

Consonant Gemination in Japanese Loanword Phonology

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Abstract

The distribution of geminate obstruents in Japanese loanwords appears very complex. Some consonants are more prone to gemination than others, on the one hand, and one and the same consonant is more likely to geminate in some phonological contexts than in others, on the other hand. This paper tackles these problems by considering the relationship between consonant gemination in native words and that of loanwords. It proposes a principled prosodic analysis by which gemination is allowed to occur if and only if it improves prosodic structure. This analysis reveals that gemination in loanwords is essentially an output-oriented phenomenon and that loanword phonology is closely related with and severely constrained by native phonology.

Keywords: Japanese loanwords, consonant gemination, prosodic structure, loanword phonology

1. Introduction

The distribution of geminate obstruents, or *sokuon*, in Japanese loanwords is notoriously complex. For example, /p/ is geminated in /kyap.pu/ ‘cap’, but not in /kya.pu.ten/ ‘captain’ (dots indicate syllable boundaries). ‘bat’ undergoes gemination, while ‘butter’ fails to do so: /bat.to/ vs. /ba.taa/. There are many pairs of words like these. Representative examples are given in (1).

(1)

		Gemination		No Gemination
<i>p</i>	<i>cap</i>	kyap.pu	<i>captain</i>	kya.pu.ten
<i>t</i>	<i>bat</i>	bat.to	<i>butter</i>	ba.taa
<i>s</i>	<i>listen</i>	ris.sun	<i>listener</i>	ri.su.naa
<i>k</i>	<i>tax</i>	tak.ku.su	<i>tact</i>	ta.ku.to
<i>g</i>	<i>frog</i>	fu.rog.gu	<i>log</i>	ro.gu

This paper discusses how the distribution of geminate obstruents as opposed to single obstruents (e.g., /pp/, /tt/, /kk/ vs. /p/, /t/, /k/) is determined in loanword adaptations in Japanese, whose native system employs consonant length contrastively. The main focus will be placed on an analysis of loanwords from English. We will propose a phonological analysis to account for both new and previously-established generalizations regarding consonant gemination in Japanese loanwords and demonstrate how severely loanword phonology is constrained by native phonology.¹

This paper is organized as follows. The next section describes basic constraints holding in the native phonology of Japanese. Section 3 proposes a principled output-oriented analysis of major gemination and non-gemination patterns in loanwords. The final section (Section 4) summarizes main points as well as questions that remain for future work.

2. Relevant Constraints in Native Phonology

2.1. Voiced geminate

As is well known, consonant length as well as vowel length is distinctive in Japanese phonology. Thus, there are many minimal pairs including those in (2) that contrast between a single consonant (singleton) and a geminate consonant (geminate). Geminate consonants appear only word-medially.

(2)

<i>Singleton</i>	<i>Geminate</i>
ki.ta ‘came’	kit.ta ‘cut (past)’
syu.tyoo [ʃu.tʃo:] ‘assertion’	syut.tyoo [ʃut.tʃo:] ‘business trip’
sa.ki ‘point, edge’	sak.ki ‘a short time ago’
ka.sya [kaʃa] ‘freight car’	kas.sya [kaʃʃa] ‘pulley’

Phonetic studies have shown that, other things being equal, consonant length is signaled primarily by consonant duration (Fujisaki & Sugito 1977, Han 1994). Thus, the closure duration of [t] is much longer in /kit.ta/ ‘cut (past)’ than in /ki.ta/ ‘came’. Geminate fricatives have a much longer frication duration than singletons: e.g., [s] is considerably longer in /kas.sen/ ‘battle’ than in /ka.sen/ ‘underline’.

While consonant length is contrastive in Japanese, not all consonants have a geminate counterpart. First, no voiced consonant, whether obstruent or sonorant, can be geminated in native phonology: /b, d, g, m, n, y, r, w/ do not have their geminated counterparts. This is symbolized by the fact that /ta.da/ ‘only’ turned into /tat.ta/, not /tad.da/, when geminated for emphasis in the course of the history. It follows from this and other facts that the native phonology of Japanese is subject to the constraint in (3), a constraint that is observed across languages.

(3) *Voiced Geminate (*VoiGem)

Voiced geminate consonants are prohibited.

Second, voiceless fricatives fall into two types, those that can be geminated ([s] and [ʃ]) as shown in (4), and those that cannot ([h]).

(4) ka.sen ‘underline’—kas.sen ‘battle’

ka.sya [kaʃa] ‘freight car’—kas.sya [kaʃʃa] ‘pulley’

Note that /h/ can be geminated in several independent contexts in native phonology, but when geminated, it alternates with [pp] rather than [hh] for historical reasons.² This is true irrespective of the following vowel, which determines the phonetic quality of /h/ ([ç], [ϕ] or [h]) in native and SJ words.³ Some examples are given in (5).⁴

(5) a. ha ‘leaf’ + ha ‘leaf’ → hap.pa ‘leaves’

b. ni.hon ‘Japan’ → nip.pon ‘Japan’

c. a.ho ‘fool’ → ap.po ‘fool (colloquial)’

d. it ‘one’ + hu ‘husband’ → ip.pu ‘one husband’

e. it ‘one’ + hi ‘day’ → ip.pi ‘first day of the month’

2.2. Syllable weight

Geminate consonants cannot occur after a long vowel or diphthong in native phonology. Thus, /to.ki/, /tok.ki/, and /too.ki/ are all legal forms, but /took.ki/ is not.

(6)

	<i>Singleton</i>	<i>Geminate</i>
<i>Short V__</i>	to.ki ‘time’	tok.ki ‘projection’
<i>Long V__</i>	too.ki ‘pottery’	*took.ki

Kubozono (1999) attributed this distributional restriction to a constraint on the optimal size of the syllable, which permits light (monomoraic) and heavy (bimoraic) syllables, but not superheavy (trimoraic) ones.

(7) *superheavy (* $\sigma_{\mu\mu\mu}$)

Trimoraic syllables are banned.

The same constraint accounts for the seemingly peculiar loanword adaptation process known as ‘pre-nasal vowel shortening’ (Lovins 1975). This process, as illustrated in (8), shortens long vowels and diphthongs before a moraic nasal, thus creating bimoraic syllables out of a string that would otherwise result in trimoraic syllables (see Kubozono 1999 for more evidence for the trimoraic syllable ban in Japanese).

(8) Pre-nasal vowel shortening

Source	Loan
<i>foundation</i>	<u>fan</u> .dee.syon, *faun.dee.syon
<i>stainless</i>	su. <u>ten</u> .re.su, *su.tein.re.su
<i>Cambridge</i>	<u>ken</u> .bu.riz.zi, *kein.bu.riz.zi
<i>corned beef</i>	<u>kon</u> .bii.fu, *koon.bii.fu

2.3. Prosodic form

Native phonology exhibits a striking tendency to favor Heavy-Light (HL) and Heavy-Heavy (HH) sequences and to disfavor Light-Heavy (LH) in word-final position. This tendency is observed in various independent phenomena in Japanese, one of which is the *zuzya-go* formation discussed in depth by Itô et al. (1996).

Zuzya-go is a jazz musicians’ secret language involving metathesis: e.g., /ma.nee.zyaa/ → /zyaa.ma.ne/ ‘manager’. The input to this process can be any word with any prosodic structure, but its output is severely constrained in prosodic terms. This is illustrated with monosyllabic and disyllabic input forms in (9) below.

(9)

Input		Output		Gloss
Prosodic form	Word	Prosodic form	Word	
L	me	HL	ee.me	eye
H	kii	HL	ii.ki	key
LL	me.si	HL	sii.me	rice
LH	go.han	HL	han.go	meal, rice
HL	tan.go	HL	gon.ta	tango
HH	too.kyoo ron.don	HH	kyoo.too don.ron	Tokyo London

In these examples, the input forms vary from a monomoraic monosyllable (L) to a disyllabic word consisting of two heavy syllables (HH). This variability in the input is quite contrastive with the uniformity in the output, where only HL or HH structures are permitted. For example, the input /me/ (L) gives rise to /ee.me/ (HL). More striking is the fact that both HL and LH inputs yield HL outputs: /go.han/ and /tan.go/ turn into /han.go/ and /gon.ta/, respectively. This output neutralization in prosodic structure results from the irregular process that HL inputs undergo, namely, the process by which input mora strings are entirely reversed: /ta-n-go/ → /go-n-ta/, */go.tan/. All in all, *zuzya-go* formation exhibits a strong tendency towards HL and HH outputs and against LH outputs.

Zuzya-go is not the only process that exhibits such a tendency. Baby words display a more remarkable tendency towards HL and HH in preference to LH and other prosodic forms. In (10), words to the left of the arrows are adult forms from which baby forms are derived.

(10) Baby words

a. LL → HL

ba.ba → baa.ba, *ba.baa 'grandma'

zi.zi → zii.zi, *zi.zii 'grandpa'

ku.tu → kuk.ku 'shoes'

da.ku → dak.ko 'to hold up'

ne.ru → nen.ne 'to sleep'

o.bu.u → on.bu 'to carry a baby piggyback'

b. LL → HH

ha.u → hai.hai 'to crawl'

buu.buu ‘car, pig’

The interesting asymmetry between HL and LH in the output is also observed in the process of loanword truncation. Crucially, HL forms are perfectly acceptable in the output, whereas LH forms are strictly prohibited (Itô 1990, Kubozono 2003).

(11) a. HL

roo.tee.syon → roo.te ‘rotation’

pan.hu.ret.to → pan.hu ‘pamphlet’

sin.po.zi.u.mu → sin.po ‘symposium’

b. LH → LL

ro.kee.syon → ro.ke, *ro.kee ‘location’

de.mon.su.to.ree.syon → de.mo, *de.mon ‘demonstration’

There are several other independent processes that display a bias towards HL and HH outputs in Japanese (see Kubozono 2003 for more evidence). Considering all these processes with respect to the wellformedness of output forms, it can be said that Japanese favors HL and HH sequences and disfavors LH sequences in word-final position. This leads us to propose the following prosodic constraint. As we will see in section 3, this constraint is primarily responsible for consonant gemination in loanwords.

(12) Prosodic Form (ProsForm)⁵

Words must end in Heavy-Heavy or Heavy-Light sequences.

2.4. Accent structure

(Tokyo) Japanese exhibits a certain bias with respect to accent structure, too. It permits two major accent patterns: accented and unaccented (McCawley 1968, Kubozono 1988/1993). Putting aside the unaccented pattern, Japanese displays a striking tendency to put an accent on the third or fourth mora from the end of the word if the word is a noun. Seen conversely, it avoids placing an accent on the penultimate or final mora of the word.

In native and SJ words, words with an accent on the antepenultimate mora, e.g., /i.no.ti/ ‘life’, overwhelm those with an accent on the penultimate or final mora, e.g. /ko.kó.ro/ ‘heart’, /o.to.kó/ ‘man’ (Kubozono 2006, 2008). This is true of loanwords, too. For example, most three-mora loanwords bear an accent on the antepenultimate mora irrespective of the location of the accent in the source words, as shown in (13).

(13) source: *banána potato Cánada cámara cláss*

loan: bá.na.na pó.te.to ká.na.da ká.me.ra kú.ra.su

This is suggestive of the constraint in (14) (Kubozono 2006) .

(14) Penultimate accent restriction ($*\mu\mu'\mu]_{PrWd}$)

In (Tokyo) Japanese, accent on the penultimate mora is prohibited in trimoraic or longer words.

Note in this connection that penultimate accent is perfectly well-formed in bimoraic nouns. Many bimoraic native nouns have an accent on the penultimate mora: e.g., /né.ko/ ‘cat’. Moreover, this penultimate pattern is by far the most common in bimoraic SJ nouns (e.g., /é.ki/ ‘station’, /tó.syo/ ‘book’), and accounts for virtually all bimoraic loanwords, as exemplified in (15).

(15) source: *bus* *location* *pill* *cab* *demonstration*
loan: bá.su ró.ke pí.ru kyá.bu dé.mo

2.5. Loss of syllabicity

It is worth referring here to the peculiar behavior of /ru/, /su/ and /fu/ (= [ϕu]) in Japanese phonology.⁶ These CV sequences seem to lose their syllabicity in several independent phenomena so that /CV+ru/, /CV+su/ and /CV+fu/ behave as if they were a heavy syllable. In other words, /ru/, /su/ and /fu/ count as one mora, but not as one syllable, with the vowel /u/ behaving like an extraprosodic element.

Consider the deaccenting rule in loanwords, for example. While loanwords generally show a remarkable bias towards the accented (vs. unaccented) pattern in Tokyo Japanese (Sibata 1994, Kubozono 2006), they tend to become unaccented if they are four moras long and involve a sequence of light syllables word-finally: /a.me.ri.ka/ ‘America’ and /mon.ba.sa/ ‘Mombasa (placename)’. However, /ru/, /su/ and /fu/ behave as if they were not syllabic in loanwords. Thus, while /a.me.ri.ka/ and /mon.ba.sa/ take the unaccented pattern as predicted by the deaccenting rule, /kón.do.ru/ ‘condor’, /ín.da.su/ ‘the Indus River’ and /mó.ro.zo.fu/ ‘Morozoff’ pattern with /rón.don/ ‘London’, /sái.daa/ ‘cider’, /bú.ru.zon/ ‘blouson’, respectively. In other words, /ru/, /su/ and /fu/ in word-final position behave like the moraic nasal and other non-syllabic moras in accent assignment (Kubozono 1996, Giriko 2008).

3. Phonological Account of Consonant Gemination in Loanwords

3.1. Segmental and contextual conditions

Japanese has three lexical strata—native, Sino-Japanese (SJ) and foreign (loanwords). Geminate consonants are relatively rare in native words but are quite common in the other two types of vocabulary. They are extremely common in the foreign stratum, as we will see shortly, but their distribution is quite severely constrained by linguistic factors. These factors fall into two kinds, those that relate to the consonant itself (segmental conditions) and those that concern the phonological environment in which gemination occurs or does not occur (contextual conditions). In this section, we will look at each of these conditions in detail and propose an output-oriented analysis to account for both old and new generalizations regarding gemination and non-gemination in loanwords.

The essential points of our analysis are as follows. First, we claim that geminate obstruents are universally more marked than singletons (*Gem >> *Single). Second, despite this markedness, obstruents can be geminated in order to improve prosodic well-formedness. Specifically, gemination is triggered by a force to create a HL or HH string in word-final position. In our analysis, this constraint dominates *Gem, which militates against geminate obstruents. Third, gemination does not occur when it is not motivated: that is, it is blocked either if it will not improve prosodic well-formedness or if it would produce a structure that is banned in native phonology.

3.2. Voicing condition

The first segmental condition concerns the voice/voiceless distinction in the consonant to be geminated. In loanwords, voiceless obstruents can be geminated, whereas voiced ones are seldom geminated. This condition is exemplified in (16).

(16)

Source	Loan	Source	Loan
Voiceless C	Gemination	Voiced C	No Gemination
<i>tap</i>	tap.pu	<i>tab</i>	ta.bu
<i>lock, rock</i>	rok.ku	<i>log</i>	ro.gu
<i>lack, rack</i>	rak.ku	<i>lag, rug</i>	ra.gu

The voiced/voiceless distinction in (16) follows directly from the constraint in (3), *VoiGem, which constrains native and SJ words very severely, as we saw in section 2.1 above. (17) describes how relevant constraints interact with each other to produce the

correct outputs.

(17) a.

lock, rock	*VoiGem	ProsForm ⁷	*Gem
☞ .rok.ku.			*
.ro.ku.		*!	

b.

log	*VoiGem	ProsForm	*Gem
.rog.gu.	*!		*
☞ .ro.gu.		*	

In (17a), the geminated form is chosen as the optimal output since it satisfies the prosodic constraint demanding HL or HH in word-final position. In this case, gemination improves the prosodic structure without violating any higher constraint. In (17b), in contrast, the ungeminated form becomes the winner since the geminated form violates *VoiGem, which dominates the prosodic constraint in the constraint hierarchy.

It must be noted here that voiced obstruents are geminated in some loanwords such as /dog.gu/ ‘dog’, /bag.gu/ ‘bag’, /bed.do/ ‘bed’ and /hed.do/ ‘head’ (Itô & Mester 1999). While it remains an open question why voiced geminates are tolerated in these instances, it is worth emphasizing two related facts here. First, many of these ‘exceptions’ are known to undergo devoicing, showing a free variation between a voiced geminate and a voiceless one: e.g., /bag.gu/~bak.ku/, /bed.do~/bet.to/.

A second fact that bears on the voiced geminate issue is that loanwords can and often do exhibit patterns that deviate from native patterns (Itô & Mester 1999). For example, [ti] and [di] are not permitted in native phonotactics but are permissible in loanwords—in such words as ‘team’ and ‘Disney’. Similarly, [p] cannot occur word initially in native words, but it can do so in loanwords, e.g., /pen/ ‘pen’. The native vocabulary cannot have more than one voiced obstruent within a morpheme due to an OCP effect, but loanwords are exempt from such a restriction (e.g., /ze.bu.ra/ ‘zebra’). In all these phenomena, loanwords are more faithful to the input than are native words and are free from markedness constraints to which native words are sensitive. The voiced geminate obstruents in loanwords can be seen as another instance showing this type of deviation from the native restriction.

3.3. [s] vs. [ʃ]

A second segmental condition on loanword gemination concerns the distinction between [ʃ] and [x], on the one hand, and [s] and [f], on the other. All of these are voiceless fricatives in the source words, but [ʃ] and [x] undergo gemination in

loanwords, while [s] and [f] generally do not. Some examples are given in (18).

(18)

Source	Loan	Source	Loan
ʃ/x	Gemination	s/f	No Gemination
<i>bush</i>	buʃ.ʃu	<i>kiss</i>	ki.su
<i>cash</i>	kyaʃ.ʃu	<i>bus</i>	ba.su
<i>Bach</i> (German [x])	bah.ha	<i>tough</i>	ta.fu
<i>Gogh</i>	goh.ho	<i>rough</i>	ra.fu

(18) involves a puzzling fact. [s] and [ʃ] belong to one and the same phoneme /s/ in the native phonology of Japanese ([ʃ] appears before [i], and [s] elsewhere), but only [ʃ] undergoes gemination in loanwords. Likewise, [x] but not [f] is geminated in loanwords despite the fact that their adapted forms—[h] and [ϕ]—are in complementary distribution in native phonology: [ϕ] before [u], [ç] before [i], and [h] elsewhere. We attribute this asymmetrical behavior between [s] and [ʃ] (or between [ϕ] and [h]) to the fact mentioned in section 2.5, namely, that /su/ and /fu/ (= [ϕu]) lose their syllabicity in word-final position in Japanese. Our output-oriented analysis accounts for the facts in (18) as in (19), where [f] and [x] are compared for illustration. (<u> means that this vowel is extraprosodic and does not contribute to syllabicity).

(19) a.

tough	*σ _{μμμ}	ProsForm	*Gem
.taff.<u>	*!	*	*
☞ .taf.<u>		*	

b.

Bach	*σ _{μμμ}	ProsForm	*Gem
☞ .bah.ha.			*
.ba.ha		*!	

The essential part of our analysis is that /fu/ and /su/ are counted as an independent mora but not as an independent syllable. Under this analysis, /tafu/ in (19a) forms one heavy syllable, [.taf.<u>], whereas its geminated counterpart, /taffu/, constitutes a superheavy syllable, [.taff.<u>]. The latter structure is rejected by the general constraint prohibiting trimoraic syllables, which dominates the prosodic constraint triggering consonant gemination. Because of this constraint interaction, the candidate with a single consonant becomes optimal in (19a).

In contrast, the output form with a geminate consonant is chosen as the optimal candidate in (19b) since it violates neither the syllable structure constraint nor the

prosodic structure constraint. In this case, gemination leads to the improvement of prosodic structure. This is true of the case of [ʃ], too: [buʃ.ʃu] wins over [bu.ʃu] as it has a Heavy-Light structure in word-final position.

Yet, the analysis in (19) raises one question regarding the gap between native and loanword phonology. As mentioned in section 2, native phonology permits [ss] and [ʃʃ] as well as their singleton counterparts (see (4) above), but does not permit [ʃʃ] or [hh]. In loanword phonology, however, [ʃ] and [h] can be geminated, while [s] and [f] (= [f]) generally cannot. The non-gemination of [s] and [f] has already been accounted for in (19). What remains to be answered is why [h] is geminated in loanwords although its geminated form is not allowed in native words.

In OT terms, this can be accounted for by ranking a constraint prohibiting [hh] (*[hh]) below ProsForm, thus assuring that the geminated form is more harmonic than the ungeminated form. However, this account is merely descriptive and not explanatory. The question still remains why loanwords permit [hh] although it is prohibited by native words. This will require phonetic as well phonological considerations. At the descriptive level, the gemination of [x] into [hh] in loanwords is just another instance showing that loanwords are sensitive to phonological (markedness) constraints to a lesser extent than native words.

3.4. Vowel length condition

There are quite a few contextual conditions to which loanword gemination is sensitive. In this and the next four sections we will consider five major contextual conditions all of which define the phonological contexts in which gemination is (un)likely to occur.

The first contextual condition on consonant gemination is a ‘vowel length condition’, by which gemination is invariably blocked if the consonant is preceded by a long vowel or diphthong (as opposed to a short vowel) in the output:

(20)

Source	Loan	Source	Loan
short V __	Gemination	longV ____	No Gemination
<i>mitt</i>	mit.to	<i>meat</i>	mii.to
<i>pick</i>	pik.ku	<i>peak</i>	pii.ku
<i>pack</i>	pak.ku	<i>park</i>	paa.ku

The vowel length condition illustrated in (20) can be accounted for by the

constraint against trimoraic syllables in a straightforward manner. This is shown in (21), where we have the same constraints and constraint ranking as in (19). In (21a), the output form with a geminate consonant is more harmonic than its ungeminated counterpart due to the force to have a Heavy-light or Heavy-heavy structure word-finally. In (21b), however, the form with a geminate consonant is less harmonic than the ungeminated form since it violates the higher ranking syllable structure constraint.⁸

(21) a.

mitt [mit]	*σ _{μμμ}	ProsForm	*Gem
☞.mit.to.			*
.mi.to.		*!	

b.

meat	*σ _{μμμ}	ProsForm	*Gem
.miit.to.	*!	*	*
☞.mii.to.			

3.5. Positional effect

A second case where gemination is sensitive to phonological context concerns what we call a ‘positional effect’. Namely, coda consonants in word-final syllables in the source language can be geminated but those in word-medial syllables cannot (Kawagoe & Arai 2002). This effect is exemplified in (22).

(22)

Source	Loan	Source	Loan
word-final C	Gemination	word-medial C	No Gemination
<i>cap</i>	kyap.pu	<i>captain</i>	kya.pu.ten
<i>dock</i>	dok.ku	<i>doctor</i>	do.ku.taa
<i>mix</i>	mik.ku.su	<i>mixer</i>	mi.ki.saa
<i>sax</i>	sak.ku.su	<i>saxophone</i>	sa.ki.so.fon
<i>box</i>	bok.ku.su	<i>boxer</i>	bo.ku.saa
<i>tax</i>	tak.ku.su	<i>taxi</i>	ta.ku.sii
<i>picnic</i>	pi.ku.nik.ku	<i>picnic</i>	pi.ku.nik.ku

To take one example, the English word ‘picnic’ consists of two syllables, /pik/ and /nik/, of which only the coda consonant of the second syllable undergoes gemination when adapted into Japanese: /pi.ku.nik.ku/, */pik.ku.nik.ku/, */pik.ku.ni.ku/. The same generalization holds in all other cases given in (22).

Our analysis of this positional effect is illustrated with the *dock*—*doctor* pair in (23). The lack of gemination in *doctor* can be accounted for in a straightforward manner by the prosodic structure constraint, ProsForm. Recall that this constraint requires that the output should end in a Heavy-Light or Heavy-Heavy syllable string in word-final position. The first candidate in (23a), /dok.ku/, satisfies this requirement. On the other hand, the first candidate in (23b), i.e., /dok.ku.taa/, does not fulfill it as gemination creates a HL string in *non-final* position. In other words, gemination of [k] in this word does not improve the prosodic structure and, hence, lacks prosodic motivation. The same analysis explains all other cases in (22) (see the next section for the motivation of coda gemination in *mix*, *sax*, *box* and *tax*).

(23) a.

dock	ProsForm	*Gem
☞ .dok.ku.		*
.do.ku.	*!	

b.

doctor	ProsForm	*Gem
.dok.ku.taa.	*	*!
☞ .doku.taa.	*	

The next tableau explains how /pi.ku.nik.ku/ is chosen for ‘picnic’.

(24)

picnic	ProsForm	*Gem
.pik.ku.nik.ku		**!
.pik.ku.ni.ku	*!	*
☞ .pi.ku.nik.ku		*
.pi.ku.ni.ku	*!	

3.6. /-ks/ vs. /-kt/, /-sk/

In word-final position, gemination readily occurs in /-ks/ but almost never in /-sk/, /-kt/, /-sp/ or /-st/ (Kawagoe & Arai 2002). This is illustrated in (25).

(25)

Source	Loan	Source	Loan
word-final -ks	Gemination	word-final -sp/-sk/-st/-kt	No Gemination
<i>tax</i>	tak.ku.su	<i>task</i>	ta.su.ku
<i>max</i>	mak.ku.su	<i>mask</i>	ma.su.ku
<i>sax</i>	sak.ku.su	<i>tact</i>	ta.ku.to
		<i>duct</i>	da.ku.to
		<i>wasp</i>	wa.su.pu
		<i>list</i>	ri.su.to

Our analysis provides a principled account for the gemination of [k] in /-ks/, as shown in (26a). The geminated pattern, /takkusu/, has /su/ in word-final position, which is non-syllabic according to our discussion in section 2.5. Accordingly, this output form consists of two heavy syllables: [tak.kus.<u>]. The ungeminated form, [ta.kus.<u>], is also disyllabic but consists of a light syllable followed by a heavy one. This prosodic form thus fails to satisfy ProsForm and, hence, cannot win over the geminated form.

(26) a.

tax	* $\sigma_{\mu\mu\mu}$	ProsForm	*Gem
☞ .tak.kus.<u>			*
.ta.kus.<u>		*!	

b.

task	* $\sigma_{\mu\mu\mu}$	ProsForm	*Gem
.tas.su.ku.		*	*!
☞ .ta.su.ku		*	

c.

tact	* $\sigma_{\mu\mu\mu}$	ProsForm	*Gem
.tak.ku.to.		*	*!
☞ .ta.ku.to.		*	

The *task* case in (26b) involves /su/ in the output but only in word-medial position. The geminated pattern in (26b), /tassuku/, is syllabified as /tas.su.ku/, which does not satisfy ProsForm despite gemination. Since gemination does not improve the prosodic structure, the ungeminated form will be chosen. Here *Gem plays a decisive role in selecting the most harmonic candidate.

A similar situation can be found in (26c), where gemination of [k] does not improve the prosodic structure, either. Since the prosodic form constraint, ProsForm, cannot be satisfied in any case, the ungeminated pattern turns out to be the winner.

3.7. *listen* vs. *listener*

Let us now consider the *listen*—*listener* pair. We saw in section 3.3 that [s] and [f] generally fail to undergo gemination due to the non-syllabic status of word-final /su/ and /fu/ in Japanese phonology. In certain phonological contexts, however, even [s] and [f] can be geminated. One such context is where they are followed by a syllabic sonorant ([ŋ] or [l]) in the source words. Thus, [s] is geminated in such words as *lesson*, *listen*, *hustle*. [f] is geminated in *shuffle* and *waffle*.

(27)

Source	Loan	Source	Loan
followed by syllabic sonorant [ŋ], [l]	Gemination	not followed by syllabic sonorant	No Gemination
<i>lesson</i>	res.sun	<i>less</i>	re.su
<i>hustle</i>	has.su.ru	<i>huss</i>	ha.su
<i>listen</i>	ris.sun	<i>listener</i>	ri.su.naa
<i>shuffle</i>	syaf.fu.ru	<i>shaft</i>	sya.fu.to
<i>tackle</i>	tak.ku.ru	<i>tact</i>	ta.ku.to

Our analysis is summarized in (28) with *listen*, *listener* and *hustle*.

(28) a.

listener	*σ _{μμ}	ProsForm	*Gem
.ris.su.naa.		*	*!
☞.ri.su.naa.		*	

b.

listen	*σ _{μμ}	ProsForm	*Gem
☞.ris.sun.			*
.ri.sun.		*!	

c.

hustle	*σ _{μμ}	ProsForm	*Gem
☞.has.sur.<u>			*
.ha.sur.<u>		*!	

First, [s] is not allowed to geminate in *listener* in (28a) since gemination does not improve the prosodic structure: the geminated output violates both ProsForm and *Gem. Its ungeminated form, /ri.su.naa/, does not satisfy ProsForm but it fulfills *Gem. Here again, *Gem plays a decisive role in selecting the most optimal candidate.

In the case of *listen* and *hustle* in (28b/c), on the other hand, gemination does improve the prosodic structure by producing HH outputs. In (28c), in particular, the

geminated output involves a HH output due to the extraprosodicity of the word-final /u/ in /ru/.

3.8. *tough* vs. *staff*

We saw in sections 3.2 and 3.3 that voiced stops as well as [f] and [s] generally resist gemination. However, they become less resistant to it if an extra consonant is added to the beginning of the word. This is exemplified in (29).

(29)

Source	Loan	Source	Loan
Complex onset	Gemination	Simple onset	No Gemination
<i>frog</i>	fu.róg.gu	<i>log</i>	ró.gu
<i>flag</i>	fu.rág.gu	<i>lag</i>	rá.gu
<i>drug</i>	do.rág.gu	<i>rug</i>	rá.gu
<i>snob</i>	su.nób.bu	<i>knob</i>	nó.bu
<i>stab</i>	su.táb.bu	<i>tab</i>	tá.bu
<i>staff/stuff</i>	su.táf.fu	<i>tough</i>	tá.fu

Gemination of [g] is generally blocked since it would produce a voiced geminate. What is it then that motivates its gemination in *flag* and *frog*? The answer to this question lies in the accent structure of /fu.rá.gu/ and /fu.ró.gu/. As noted in section 2.4, Japanese has a constraint against accenting the penultimate mora in trimoraic or longer words. Non-gemination of [g] in *flag* and *frog* produces a phonological structure violating this constraint. In contrast, gemination in these words helps to avoid this marked accent structure since it serves to shift the accent from the penultimate to the antepenultimate mora while keeping the accent on the same vowel/syllable: /fu.rág.gu/ and /fu.róg.gu/.

Non-gemination of [g] in *lag* and *log* does produce an output form with a penultimate accent, too, but this bimoraic output does not violate the prosodic constraint in question. We can account for this interesting interaction between accent structure and consonant gemination by positing the penultimate accent restriction in (14) higher than *VoiGem. This is illustrated in (30).

(30) a.

log	*μμ'μ] _{PrWd}	*VoiGem	ProsForm	*Gem
róg.gu.		*!		*
☞ ró.gu.			*	

b.

frog	* $\mu\mu'\mu$]PrWd	*VoiGem	ProsForm	*Gem
φ .fu.róg.gu.		*		*
.fu.ró.gu.	*!		*	

Similarly, we can account for the difference between *tough* and *staff* by positing the penultimate accent restriction higher than * $\sigma_{\mu\mu\mu}$, as shown in (31).

(31) a.

tough	* $\mu\mu'\mu$]PrWd	* $\sigma_{\mu\mu\mu}$	ProsForm	*Gem
.táff.<u>		*!	*	*
φ .táf.<u>			*	

b.

staff	* $\mu\mu'\mu$]PrWd	* $\sigma_{\mu\mu\mu}$	ProsForm	*Gem
φ .su.táff.<u>		*	*	*
.su.táf.<u>	*!		*	

It must be noted here that gemination is not the only solution to avoid the marked accent structure. An alternative solution is to change the accent structure of the output either by deleting the accent or by moving it onto a different syllable. These solutions are actually used in many words including those in (32): superscribed /^o/ denotes that the word is unaccented. Not surprisingly, accent change and consonant gemination are complementary to each other so that they do not co-occur in one and the same output form. The English word *flag*, for example, results either in /fu.rág.gu/ (geminated, but with no change in accent position) or in /fu.ra.gu^o/ (unaccented, but with no gemination). The geminated, unaccented form /fu.rag.gu^o/ never surfaces in the output.

(32) a. deaccenting: *flág* → fu.ra.gu^o, *plúg* → pu.ra.gu^o, *blóg* → bu.ro.gu^o

b. accent shift: *plúg* → pú.ra.gu, *cláss* → kú.ra.su, *clúb* → kú.ra.bu

It is possible to account for this interesting interaction between accent change and consonant gemination by positing the faithfulness constraint in (33) and ranking it as relative to *VoiGem or * $\sigma_{\mu\mu\mu}$. The variation between /fu.rág.gu/ and /fu.ra.gu^o/, for example, can be dealt with as in (34), where Faith-acc >> *VoiGem will select the geminated and accented form as in (34a) and the reverse ranking will choose the ungeminated, deaccented (or accent-shifted) form as in (34b).

(33) Faith-accent

The accented vowel in the input must be accented in the output.

(34) a.

flág	*μμ'μ]PrWd	Faith-acc	*VoiGem	ProsForm	*Gem
☞.fu.rág.gu.			*		*
.fu.rá.gu.	*!			*	
.fu.ra.gu.°		*!		*	
.fú.ra.gu.		*!		*	

b.

flág	*μμ'μ]PrWd	*VoiGem	Faith-acc	ProsForm	*Gem
.fu.rág.gu.		*!			*
.fu.rá.gu.	*!			*	
☞.fu.ra.gu.°			*	*	
☞.fú.ra.gu.			*	*	

4. Conclusion

4.1. Summary

In this paper, we looked at various facts regarding gemination in Japanese phonology, especially in loanwords. The distribution of geminate obstruents in Japanese loanwords appears very complex at first glance, but it can be accounted for in a principled manner if one considers various conditions on the occurrence of geminate obstruents in native phonology (in native and SJ words). The basic claim underlying our analysis is that gemination in loanwords is essentially an output-oriented phenomenon. While gemination itself creates a marked structure, it is permitted when and only when it improves output structure. Specifically, it occurs in contexts where it creates Heavy-Light or Heavy-Heavy syllable strings in word-final position. On the other hand, it is blocked in contexts where it would not improve prosodic structure or it would produce a more marked structure in one way or another.

With these ideas in mind, we proposed an Optimality-theoretic analysis that can provide a simple and principled account for all major gemination and non-gemination patterns in loanwords. The relevant constraints in our analysis are ranked as follows:

(35) *μμ'μ]PrWd >> *VoiGem, *σμμμ >> ProsForm >> *Gem

The output-oriented account proposed here is compatible with the idea that loanword phonology is severely constrained by native phonology (Kubozono 2006) or, in phonetic terms, that speech perception is highly constrained by the phonological structure of the listener's native language (Best et al. 1988).

4.2. Future agenda

This study has uncovered several interesting questions for our future work. Two questions emerge regarding the gap between native and loanword phonology. One of them concerns the gemination of (German and Dutch) [x] into [hh] in Japanese loanwords. As mentioned above, [h] turns into [pp] and not into [hh] when geminated in native phonology. It remains unclear why [hh] is tolerated only in loanwords. Equally interesting is the fact that voiced obstruents (especially [g] and [d]) are geminated in some loanwords, e.g., /bag.gu/ ‘bag’, /bed.do/ ‘bed’, despite that they are not allowed to geminate in native words (recall the gemination of [d] into [tt] in /ta.da/ → /ta.tta/ ‘only’). It is interesting to ask why voiced geminates are allowed to occur in some loanwords.

A third question that remains unanswered concerns the fact that [t] in [tʰ] in English is not geminated in Japanese, e.g., /bo.to.ru/, */bot.to.ru/ ‘bottle’; /sya.to.ru/, */syat.to.ru/ ‘shuttle’. Given that other voiceless obstruents are geminated in the same phonological context, e.g., /kyas.su.ru/ ‘castle’, /ap.pu.ru/ ‘apple’, /tak.ku.ru/ ‘tackle’, /waf.fu.ru/ ‘waffle’, it is strange to find that only [t] is not allowed to geminate in this particular context. This looks particularly peculiar since [t] is at least as prone to gemination as other voiceless obstruents in other phonological contexts.

Another puzzling fact about gemination can be found in loanwords from other languages. Although our analysis in this paper was mainly restricted to loanwords from English and German, loanwords from Korean seem to display somewhat different patterns from those that derive from English. One notable case is that voiceless coda stops generally do not geminate. /pak/ ‘Park (Korean surname)’, for example, has basically the same syllable structure as the English word ‘pack’, but its coda consonant nevertheless fails to undergo gemination when adapted into Japanese: /pak/ → [pa.ku], *[pak.ku]. We need to ask why the same phonological string is adapted into Japanese in different ways and, for that matter, what phonetic details contribute to this adaptation difference. This question leads us to a new aspect of loanword phonology as it points to the necessity of comparing loanwords from English with those from other languages (e.g., Korean, French) and explaining their differences and similarities.

Finally, it is necessary to ask about the universality of the constraints used in our analysis, all of which hold in the native phonology of Japanese. It is equally important to explore the empirical basis of the phonological constraints. The former question will require a detailed cross-linguistic survey, while the latter will require phonetic, physiological and/or cognitive experimentation and considerations.

Notes

¹ In this paper, the term ‘native phonology’ is used contrastively with ‘loanword phonology’, referring to the phonology of native and Sino-Japanese words.

² Modern Japanese /h/ derives from old Japanese [p] and is believed to be underlyingly /p/ in modern Japanese (Itô & Mester 1996).

³ /h/ has three allophones in Japanese: [ç] and [ϕ] appear before /i/ and /u/, respectively, while [h] appears other vowels.

⁴ [pp] occurs in reduplication in (5a), in emphatic forms in (5b-c), and in compound-medial positions via regressive place assimilation in (5d-e).

⁵ This constraint is here stated descriptively, and can perhaps be formally understood as resulting from the interaction of several constraints, including NonFinality and FootForm, as well as accentual constraints (see Itô et al. 1996 for a proposal in this direction). In this paper we retain this preliminary formulation, leaving its formal investigation for future work.

⁶ In what follows, [ϕu] is represented as /fu/ rather than /hu/ to show the correspondence between [ϕ] in loans and [f] in source words.

⁷ A violation mark is assigned if the form does not end in HH or HL.

⁸ It may be worth adding here that *σ_{μμμ} can be violated in some languages. In Finnish, for example, geminate consonants can appear before long vowels both in native words and loanwords: e.g., /piik.ki/ ‘peak’, /paak.ki/ ‘park’.

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