19] But see Cho et al (2002) for a different result.

[20] [dʒ] marks the voiced allophone of the Korean lax affricate /c/.

characteristics such as degree of aspiration and vocal fold stiffness, which relates to the F0 of the following vowel. This analysis can account for the /z/ adaptation in both phrase-initial and medial positions, as illustrated in tableaux (29) and (30), where IDENT (voice) is replaced by IDENT-LARYNGEAL.

(29)

	ka[z]ari	IDENT-LARYNGEAL	IDENT-[anterior]	IDENT-RELEASE	IDENT-CLOSURE
a. ☞	ka[dʒ]ari		*		*
b.	ka͟sari	*!			
c.	ka͟s*ari	*!			

(30)

	[dᶻ]akane	*%%[+voice]	IDENT-LARYNGEAL	IDENT-[anterior]	IDENT-RELEASE	IDENT-CLOSURE
a.	[dʒ]akane	*!		*		
b. ☞	c͟akane			*		
c.	s͟akane		*!			*

In the next section we turn to cases where the phonological voiced vs. voiceless contrast is rendered differently depending on the donor language.

4.5 Laryngeal features in stop consonants

Japanese has a two-way laryngeal contrast of voiced and voiceless stops and also has length contrast of singleton vs. geminate for voiceless stops. On the other hand, Korean distinguishes three categories of stops: aspirated, tense, and lax, which are distinguished by a combination of phonetic correlates that include VOT, F0 and voice quality of the following vowel as well as closure duration in word-medial position. (See Cho et al. 2002 for a recent comprehensive review). While the Korean stops have been intensively studied for over forty years, the proper phonetic and phonological characterization of these consonants remains controversial. When comparing Japanese and Korean, there is no straightforward correspondence (phonological or phonetic) between the stop categories of the two languages. Therefore, by examining how Japanese stops—often with conflicting cues with respect to the Korean stop categories—are mapped to Korean, we can gather evidence on the relative importance of the various phonetic correlates in defining the Korean stop categories. These results can then be compared with the findings of experimental phonetic studies that construct stimuli with conflicting cues which subjects are tasked with categorizing as tense, lax, or aspirated.

In this section we first present the pattern of adaptation of Japanese stops into Korean. Then we examine the phonetic properties of the stops of two languages carefully to see which of the phonetic parameters relevant for Korean stop categorization play more central roles. Also, we will compare the Japanese loanwords with English and French loanwords and see how phonologically

equivalent consonants are adapted differently depending on the donor language, due to differences in their phonetic realization.

First, Japanese voiced stops are adapted as Korean lax stops regardless of position in the word. The table in (30) summarizes this point and provides a few representative examples.

(30)

Japanese		Korean adaptation			
		Lax	Tense	Aspirated	
word-initial	/d/	/t/ 30	/t*/ 0	/t^h/ 0	(/n/~/t/: 1)
	/g/	/k/ 24	/k*/ 0	/k^h/ 0	
	/b/	/p/ 24	/p*/ 0	/p^h/ 0	(/p/~/p*/: 1)
intervocalic	/d/	/t/ 109	/t*/ 0	/t^h/ 0	
	/g/	/k/ 136	/k*/ 0	/k^h/ 0	(/k/~/k*/: 3)
	/b/	/p/ 171	/p*/ 0	/p^h/ 0	
post-nasal	/d/	/t/ 9	/t*/ 0	/t^h/ 0	
	/g/	/k/ 10	/k*/ 0	/k^h/ 0	
	/b/	/p/ 18	/p*/ 2	/p^h/ 0	

Japanese	Korean	
dai	**t**ai	‘table’
gara	**k**ara	‘fake’
beNtoo	**p**ent*oo	‘lunch box’
so**d**enasi	so**t**enasi	‘sleeveless shirt’
ma**g**uro	ma**k**uro	‘tuna’
na**b**e u**d**oN	na**p**e u**t**oŋ	‘type of udon’
daN**d**ori	**t**an**t**ori	‘arrangement’
baN**g**umi	**p**aŋ**k**umi	‘programme’
doN**b**uri	**t**om**p**uri	‘bowl of rice with food on top’

Second, the adaptation of Japanese singleton voiced stops is more complex and varies with position in the word (initial vs. medial) and place of articulation. Post-nasally, all three voiceless stops are adapted as tense. Japanese /k/ is adapted as Korean lax /k/ initially but primarily as tense /k*/ intervocalically. Japanese /t/ is adapted as Korean lax /t/ in both initial and intervocalic positions.

(31)

Japanese		Korean adaptation			
		Lax	Tense	Aspirated	
word-initial	/t/	/t/ 101	/t*/ 3	/t^h/ 0	
	/k/	/k/ 240	/k*/ 1	/k^h/ 4	(/k/~/k*/: 1)
	*/p/[21]				
intervocalic	/t/	/t/ 158	/t*/ 0	/t^h/ 1	(/t/~/t*/:1)
	/k/	/k/ 41	/k*/ 374	/k^h/ 5	(/k/~/k*/: 1, /k*/~/k^h/:8)
	*/p/				
post-nasal	/t/	/t/ 0	/t*/ 8	/t^h/ 0	
	/k/	/k/ 5	/k*/ 25	/k^h/ 1	
	/p/	/p/ 0	/p*/ 13	/p^h/ 1	

Japanese	Korean	
ta**t**ami	**t**a**t**ami	‘Japanese straw floor covering’
katuo	**k**as*ɨo	‘bonito’
si**t**a	si**t**a	‘subordinate’
mi**k**aɴ	mi**k***aŋ	‘tangerine’
be[n]**t**oo	pen**t***oo	‘lunch box’
a[ŋ]**k**o	aŋ**k***o	‘red bean jam’

Finally, Japanese voiceless geminates are adapted as Korean tense consonants without exception.

(32)

Japanese	Korean adaptation		
	Lax	Tense	Aspirated
/tt/	/t/ 0	/t*/ 2	/t^h/ 0
/kk/	/k/ 0	/k*/ 15	/k^h/ 0
/pp/	/p/ 0	/p*/ 15	/p^h/ 0

Japanese	Korean	
ja**tt**oko	ja**t***ok*o	‘pincers’
te**kk**iri	tɛ**k***iri	‘certainly’
te**pp**aɴjaki	te**p***aŋ jak*i	‘type of Japanese cooking’

Now let us examine the phonetic properties of the stops of the two languages and see how the attested adaptation patterns can be explained.

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[21] In the native and Sino-Japanese strata of the Japanese lexicon /p/ is only found as a part of geminate or a homorganic nasal plus stop cluster. /p/ occurs in word-initial or intervocalic position only in Western loanwords or onomatopoetic words. The only example of word-initial and intervocalic /p/ in an onomatopoeic word found in our corpus is /pikapika/ ‘glittering’, which is adapted to Korean with a tense /p*/ as /p*ik*ap*ik*a/. Word-initial /p/ found in loanwords from the Western stratum of the Japanese lexicon show a more varied adaptation pattern. See Ito et al (in preparation) for more details.

First, the average VOT values of the three series of Korean stops in initial position from Lisker and Abramson (1964)'s seminal study are summarized in (33).

(33)

		Lax	Tense	Aspirated
Word-initial	labial	22	7	89
	coronal	30	11	100
	dorsal	48	20	125
	av.	33	25	105
Word-medial	labial	13	5	75
	coronal	22	12	78
	dorsal	44	21	93
	av.	26	13	82

The aspirated stops are clearly distinguished from the other stop categories by their high VOT values, a function of wide glottal opening at stop release (Kagaya 1974). But, as noted by Lisker and Abramson (1964) and others (Kim, C-W. 1965, Han & Weitzman 1970), the separation between the lax and tense categories is not very good. The problem is aggravated in word-medial position, where the lax stops undergo intersonorant voicing (Cho, Y. Y. 1990, Silva 1992, Jun, S-A. 1993), further reducing the VOT difference between the lax and tense stop categories.[22] As expected, experimental investigation has shown that VOT alone is not sufficient to distinguish the three-way contrast (Han and Weitzman 1970, Han, J-I. 1996, Kim *et al*. 2002). Rather the contrast between lax and tense stops is more adequately signaled by properties of the following vowel and in the case of intervocalic position also by the duration of the stop closure, to which we will return shortly.

More specifically, F0 is raised following tense and aspirated stops while no comparable F0 raising is found following lax stops (Kagaya 1974, Kim *et al*. 2002, Cho *et al*. 2002). The difference in F0 is phonologized in the Seoul and Cenla dialects where the accentual phrasing is signaled by boundary tones. Words beginning with tense or aspirated consonants systematically take a H-initial boundary tone while other words take a L-initial boundary tone (Jun, S-A. 1994). Kim *et al*. (2002) report that in an experiment where stimuli whose consonantal portion (closure and VOT) and vocalic portion (F0 and breathy vs. pressed voice) carry conflicting laryngeal feature information, subjects overwhelmingly relied on the vocalic portion of the signal to distinguish lax

[22] While the studies cited above find the VOT values of lax stops very close to tense stops to the extent that the two categories are not well separated, other studies find much higher VOT values for lax stops (Silva 1992, Han, J-I. 1996, Jun, S-A. 1998, Cho *et al*. 2002 among others) and Silva *et al*. (2004) goes even further and claims that for many younger speakers of Korean, VOT values for lax and aspirated stops have merged. It seems that the VOT values for the middle category (i.e., lax stops) are unstable and subject to dialectal and generational variations. Since the loan adaptation under discussion mostly occurred in the earlier part of last century, we can assume that the VOT values of the standard Korean at the time of borrowing were close to those reported in the earlier literature.

stops (low F0 on the following vowel) from the others (high F0 on the following vowel). (See Kim, H. this volume for further discussion). Kim *et al.* (2002)'s experimental result is summarized in (34).

(34)

	Stimuli		Response type (%)		
	Consonantal portion	Vocalic portion	Lax	Tense	Aspirated
a.	Lax	Tense	4	**66**	30
b.	Lax	Aspirated	6	24	**70**
c.	Tense	Lax	**92**	7	1
d.	Aspirated	Lax	**81**	0	19
e.	Tense	Aspirated	5	**78**	17
f.	Aspirated	Tense	0	23	**77**

*Majority response in each category is highlighted in boldface.

First, when the consonantal portion carries the cues for a lax stop but the vocalic portion carries the cues for a tense or aspirated stop (i.e., high F0), (34a,b), the majority of responses follow the vocalic cues (tense or aspirated). When the vocalic portion carries the lax stop cues (low F0) and the consonantal portion carries the cues for a tense or aspirated stop (34c,d), again the response relies overwhelmingly on the vocalic cues and chooses the lax stop. When the stimuli of tense and aspirated stops are cross-spliced (34e,f), the salient vocalic cue (high F0) is ambiguous between tense and aspirated categories and the decision is passed down to VOT (the consonantal portion). Moreover, a recent study by Kenstowicz and Park (submitted) finds that even in the pitch-accent Kyengsang dialect, consonant-induced F0 modulation, although far less extensive than found in non-pitch accent dialects, extends well into the middle of the vowel, indicating the phonologization of the consonant-induced F0 perturbation.

Also crucial is the length of closure duration, especially in word-medial position, where this cue is reliably available. According to Han, J-I. (1996), the closure duration of tense stops is on average about twice as long as their lax counterparts. (Aspirated stops also have long closure duration, comparable to tense stops.) And in an experimental situation, a series of otherwise identical stimuli (VOT or F0) with varying closure duration can be perceived as tense or lax depending on closure duration. However, in word-initial position, the duration cue is not available and the closure duration difference between lax and tense stops is not as large. Han, J-I. (1996) finds that a change in closure duration has almost no effect on the stop's laryngeal feature classification in word-initial position.

Finally, in addition to the difference in F0 values, there are further differences in the voice quality of the following vowel such as breathiness, indicated by the difference between the amplitude of the first and the second harmonics (H1-H2), and the sharpness of the formant onset. But these factors seem to play a subsidiary role and only come into play when the others are not decisive. To summarize, while long VOT lag is a clear cue for the aspirated stops, the distinction between tense and lax stops is signaled primarily by the F0

of the following vowel word-initially (F0 > VOT > voice quality) and in word-medial position, closure duration also plays an important role. With this background, we return to the Korean adaptation of Japanese stops.

Given these acoustic correlates of the Korean consonant contrast, we can examine how the Japanese stops are expected to map to the Korean categories and see how these predictions match up with the actual adaptation patterns.

First, as seen in (30), Japanese voiced stops are uniformly mapped to Korean lax stops regardless of position within the word. Unlike the voiced stops of English, Japanese voiced stops are genuinely voiced even in word-initial position and produced with significant pre-voicing (negative VOT). Therefore, if the closest match in Korean stops were based on VOT value alone, Korean tense stops, which have the lowest VOT values (cf. (33)), should be selected as the best match for Japanese voiced stops. In fact, the Japanese voiced stops are adapted as Korean lax stops, which are slightly aspirated in this position. Proper voicing of Japanese voiced stops in word-initial position is known to be one of the most difficult aspects of Japanese pronunciation for Korean speakers. Rather, Korean speakers produce Japanese voiced stops with a significant amount of aspiration, akin to Korean lax stops (Lee, H-J. 2000). We can account for this seemingly puzzling pattern of adaptation by recognizing the experimental finding that VOT is not a crucial determinant in distinguishing tense and lax stops.

Rather, it is the absence of high F0 on the following vowel in voiced stops of Japanese that makes them a better match to Korean lax stops than to tense or aspirated ones. In line with a general cross-linguistic tendency, voiced stops of Japanese lower F0 on the initial portion of the following vowel while F0 is higher for voiceless stops (Kawasaki 1983, Ishihara 1998). The lowering of F0 following a voiced stop is ensured even when the mora is accented and carries a high tone; the F0 peak for the high tone is realized with a slight delay (Kawasaki 1983).[23] The consistent adaptation of Japanese voiced stops as Korean lax stops corroborates Kim et al (2002)'s finding (replicated by Kim, H. this volume) that F0 overrides VOT cues in distinguishing Korean stop categories.

The adaptation of voiced stops to lax stops is also attested in loanwords from French and English, which also have voicing contrast in stops similar to Japanese.[24] However, the loanwords from the three languages diverge in how

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[23] A similar pattern of F0 sequencing in a syllable with a lax stop and High tone is found in Keyngsang dialect as well (Kenstowicz and Park submitted).

[24] Word-initial pre-vocalic voiced stops in certain English loanwords are pronounced as tense stops in Korean: *k*eim* 'game', *p*ɛk* 'bag', *p*anana* 'banana' etc. (Lee, S-K. 1996, Oh 2004). Because these words tend to be older loans likely adapted before the end of WWII, the tense realization is often attributed to Japanese influence (Kwon Y-J. 1995). However, as we have just seen, Japanese voiced stops are consistently adapted as lax stops of Korean. Lee, S-K. (1996) and Oh (2004), on the other hand, explain the tense realization of English voiced stops as reflexes of a general change of tensification of lax stops in Korean. The fact that these changes only affect those stops that are prevocalic in the English input but not those that are part of a cluster (*k*eim* 'game' vs. *kɨræm*, **k*ɨræm* 'gram') suggests that the adaptation of these loanwords continues to be sensitive to the original source even after they are firmly established as part of the Korean lexicon.

voiceless stops are adapted to Korean. English voiceless stops are adapted as Korean aspirated stops while French voiceless stops are adapted as Korean tense stops.[25] (See Kenstowicz 2005 and references cited therein.)

(35)	English	Korean	French	Korean
	ban**k**	pɛŋ**k**^{h}ɨ	bou**ti**q**u**e	pu**t***i**k***ɨ
	da**t**e	tei**t**^{h}ɨ	Daudet	tote
	ga**t**e	kei**t**^{h}ɨ	gre**c**o-roman	kɨre**k***o romaŋ
	push	**p**^{h}us*i	**P**aris	**p***ari
	tank	**t**^{h}ɛŋk^{h}ɨ	**T**oulouse	**t***ulluc**ɨ**
	kiss	**k**^{h}is*ɨ	**C**annes	**k***anɨ

Since English voiceless stops are aspirated in many of their most salient realizations while French stops are not aspirated, this looks like another case where the adaptation takes into account a noncontrastive but salient feature.[26]

Japanese voiceless stops show a more complex pattern of adaptation, as we recall from (31). Word-initially, voiceless stops map to lax stops and so the voicing contrast of Japanese is neutralized in this position in the loans. On the other hand, word-medially, voiceless stops are adapted as tense except for coronal stops in intervocalic position. This pattern of adaptation differs from the that found in English or French loanwords discussed above. We will examine the word-initial position first and then discuss the word-medial position.

The voiceless stops of Japanese are usually described as weakly aspirated or unaspirated, similar to voiceless stops of French (Vance 1987, Akamatsu 1997). They have far shorter VOT values than English voiceless stops or Korean aspirated stops.

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[25] Kim H. (2006) states that the French voiceless stops are variably adapted as tense or aspirated stops. The aspirated stop adaptation may reflect the influence of normative orthographic convention established by the National Academy of Korean Language (http://korean.go.kr). But there are some lexical items like *k*ont*^{h}*i* 'conte' and *p*aret*^{h}*i* 'palette', where both tense and aspirated adaptation of voiceless stops are attested in a single word. The distribution of tense and aspirated stops in French loanwords merits further study.

[26] Iverson and Salmons (1995) and Avery and Idsardi (2001) analyze the voicing contrast of English as an aspiration contrast. Under this alternative analysis of the English stop contrast, no recourse to noncontrastive phonetic information is necessary. In any case, the matter is more complex because the adaptation of English voiceless stops does not faithfully track the distribution of aspiration in English. Rather, all voiceless stops from English are adapted as aspirated—even when they are realized as unaspirated (Oh 1996).

English		Korean
poker	[p^{h}]	p^{h}ok^{h}a
spy	[p]	sɨp^{h}ai
happy	[p]	hɛp^{h}i

This difference is not well understood. Kenstowicz (2005) treats it as maximization of contrast overriding faithfulness to the English source. Another possibility is that this is due to the imperfect L2 acquisition of English by Korean speakers (cf. Kenstowicz 2005's analysis of lack of flapping in L2 English of Koreans). In other words, average Korean speakers of English are not aware of the precise context of stop aspiration and the equivalence "English voiceless stop = Korean aspirated stop" drawn from the initial stage of English instruction is extended to other contexts.

(36) Comparison of average VOT values (ms) of word-initial voiceless stops of English, Japanese, and French (English and Japanese values from Shimizu 1999 and French values from O'Shaughnessy 1981)

	English (SD)	Japanese (SD)	French
/p/	68 (15.3)	41 (17.1)	22
/t/	82 (18.6)	30 (12.7)	41
/k/	85 (20.1)	66 (12.1)	54
Av.	78	46	39

In other words, unlike English voiceless stops, which consistently map to aspirated stops in Korean, Japanese voiceless stops have a VOT that is too brief to be identified with a Korean aspirated stop: Japanese average of 46 ms. (Shimizu 1999) vs. Korean 105 ms. (Lisker and Abramson 1964). Continuing with the assumption that VOT is not a crucial cue distinguishing tense and lax stops, we need to consider F0 on the following vowel.

In line with the cross-linguistic tendency (Kingston and Diehl 1994), in Japanese F0 at the onset of a vowel following a voiced consonant is lower than that following a voiceless consonant (Kawasaki 1983, Ishihara 1998, Lee, H-J. 2000). Ishihara (1998) reports data indicating a c. 30 Hz. difference between voiced and voiceless /da/ vs. /ta/ syllables at the beginning of an accentual phrase for several Japanese subjects. For Korean where the phrase-initial lax vs. tense/aspirated contrast is strictly correlated with a L vs. H boundary tone, Jun, S-A. (1996) finds F0 differences of much greater magnitude (c. 50 - 80 Hz). In a study that directly compared the F0 at the onset of the vowel following word-initial stops in Japanese and Korean, Lee, H-J. (2000) similarly found that F0 following a voiceless stop was consistently higher than that following a voiced stop in Japanese. But the difference between voiced and voiceless context in Japanese was between 10-20 Hz. while for Korean, the difference between the lax and tense/aspirated contexts was in the 20-50 Hz. range. Moreover, the F0 perturbation due to the voicing of the preceding stop is limited to the initial 5-6 pitch periods in Ishihara's Japanese subjects (1998) and does not extend into the middle of the vowel. This contrasts sharply with Korean where the vowels following the tense and aspirated stops in the initial syllable of the accentual phrase are realized with a phonological H tone that persists through the entire vowel. In sum, the F0 contours on the vowels following the Japanese word-initial voiceless stops appear to differ in both magnitude and extension from the contour following a Korean tense consonant.[27] This discrepancy plausibly thwarts adaptation as a tense consonant. Given the F0 > VOT > voice quality

[27] An obvious question that follows is how the pitch accent in Japanese input affects the laryngeal adaptation. We haven't investigated the effect of pitch accent in our corpus systematically; but given the fact that the adaptation pattern can be more or less adequately described as a function of consonant identity and position with word alone, it is unlikely that pitch accent has any significant effect. We conjecture that the Korean speakers factor out the effect of pitch accent in their calculation of F0 for the purpose of laryngeal adaptation. See Kenstowicz and Park (submitted) for a study of how Kyengsang dialect of Korean, a pitch accent dialect, utilizes the F0 dimension to signal both tone and the laryngeal category of the preceding consonant.

hierarchy, the decision is passed to VOT. In terms of VOT, Korean lax stops (33 ms.) very closely match Japanese voiceless stops (46 ms.) in word-initial position and so lax is selected as the best alternative.

Turning briefly to the contrast with the French voiceless stops, which map to tense stops of Korean in loanwords, unfortunately, we don't know of any study that directly compares the VOT values of French and Japanese stops. But if we compare the published data from various sources, French voiceless stops seem to have slightly lower VOT values than Japanese stops. Homma (1981) and Shimizu (1999) put the average VOT for Japanese voiceless stops at 37ms and 45 ms respectively while Caramazza et al (1972) and O'Shaughnessy (1981) reports average VOT of 24 ms and 39ms for French voiceless stops, with Kessigner and Blumstein (1997) similarly showing mean VOT in the 20's for French voiceless stops. These values put the French stop intermediate between tense and lax stops of Korean. How then can we account for the different adaptation pattern of Japanese and French voiceless stops?

Again, continuing with the assumption that F0 is a more crucial cue than VOT in distinguishing tense and lax categories of Korean stops, the puzzling contrast between the voiceless stop adaptations from Japanese /t/ -> Korean /t/ vs. French /t/ -> Korean /t*/ in the word-initial position may also find explanation in the different role of F0 in the two languages. Japanese is a pitch accent system where lexical contrasts are signaled by F0 contour while F0 plays no such role in French. Given the difference in the status of F0 in the two languages, there may be a difference in the extent to which the consonant voicing-induced F0 difference persists into the syllable—namely, the consonantal effect on F0 may be more extensive in French than Japanese, making the F0 raising following French voiceless stops more extensive than that in Japanese. Again, we don't know of any study that directly compares the consonant-induced F0 effect in Japanese and French and have to rely on published data from different studies. Ishihara (1998) reports F0 differences that persist up to 40 ms. for Japanese while Jun found F0 extension for French in the 40-60 ms. range. Clearly more study is required to determine whether the magnitude and extent of F0 perturbations in Japanese vs. French provides a sufficient basis to explain the systematic divergences in the Korean adaptation of voiceless stops from these two languages.

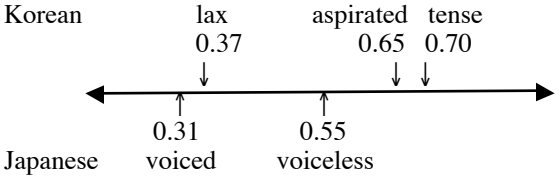
The next question is why the voiceless stops of Japanese sometimes map to tense stops of Korean in word-medial position. Unlike word-initial position, in word-medial position there is the additional cue of stop closure duration that factors into the laryngeal mapping. Available data on Japanese stops in intervocalic position consistently shows that voiceless stops have a longer closure duration than voiced stops and voiceless geminates are close to three times longer than voiceless singletons (Homma 1981, Lee, S-M. 1991, Kawahara 2005).

(37) Average closure duration of intervocalic stops (ms) (Homma 1981)

/b/	55	/p/	77	/pp/	183
/d/	35	/t/	62	/tt/	170
/g/	41	/k/	61	/kk/	175

Since closure duration can vary depending on speech rate, we can compare the closure duration of different consonants by normalizing it as a ratio of closure duration (CL) with respect to the length of the preceding vowel (V1) and the consonantal closure combined (CL/(CL+V1)). According to (Lee, S-M. 1991), in Korean the relativized closure duration of an intervocalic stop (CL/(CL+V1)) is longest for the tense stops and shortest for the lax stops (tense 0.70 > aspirated 0.65 > lax 0.37). In Japanese the relative closure duration is 0.55 for the voiceless stop and 0.31 for the voiced. Notice that the value for the Japanese voiced stop (0.31) is very close to the value for the lax stop of Korean (0.37).

(38) Relativized closure duration of Korean and Japanese stops



So, all three phonetic properties (low VOT, low F0 and short relativized closure duration) of Japanese voiced stops favor the mapping to Korean lax stops in word-medial position. For the voiceless stops, the relative closure duration of 0.55 is considerably longer than the value for Korean lax stops (0.37) although not as long as that for tense stops (0.70). The perception experiment by Han, J-I. (1996) finds that the category boundary in closure duration between lax and tense labial stops occurs about halfway between the average closure duration of lax and tense stops. Assuming a similar location of lax vs. tense category boundary in closure duration for stops at other places of articulation, the fact that the relative closure duration of Japanese voiceless stops falls halfway between the values for tense and lax stops of Korean is consistent with the ambiguous mapping of voiceless stops in this position.

The mapping of Japanese geminates to Korean tense consonants makes sense on phonological and phonetic grounds. The Korean tense series has longer closure duration than the lax series (reflected in the Hangul orthography as doubling of the corresponding lax consonant symbol). The tense consonants derive historically from consonant clusters. Finally, they are the surface realization of an underlying lax obstruent that has combined into a cluster (the ubiquitous obstruent tensing process of Korean phonology). Clearly, a relatively long period of voicelessness is a signature of this consonant type (Kang and Kang 2006).

As for the role of F0 in word-medial position, most studies on the role of F0 in laryngeal distinctions examined word-initial stops only, where the F0 difference induced by consonantal feature is phonologized as a tonal contrast. Relatively little is known about the function of F0 in word-medial position. Kang and Dilley (2005) is one of the few exceptions. They investigated the role of F0 on the distinction between lax and aspirated stops in AP-medial position where no specific tone is associated (specifically the third syllable in an AP consisting of five syllables). Through a perception experiment they found that F0 still plays a significant role in distinguishing among laryngeal categories in this position. Interestingly, however, raising of F0 by a fairly small amount (10-

20Hz) was enough to shift the majority response from the lax to the aspirated category, particularly when it was accompanied by a change in closure duration in the right direction. Therefore, we may cautiously conjecture that unlike word-initial position, where the F0 difference between lax vs. tense/aspirated context is extensive and we therefore expect a similar extensive raising of F0 to induce a tense or aspirated percept, in word-medial position there is no comparable degree of F0 raising for tense and aspirated contexts and therefore the F0 raising required for a tense or lax percept may not be quite as extensive. Consequently, the F0 raising found in the vowel following Japanese voiceless stops may be sufficient to push the signal closer to the tense stop category of Korean. However, further study is necessary to determine how different degrees and patterns of F0 raising affect perception of the laryngeal distinctions in Korean stops.

Also, it is notable that the VOT values for Japanese voiceless stops (39) reported by Homma (1981) are in general considerably lower in word-medial position (average of 15.6 ms.) compared to word-initial position (37.3 ms.). As a result, the average VOT value of Japanese voiceless stops in word-medial position (15.6 ms.) falls fairly close to that of Korean tense stops (13.7ms.). The intervocalic geminates also have minimal VOT values (average of 17.3 ms.) that reinforce the duration-based mapping to Korean tense consonants.

(39) Average VOT values (ms) of Japanese voiceless stops (Homma 1981)

	Word-initial	Inter-vocalic		Intervocalic
/p/	27	7	/pp/	11
/t/	32	16	/tt/	13
/k/	53	24	/kk/	28

So, all in all, the phonetic cues present in Japanese medial voiceless stops are indeterminant between tense and lax categories of Korean or slightly favor tense perception depending on one's interpretation of the available phonetic data. But, it is notably not the case that both /k/ and /t/ vary between tense and lax stop adaptations in our corpus. Rather medial /t/ is consistently adapted as lax while medial /k/ (and affricate [tʃ]) is primarily adapted as tense. What could be the reason for this asymmetry?

The first possibility we can consider is a difference in closure duration. Perhaps Japanese /k/ is consistently longer than /t/ such that /k/ is more likely to be identified as tense in comparison to /t/. However, this is not the pattern we find in the available data (summarized below in ms).

(40)

p	t	k	
77	62	61	Homma 1981
75	61	67	Han 1990
62	52	48	Sato 1998

These sources indicate that closure duration for [k] is not consistently longer than [t], if at all. The relativized closure duration (CL/(CL+V1)) calculated from the raw data provided in Kawahara (2005) also fails to show a consistent difference in [k] vs. [t] duration in the expected direction and worse, [t] comes

out as much longer than [k], the opposite of what is expected if closure duration were responsible for the asymmetry.

(41)

	p	t	k
Average closure duration (ms)	73	66	54
Average Relativized closure duration	0.69	0.63	0.55

In terms of VOT, consistent with cross-linguistic tendencies, [k] has a longer VOT lag than [t]. Therefore, VOT does not necessarily favor tense perception of Japanese /k/ more than Japanese /t/.

Then what about F0? Kawahara (2005) provides F0 values of the vowel onset following intervocalic stops in Japanese. On average, the F0 following /k/ (323.0 Hz.) is higher than the F0 following /t/ (301.2 Hz.) by over 20 Hz. This difference is consistent through all speakers and vocalic contexts. This is the only acoustic correlate that points to the adaptation pattern we find. If this difference in F0 indeed makes a meaningful difference, higher F0 seems to push [k] over to the tense category compared to [t], whose relatively low F0 favors a lax mapping. The higher F0 for the vowel following a dorsal consonant is understandable given the correlation between the tongue height and larynx height (Kim et al. 2005). Namely, it is a natural consequence of tongue body raising (for [k]) that the larynx is raised and as a result the vocal folds are stretched and stiffened leading to a raised F0.

To add one further speculation as to the /t/ -> /t/ but /k/ -> /k*/ asymmetry, in their discussion of enhancement gestures to support phonological contrasts in nonsalient positions in English, Keyser and Stevens (2006) comment on the greater prevalence for glottalization on syllable-final alveolar consonants compared to labials and velars. They point to a study by Svirsky et al (1997) who report tongue stiffening in the production of the English labial stop as a maneuver to inhibit expansion of the vocal tract volume that would otherwise lead to vocal fold vibration. Keyser and Stevens speculate that a similar stiffening is extended to velars but is blocked on alveolars because they require flexibility in the tongue blade in order to make an alveolar closure. Glottalization is viewed as an alternative backup maneuver to inhibit voicing. It is conceivable that a similar stiffening process is operative in Japanese and holds for the labials and velars but is blocked on the coronal. Given the fact that overall tension and stiffening of vocal tract is mentioned to be one of the characteristics of tense consonants in Korean (Kim C-W. 1965), the asymmetrical adaptation of Japanese /t/ and /k/ might be related to the differential stiffening of the tongue body along the lines suggested in Keyser and Stevens (2006).

Finally, we end the discussion with another speculative note. Another possible explanation for the /t/ vs. /k/ asymmetry is historical change in the phonetic properties of these stops since the time of borrowing. In other words, it might be a misguided venture to try to find the explanation for these mappings solely based on the current phonetic state of these stops. Jun Sang-Beom (personal communication) points out that his intuition as a native speaker with knowledge of Japanese clearly indicates that intervocalic voiceless stops of Japanese, both /t/ and /k/, match Korean tense stops most closely. This

observation is in line with reports that Korean speakers frequently confuse the singleton and geminate voiceless stops of Japanese (again for /t/ as well as /k/) in their speech or writing (Kim S. 1996, Kim Y. 2004). Given the fact that Japanese geminate stops are consistently mapped to Korean tense stops, the noted confusion is evidence that these Korean learners perceive Japanese voiceless singletons in medial position as tense stops.

Also, contrary to the almost uniform mapping of Japanese /t/ to Korean lax /t/ attested in established loanwords included in our corpus, some Japanese proper names with intervocalic /t/ are often pronounced with tense /t*/ (K. *kjot*o* < J. *kjoto* 'Kyoto', K. *tok*jo* < J. *tookjo* 'Tokyo', K. *it*o hiropumi* < J. *ito hirobumi,* K. *it*ai it*ai* < J. *itai itai*). Also, it is notable that the normative orthographic conventions of Japanese words in South and North Korea do not treat word-medial /t/ and /k/ differentially. Word-initial /t/ and /k/ are dictated to be transcribed with a lax stop 't' and 'k' in both parts of Korea; and word-medial /t/ and /k/ map to aspirated 'th' and 'kh' in the South and to tense 't*' and 'k*' in the North.

As mentioned at the outset, the majority of the established Japanese loanwords were adapted to Korean during the first half of the 20th century. Since then Korean stops have undergone a fairly extensive change in VOT, as mentioned earlier (see footnote 23). According to the studies published in 1960's and 1970's, the lax stops have a relatively low VOT value, closer to tense stops than to aspirated stops. However, literature published in the 1990's and 2000's shows much higher VOT values for the lax stops, bringing them closer to aspirated stops. The Japanese stops have undergone a significant change over the last couple of centuries. The voiced stops used to be a prenasalized and the nasal quality still persists to an extent in the pronunciation of /g/ in Tokyo dialect. It is notable that there are several loans that map Japanese voiced stops to Korean with a nasal component (K. *tampɛ* < J. *tabako* 'cigarette' K. *nɛmpi* < J. *nabe* 'pot'), arguably reflecting the earlier state of affairs in Japanese.[28] Given these recent changes that the stops of the two languages have undergone, it is not unlikely that the asymmetrical mapping of intervocalic /t/ and /k/ reflects something about the state of affairs in the early part of 20th century or earlier.

In sum, we find that for the most part the adaptation of Japanese stops into Korean makes sense in terms of the F0 > VOT > Voice quality hierarchy of cues found in the experimental literature (Kim *et al.* 2002, Kim, H. this volume). If we take the word-medial t vs. k asymmetry seriously, Kawahara (2005)'s data suggest that F0 overrides closure duration and VOT as a cue to distinguishing tense and lax stops when in conflict and we can further establish the hierarchy F0 > closure duration. Overall, the phonetic research and our loanword data point to F0 as the most important cue in distinguishing tense and lax categories.

A proper phonological characterization of the lax vs. tense stop contrast has been a topic of much debate in Korean phonology and we can briefly discuss the implications of the current data on this issue. We start by assuming that in the absence of phonological evidence to the contrary, the phonetic property that plays the strongest role in the phonetic (perceptual) distinction is the basis of the underlying phonological contrast while other phonetic properties are supplied as

[28] See Kim, K-H. (2002) for an alternative account for these loans.

enhancements (Keyser and Stevens 2001, 2006), i.e., phonetic maneuvers that are under the active control of the native speaker, part of his Phonetic Knowledge (Kingston and Diehl 1994). In our data, VOT (a manifestation of degree of glottal constriction at the stop release) turns out to play a very limited role in distinguishing tense and lax stops and [constricted glottis] is not the best feature to represent this contrast. Here, we are in agreement with Kim C-W (1965), who points out the inadequacy of VOT as a cue to properly distinguish lax and tense stops and also with Avery and Idsardi (2001), when they argue against defining the three-way laryngeal contrast in Korean as contrast along a single phonetic dimension, i.e., glottal width. However, given the subordinate role closure duration plays in our data, the current data do not support Avery and Idsardi (2001), Han, J-I. (1996), or Jun, J. (1994), who define the lax vs. tense contrast fundamentally as a length contrast (singleton vs. geminate). Rather, the fact that F0 emerges as the most important cue in the tense vs. lax contrast, along with the fact that aspirated and tense categories form a natural class phonologically inducing a high tone on the following vowel, supports those proposals that explicitly recognize this natural class. One such proposal is made by Kim, C-W. (1965) who suggests [tense] as a feature that makes exactly this phonological distinction, although with this feature, F0 raising on the following vowel is not straightforwardly expressed. In this respect, [+stiff vf] will be a more adequate feature (cf. Kim and Duanmu 2004). So our conclusion is that the feature of glottal tension is the basic feature that defines the lax vs. tense/aspirated contrast, with glottal width further distinguishing the tense from the aspirated.

(42)		lax	aspirated	tense
	[stiff vf]	-	+	+
	[spread glottis]	(-)	+	-

5. Conclusion

In this paper, we reported the results of an analysis of some 1,300 Japanese loanwords in Korean. The results support a more complex view of loanword adaptation where adaptation has access to sub-phonemic details of the input language but at the same time, the mapping to the native category is not based on mechanical matching of phonetic similarity. Rather, the mapping to the native category is informed by the phonetic and phonological grammar of the borrowing language such that the priority in the matching of phonetic properties is determined by the hierarchy of phonological features and related phonetic properties (enhancements) in the native language. Also noted is a possibility that the adapters may use a more global knowledge of the system of phonetic contrasts in the input language such that adaptation strives to maintain the contrast of the input language in the adapted output. Admittedly, much of the discussion in this paper is speculative, based on the interpretation of various phonetic data from diverse sources. It is our hope that the speculations and questions posed in this paper serve as a catalyst to stimulate careful studies in comparative phonetics of Japanese, Korean, English, and French.

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