

## English Loans in Japanese: Constraints in Loanword Phonology

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This paper provides an account of the phonological adjustments of English words borrowed into Japanese, focusing crucially on the conditions under which obstruents in English are realized as geminates in Japanese. I argue that well-formedness conditions in native Japanese phonology are not sufficient to account for the realization of obstruents in loanwords. What is also called for is a set of loanword specific faithfulness constraints, which ensure that the properties of foreign input are preserved as well as possible in the output. Although it has been claimed that there are no loanword specific constraints, it seems natural that loanword phonology is subject to its own set of faithfulness conditions, whose role is to mirror the foreign source as closely as possible. The analysis is couched in Optimality Theory (Prince and Smolensky 1993).

### 1. Introduction

Words borrowed from one language into another may be subjected to a number of adjustments. It has been claimed that such adjustments are induced solely by the well-formedness conditions in the host language (Silverman 1992; Yip 1993). It has also been argued that well-formedness conditions in the native phonology may be relaxed, but no new constraints may be added, for the purposes of loanwords (Itô and Mester 1993).

In this paper, I argue that loanword-specific conditions do play a role in the phonology of Japanese. This paper provides an account of the phonological adjustments of English words borrowed into Japanese, focusing crucially on the conditions under which obstruents in English are realized as geminates in Japanese. Consonant Geminataion (CG) is generally observed when the original English obstruent appears word-finally, following a short vowel. For example, the English word *cut* is realized as [katto] in Japanese. The English source does not have any geminates, thus it is puzzling that the Japanese counterpart is realized with a geminate. Well-formedness constraints in native Japanese phonology are not sufficient to account for the gemination. Since Japanese does not allow word-final obstruents, obviously phonological adjustments are necessary to realize the word-final obstruents in the English source: that is, the word *cut* cannot be realized as \**kat*. This form would violate the Japanese coda constraint, which prohibits a syllable-final obstruent unless it is part of a geminate: **Coda** (Itô 1989). Violation of **Coda** can be avoided if a vowel is inserted after the obstruent, yielding \**ka.to.*, yet this perfectly

legitimate form is not the output form. As was mentioned before, the form with a geminate is the surface form. This suggests that constraints other than the well-formedness conditions in Japanese are necessary to account for the realization of obstruents in loanwords. What is also called for, I argue, is a set of constraints requiring that output forms mirror the foreign source as closely as possible. I propose an analysis utilizing both the Japanese well-formedness conditions and loanword specific constraints to account for CG. The analysis is framed in Optimality Theory (Prince and Smolensky 1993).

The structure of this paper is as follows. In section 2, I discuss several adjustments observed in English loans in Japanese. In section 3, I summarize the consonant gemination (CG) data. In section 4, I review previous analyses and propose constraint-based account in section 5. I conclude the paper in section 6.

## 2. Adjustments Observed in English Loans in Japanese

The following table shows the Japanese inventory (Nakajou, 1989):

(1)	p		t		k	ʔ
	b		d		g	
	ɸ	s	ʃ	ç		h
		z	ʒ			
		ts	tʃ			
		dz	dʒ			
			r			
	m		n	ɲ	ŋ <sup>N</sup>	
				j	w	
	i	ɯ				
	e	o				
	a					

Japanese syllable structure is (C)(G)V(V)(C), where G is the glide [j] (Itô 1986; Vance 1987). Coda consonants must be either the first half of a geminate or a nasal. Only the following consonants can be geminated: [p, t, k, s, ʃ, ts, tʃ]. Voiced geminates do not exist in the native lexicon. It should be noted that syllables with more than two moras do not occur in monomorphemic words in the native lexicon. This means that syllables of (C)(G)VVC, (C)(G)VVN or (C)(G)VNC form, where N is a nasal and C is a non-nasal, does not occur<sup>1</sup>. We can attribute this to the undominated constraint \*SUPERHEAVY

<sup>1</sup> Polymorphemic words may contain superheavy syllables: e.g. [toot.ta] 'passed' < toor 'pass' + ta 'past-tense marker', [ron.donk.ko] 'Londoner' < rondon 'London' + ko 'native'.

**SYLLABLE**, which prohibits extraheavy syllables in monomorphemic words. Some examples with different syllable types are given in (2):

- (2) [kja.kɯ] 'guest'      [hɒŋ] 'book'  
      [kit.te] 'stamp'      [kɯɯ.ki] 'air'

English and Japanese have different sets of well-formedness conditions, thus when an English word is borrowed into Japanese, naturally a number of adjustments take place (the description of adjustments below are based on National Language Research Institute (1990).

English consonants which have no counterparts in Japanese are realized as Japanese consonants with the same (or similar) place, voicing and manner (except [v], which is realized as [b], due to the lack of voiced bilabial fricative [β] in Japanese).

- (3) English      Japanese
- |          |   |     |          |         |
|----------|---|-----|----------|---------|
| [f]      | → | [ɸ] | fur      | [ɸaa]   |
| [v]      | → | [b] | view     | [bjɯɯ]  |
| [θ]      | → | [s] | Ithaca   | [isaka] |
| [ð]      | → | [z] | mother   | [mazaa] |
| [l], [ɹ] | → | [ɾ] | fly, fry | [ɸɯɾai] |

Note that both English [l] and [ɹ] are realized as [ɾ], since it is the only liquid in Japanese.

English vowels which have no Japanese counterparts are realized as Japanese vowels with a similar height and backness. English tense vowels are realized as long vowels in Japanese, while most lax vowels are realized as short. Some lax vowels are realized as long vowels in Japanese, presumably since they are phonetically long.

- (4) Lax vowels
- |     |   |      |       |         |
|-----|---|------|-------|---------|
| [ɪ] | → | [i]  | pin   | [piN]   |
| [ɛ] | → | [e]  | pen   | [peN]   |
| [æ] | → | [a]  | rally | [ɾaɾii] |
| [ə] | → | [aa] | turn  | [taaN]  |
| [ɔ] | → | [oo] | call  | [koorɯ] |

Tense Vowels	[i]	→	[ii]	key	[kii]
	[u]	→	[ɯɯ]	cue	[kʲɯɯ]
	[oU]	→	[oo]	zone	[zoon]

Japanese does not have consonant clusters other than a consonant followed by [j] in onset position. When an English word with a consonant cluster is borrowed into Japanese, vowels are inserted to break the cluster. It should be noted that no member of consonant clusters is deleted:

- (5) star → [sɯtaa]  
grill → [gɯɾiɾɯ]  
friend → [fɯrendo]

In general, [ɯ] is the inserted vowel except after dentals and palatal affricates (for a more detailed discussion, see Lovins (1975)).

It was mentioned before that Japanese allows two types of coda consonant: a placeless nasal and the first half of a geminate. The coda nasal appears in loanwords when an English source has [n] in the coda position. This is not the case for other English nasals. [m] is realized as [mɯ], while [ŋ] becomes [ŋɯ]. Examples are given below<sup>2</sup>:

- (6) skin → [sɯkiɴ]  
run → [ɾaɴ]  
skim → [sɯkiɱɯ]  
rum → [ɾaɱɯ]  
sing → [ʃiŋɯ]  
lung → [ɾaŋɯ]

The adjustments discussed so far follow directly from constraints on Japanese segments and syllable structure<sup>3</sup>.

<sup>2</sup> It seems that the coda nasal also appears when [m] is preceded by a homorganic consonant:

hamburger → [haŋbaagaa]  
impact → [iŋpakɯto]

Yet when the English source contains two [m]'s orthographically, the coda nasal may or may not appear:

hammer → [haɱmaa]  
summer → [samaa]

<sup>3</sup> Although only segmental adjustments are discussed in this section, it should be noted that there is another type of adjustment in loanwords in Japanese: the pitch accent assignment. Since Japanese is a pitch-

### 3. Consonant Gemination: Data

Let us now turn to the Consonant Gemination data. As was mentioned in section 1, obstruents in English words are often realized as geminates in their Japanese counterparts, even though the corresponding English words do not contain any geminate (the description of Consonant Gemination (CG) below is based on Lovins (1975), Ono (1991) and National Language Research Institute (1990).

#### 3.1 Word-final Obstruents

Word-final voiceless obstruents in the English source are usually geminated:

- |     |      |         |   |              |
|-----|------|---------|---|--------------|
| (7) | [p]  | tulip   | → | [tʃwɯɾippɯ]  |
|     | [t]  | blanket | → | [bɯɾanketto] |
|     | [k]  | kick    | → | [kikkɯ]      |
|     | [tʃ] | pitch   | → | [pittʃi]     |
|     | [ʃ]  | finish  | → | [ɸiniʃɯ]     |

It is important to note that voiced geminates do not exist in the native Japanese lexicon nor do they result from morpheme concatenation, yet they may result from word-final CG in loanwords:

- |     |      |      |   |         |
|-----|------|------|---|---------|
| (8) | [d]  | bed  | → | [beddo] |
|     | [g]  | dog  | → | [doggɯ] |
|     | [dʒ] | edge | → | [eddʒi] |

The following voiced consonants, however, are never realized as geminates:

- |     |     |        |   |         |           |
|-----|-----|--------|---|---------|-----------|
| (9) | [b] | Bob    | → | [bobɯ]  | *[bobbɯ]  |
|     | [z] | fizz   | → | [ɸizɯ]  | *[ɸizzɯ]  |
|     | [ʒ] | vision | → | [biʒON] | *[biʒʒON] |
|     | [l] | bill   | → | [biɾɯ]  | *[biɾɾɯ]  |

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accented language, all loanwords must receive a certain pitch accent pattern. Traditionally (Akinaga 1966; McCawley 1968; National Language Research Institute; Haraguchi 1991), it has been argued that the accent in loanwords falls on the antepenultimate mora (e.g. *vanilla* is realized as [banira], where [ba] is accented), or on the mora which corresponds to the English stressed vowel (e.g. *system* is realized as [ʃisɯtɯmɯ], where [ʃi] is accented). Older loans may be unaccented: e.g. *pistol* is realized as [pisɯtoɾɯ] with no accent. But see Kubozono (1994) for syllable-based accent assignment rule.

These consonants, except [b], are all voiced continuant segments. One may assume that CG does not apply to a voiced [+cont] segment. Spirantization of [b] may explain its irregular behavior. Vance (1987) notes that intervocalic [b] in Japanese is often changed to the bilabial fricative [β]. We can posit that CG does not apply to [b], since it is treated as a voiced continuant.

### 3.2 Word-medial obstruents

Word-medial voiceless obstruents in English are realized as geminates when they are preceded by a stressed vowel:

- (10) [p] háppy → [happii]  
[t] cótton → [kott<sup>h</sup>on]  
[k] hóckey → [hok<sup>h</sup>kee]  
[s] éssay → [essei]  
[f] fáshion → [faff<sup>h</sup>on]

However, no medial gemination is observed when the English source is preceded by an unstressed vowel:

- (11) [p] suppórt → [sapooto] \*[sappooto]  
[t] guitár → [gitaa] \*[gittaa]

In addition, it seems that word-medial CG is affected by the English orthography. When a word-medial obstruent in the English source is orthographically a single consonant, CG does not occur even when the obstruent is preceded by a stressed vowel:

- (12) [ʃ] edítion → [ediʃon] \*[ediʃʃon]  
condition → [kondiʃon] \*[kondiʃʃon]

Interestingly, word-medial voiced obstruents in English are never geminated regardless of the stress position:

- (13) [d] Chéd<sup>h</sup>dar → [tʃedaa] \*[tʃeddaa]  
[g] búggy → [bagii] \*[baggii]

### 3.3 Further issues

There are several departures from the above generalization of CG. CG does not occur when an English obstruent follows a long vowel:

- (14) repeat → [ripiito]    \*[ripitto]  
 debate → [dibeeto]    \*[dibetto]  
 grape → [gʷreeppʷ]    \*[gʷreppʷ]

This follows from \***SUPERHEAVY SYLLABLE**, which prohibits syllables with more than two moras.

In addition, no loanwords are realized with two geminates. When there are two possible targets for CG, only the word-final obstruent is realized as a geminate<sup>4</sup>:

- (15) racket → [rakettō]    \*[rakkketto], \*[rakkketo]  
 pocket → [pokettō]    \*[pokkketto], \*[pokkketo]  
 ketchup → [ketfappʷ]    \*[ketttfappʷ], \*[ketttfapʷ]

### 3.4 Consonant Clusters

So far we have seen the CG of a single consonant. When an English word with a consonant cluster is borrowed into Japanese, CG is usually not observed:

- (16) [pt] kept → [kepwto]    \*[keppwto], \*[kepwttō]  
 [kt] perfect → [paaʔekwto]    \*[paaʔekkkwto], \*[paaʔekwttō]  
 [ft] gift → [giʔwto]    \*[giʔʔwto], \*[giʔwttō]  
 [kst] text → [tekiswto]    \*[tekkkiswto], \*[tekisswto], \*[tekiswttō]  
 [sp] grasp → [gʷraswppʷ]    \*[gʷrasswppʷ], \*[gʷraswppʷ]  
 [st] cast → [kjaswto]    \*[kjasswto], \*[kjaswttō]  
 [sk] task → [taswkw]    \*[tasswkw], \*[taswkkw]

<sup>4</sup> Words may contain more than one geminate only when they consist of two free morphemes:

rapp <u>u</u> topp <u>u</u>	'laptop'
hatt <u>f</u> ibakk <u>w</u>	'hatchback'
bu <u>kk</u> wrettō	'booklet'
pikk <u>w</u> app <u>u</u>	'pickup'

We can see that above words consist of two free forms: laptop < lap + top, hatchback < hatch + back, etc.

However, some clusters do show CG, in addition to the vowel insertion which breaks up the cluster (cf. (5)). *-Cl* clusters geminate unless C is an alveolar stop:

- (17) [pl] apple → [appɹrw]  
           nipple → [nippɹrw]  
       [kl] tackle → [takkrw]  
           knuckle → [nakkrw]  
       [fl] waffle → [waffɹrw]  
       [sl] castle → [kjassɹrw]  
           hustle → [hassɹrw]  
 but: [tl] bottle → [botɹrw]   \*[bottɹrw]  
       kettle → [ketɹrw]   \*[kettɹrw]

Interestingly, no CG is observed when the C in *-Cl* clusters is a voiced obstruent:

- (18) [dl] middle → [midɹrw]   \*[middɹrw]  
       [gl] struggle → [swtoragɹrw]   \*[swtoraggɹrw]

In addition, CG does not occur when the C in *-Cl* clusters is orthographically a single consonant:

- (19) [pl] triple           [toripɹrw]   \*[torippɹrw]  
       [kl] article       [aatikɹrw]   \*[aatikkɹrw]

It should be noted that the gemination pattern in *-Cl* clusters is similar to that of word-medial gemination described above.

Word-final *-Cs* clusters are also realized with a geminate. CG in *-Cs* clusters occurs regardless of the stress position or English orthography:

- (20) [ps] pops       → [poppɹsw]  
           chips      → [tʃippɹsw]  
       [ks] box       → [bokkɹsw]  
           wax       → [wakkɹsw]  
           óρθodox → [oosodokkɹsw]



We can see that CG occurs even when the preceding vowel is not stressed (as in *ó*rdodox) and the C is orthographically a single consonant (as in all the examples above).

The CG data seem to be quite complicated. As we have seen, they do not follow directly from constraints on Japanese segments and syllable structure. Many researchers have attempted to account for this phenomenon, yet their analyses are far from complete. Different researchers, however, have captured different aspects of CG, and it is helpful to see what they have found. In the next section, some of the previous analyses are reviewed and their problems are pointed out. I propose a constraint-based analysis in section 5.

## 4. Previous Analyses

### 4.1 Stress

Akasaka (1972, cited in Ooe 1991) claims that English obstruents following a stressed vowel are realized as geminates. This explains the word-medial CG of voiceless obstruents: e.g. *háppy* [happii]. However, as was shown in (13), voiced obstruents are not always realized as geminates in this environment: e.g. *Chéddar* [tʃedaa]. In addition, when the stressed vowel is long, there is no gemination whether the obstruent is voiced or not: e.g. *repeat* [ripiito] (see (14)). Finally, it should be noted that in words like *rácket* [raketto], it is the obstruent following an unstressed vowel that is realized as a geminate (see (15)). Thus, it is clear that English stress is not the only condition for CG.

### 4.2 English Orthography

Ooe (1968) and Imai (1980) claim that orthographically doubled consonants in English are realized as geminates in Japanese. According to them, the gemination in the following words is attributable to their spellings:

- |      |     |        |   |           |
|------|-----|--------|---|-----------|
| (21) | [p] | happy  | → | [happii]  |
|      | [t] | cotton | → | [kottton] |
|      | [k] | kick   | → | [kikkw]   |

This analysis accounts for the irregularity of gemination of [ʃ] in word-medial position: *fáshion* → [faʃʃon] vs. *édition* → [ediʃon], \*[ediʃʃon] (cf. (12)). However, note that words like *lip* and *cut* are realized as [rippw] and [katto], respectively. Also, in *rácket* [raketto], an orthographically single consonant is realized as a geminate, while a doubled one in the same word is realized as a single consonant (see (15)). Therefore, there must be other factors that condition CG.

### 4.3 Phonetic Closeness

In English, word-final obstruents following a stressed vowel are considerably lengthened. Ohso (1973) claims that word-final CG occurs due to an attempt to make the Japanese counterparts phonetically close to the English source. Since a Japanese geminate is phonetically a long consonant, geminating the final consonant makes the Japanese output phonetically close to the original English word. She further claims that word-medial CG may be affected by English orthography.

It is hard to believe that Japanese speakers recognize the duration difference between a word-final consonant in a stressed syllable and those in an unstressed syllable. In fact, gemination occurs even if the last syllable is not stressed: e.g. *édit* [editto].

Ohso gives a slightly different view in her earlier work (Ohso 1971, cited by Lovins 1975). She claims that CG is the result of an attempt to preserve the English closed syllable. Word-medial CG may or may not occur, since the syllable boundary in word-medial position is not clear to Japanese. This analysis seems plausible, except that it does not account for the difference between CG of word-medial voiceless and voiced obstruents. Note that word-medial voiced obstruents are not geminated in their Japanese counterparts, while voiceless ones do. Lovins (1975) also states that word-medial gemination seems to be conditioned by other factors, such as English stress. She notes that word-medial CG usually occurs when the preceding vowel is stressed, while word-final gemination occurs whether the preceding vowel is stressed or not.

## 5. Proposal

We have seen that previous analyses capture subsets of the data, but not all the data. In this section, I will propose an analysis of Consonant Gemination in Optimality Theory (Prince and Smolensky 1993; McCarthy and Prince 1993). In this framework, phonological and morphological representations are not derived by rules. Rather, a set of ranked constraints on well-formedness evaluates the set of all possible output candidates for a given input and selects the most preferred output. A candidate is considered to be optimal when it best satisfies the whole constraint set. This does not mean it has to meet all the constraints. Constraints are violable in this framework. Yet violation must be minimal. The optimal output is the form that satisfies the higher ranked constraints with minimal violations of lower-ranking constraints.

Following Silverman (1992), I assume that the non-linguistic acoustic signal of a foreign language is the input to the loanword phonology. This indicates that Japanese speakers do not have an access to the prosodic structure of English.

### 5.1 Word-final CG of voiceless obstruents

I propose that there are four constraints that are playing a crucial role in the word-final CG cases:

#### NO PLACE IN CODA

Only placeless consonants can appear in the coda (Itô 1986, 1989)

#### LOANWORD CORRESPONDENCE<sup>5</sup>

Segmental content of a foreign source has to be preserved in the host language.

#### ALIGN (PrWord<sub>E</sub>, R, Syllable<sub>J</sub>, R)

The right edge of the English word must be aligned with the right edge of the Japanese syllable.

#### FILL

Syllable positions are filled with segmental material (Prince and Smolensky 1993; McCarthy and Prince 1993)

**NO PLACE IN CODA** restricts the set of possible codas to be the first half of a geminate or a nasal. This constraint is undominated in both native Japanese and loanwords. The next two constraints, which I propose, are loanwords specific. **LOANWORD CORRESPONDENCE** ensures that segmental content of a foreign input be preserved in the host language. This is also an undominated constraint. **ALIGN** requires that the right edge of the English word be aligned with the right edge of the Japanese syllable. It should be noted that this constraint aligns the English word edge with the Japanese syllable edge. I assume that there is another kind of **ALIGN** constraint which requires the right edge of the English word be aligned with the right edge of the Japanese word. However, it is not always possible to align the English word edge with the Japanese word edge, since Japanese syllable structure is much more restricted than English syllable structure. In such cases, the alignment with the next highest prosodic structure is required and that is induced by the **ALIGN** (PrWord<sub>E</sub>, R, Syllable<sub>J</sub>, R).

Let us consider the word-final CG observed in the word *cut* [katto]:

<sup>5</sup> This constraint should be distinguished from the constraint **FAITHFULNESS** that Yip (1993) proposes. Yip's constraint ensures that the input and the output be identical. Thus, an output with an epenthetic vowel, for example, violates **FAITHFULNESS**. However, such an output is not a violation of **LOANWORD FAITHFULNESS**, as long as it contains every segment in the input.

(22) cut → [katto]

	Correspond	Coda	Align	Fill
ka.	*!			
kat.		*!		
ka.to.			*!	*
kat.to.				**

Since Japanese does not allow word-final obstruents, the word *cut* cannot be realized as *\*kat*. This form violates **NO PLACE IN CODA**. Violation of the coda constraint can be avoided if a vowel is inserted after the obstruent, yielding *\*ka.to*. However, this is not the surface form. Obviously, well-formedness constraints in native Japanese phonology are not sufficient to account for the surface form. Violation of **NO PLACE IN CODA** can also be avoided if the word-final [t] is not preserved in the Japanese counterpart (thus *\*ka*), yet this is not the optimal form, either. I attribute this to the undominated constraint **LOANWORD CORRESPONDENCE**. The actual output is *kat.to*, and this is due to the higher ranking of **ALIGN** than **FILL**.

## 5.2 Word-medial CG

I assume that word-medial CG is induced by a different constraint than word-final CG, following Ohso (1971). I argue that word-medial CG results from the pressure to retain the prominence of the original stressed syllable, and is due to the following constraint:

### TONIC SYLLABLE

English stressed syllable must be heavy in the corresponding Japanese form<sup>6</sup>.

**TONIC SYLLABLE** accounts for the CG in *cotton* [kotton]:

(23) cotton → [kotton]

	Tonic	Fill
ko.ton.	*!	
kot.ton.		*

The geminated form is preferred, although it violates **FILL**, since **FILL** is ranked lower than **TONIC SYLLABLE**. One may ask why the Japanese syllable becomes heavy by gemination

<sup>6</sup> As was mentioned before, this constraint seems to be affected by the English orthography. When the obstruent in the English source is spelled with a single consonant, the pressure to make the corresponding Japanese syllable heavy seems to be weakened.

rather than vowel lengthening. As Fukui (1986) and Poser (1988) have shown, a floating mora in Japanese is always filled by leftward spreading in the native Japanese lexicon. The same strategy seems to apply in loanword phonology.

### 5.3 CG of Voiced Obstruents

It was noted before that no voiced geminates are permitted in the native Japanese lexicon. However, voiced [-cont] geminates are observed in loanwords. I assume that the constraint **\*VOICED [-CONT] GEMINATES** is relaxed in loanword phonology and it is ranked as follows: **ALIGN » \*VOICED [-CONT] GEMINATES » TONIC SYLLABLE**. CG of word-final voiced obstruents does occur, due to the lower ranking of **\*VOICED [-CONT] GEMINATES** than **ALIGN**. Consider the following:

(24) *bed* → [beddo]

	Coda	Align	*Voiced [-ct] Gem	Fill
<i>bed.</i>	*!			
<i>be.do.</i>		*!		*
<i>べど bed.do.</i>			*	**

The form *bed.* cannot surface since it violates the undominated coda constraint. The form *be.do.*, which does not contain a geminate but violates **ALIGN**, is not the surface form, either. The third candidate with a voiced geminate is the optimal form.

CG of word-medial obstruents, on the other hand, does not occur due to the higher ranking of **\*VOICED [-CONT] GEMINATES** than **TONIC SYLLABLE**.

(25) *buggy* → [bagii]

	Align	*Voiced [-ct] Gem	Tonic	Fill
<i>ばが ba.gii.</i>			*	
<i>bag.gii.</i>		*!		*

Both candidates satisfy **ALIGN**. The second candidate satisfies **TONIC SYLLABLE** as well, yet it is not the surface form. It violates **\*VOICED [-CONT] GEMINATES**, which ranks higher. The first candidate is the optimal form, since it satisfies **\*VOICED [-CONT] GEMINATES**.

## 5.4 Further Issues

We saw before that no gemination occurs following a long vowel. We posited that this is due to the undominated constraint **\*SUPERHEAVY SYLLABLE**, which can be formally stated as:

### **\*SUPERHEAVY SYLLABLE**

Syllables with more than two moras are prohibited in monomorphemic words.

This constraint is actually relaxed in loanwords, since syllables of the form (C)(G)VVN does occur: e.g. *scene* [ʃiːN]. Only those syllables of (C)(G)VVC or (C)(G)VNC form is prohibited in loanwords. We can assume that **\*SUPERHEAVY SYLLABLE** can be divided into two parts, **\*SUPERHEAVY SYLLABLE - N** and **\*SUPERHEAVY SYLLABLE - C**. The former prohibits superheavy syllables ending in a nasal and the latter prohibits those ending in a non-nasal consonant (this is similar to the division of **\*VOICED GEMINATES** into **\*VOICED [-CONT] GEMINATES** and **\*VOICED [+CONT] GEMINATES** shown above). Only **\*SUPERHEAVY SYLLABLE - C** is undominated in loanword phonology. This constraint accounts for the realization of the word *beat*:

(26) *beat* → [biːto]

	*Super heavy - C	Align	Fill
❌ biː.to		*	*
biːt.to	*!		**

Gemination does not occur when the preceding vowel is long, since it creates a superheavy syllable.

In (15), it was noted that word-medial gemination never occurs if word-final gemination is possible. CG occurs only once per word. I assume that this is due to the following constraint:

### **\*TWO GEMINATES**

More than one geminate per word is prohibited.

This constraint restricts the number of geminates in a word<sup>7</sup>. No loanword has more than one geminate, thus we can assume that this is an undominated constraint. Let us consider the realization of the word *racket*:

(27) *racket* → [raketto]

	*Two Gem	Align	Tonic	Fill
ra.ke.to.		*!	*	*
rak.ke.to.		*!		**
ra.ket.to.			*	**
rak.ket.to.	*!			***

The first two candidates violate **ALIGN**, thus they are not optimal. The fourth candidate, which satisfies both **ALIGN** and **TONIC SYLLABLE** is ruled out since it violates **\*TWO GEMINATES**, which is undominated and higher ranked than the two. The third candidate, which has one geminate and satisfies **ALIGN**, is the optimal form.

It was pointed out that a voiced continuant is never geminated both word-finally and word-medially. Although the constraint which bans voiced [-cont] geminates is relaxed in the loanword phonology, the one which prohibits voiced [+cont] geminates is not:

#### **\*VOICED [+CONT] GEMINATE**

Voiced [+cont] geminates are prohibited.

This is an undominated constraint, and thus a voiced continuant in the English source is never realized as a geminate:

(28) *fizz* → [ɸizɯ]

	*Vc [+ct] Gem	Align	Fill
fi.zɯ		*	*
fiz.zɯ	*!		**

<sup>7</sup> I do not know any literature that talks about this kind of constraint in the native lexicon. Yet it is plausible that the core lexicon has **\*TWO GEMINATES** for monomorphemic words. It is known that Old Japanese did not have any geminates. Geminates were introduced when Chinese words were borrowed into Japanese. Geminates appeared at the morpheme boundary in Chinese. Thus it may be the case that the number of geminates in a monomorphemic word is limited in the core lexicon. This is not to say geminates are completely prohibited in monomorphemic words in the core lexicon. It is known that the consonant [p] always appears as a geminate in Yamato and Sino-Japanese (McCawley 1968; Ito and Mester 1993). Therefore, the constraint on the number of geminates per word should allow at least one geminate.

The second candidate satisfies **ALIGN**, yet it violates the undominated **\*VOICED [+CONT] GEMINATE**. The first candidate is preferred, although it violates **ALIGN**, since it satisfies **\*VOICED [+CONT] GEMINATE**.

## 5.5 Consonant Clusters

It was shown before that CG does not occur in most consonant clusters. I assume that this is due to an undominated constraint which bans two consecutive epenthetic segments:

### \*CONSECUTIVE UNFILLED POSITION

Consecutive unfilled structural positions are prohibited.

This constraint can be understood as one of the faithfulness constraints, which ensures that the input and the output differ minimally (McCarthy and Prince 1994). **\*CONSECUTIVE UNFILLED POSITION** seems to be undominated in the native lexicon as well. This constraint accounts for the realization of the word *task* (underlined segments are epenthetic):

(29) *task* → [tasɯkɯ]

	Cons	Coda	Align	Fill
task.		*!		
tas.kɯ		*!	*	*
tas.sɯ.kɯ			*	***!
ta.sɯk.kɯ	*!			***
ta.sɯ.kɯ			*	**

The first and second candidates cannot be the optimal form, since they violate the undominated **NO PLACE IN CODA**. The fourth candidate satisfies **ALIGN** (note that unless [k] is in the coda position, **ALIGN** is violated), yet it has two consecutive epenthetic segments. Between the third and the fifth candidates, the non-geminated form is preferred, since it has fewer violations of **FILL**.

We have seen that when the English source contains *-Cl* and *-Cs* clusters, C geminates (see data in 3.4).

I assume that Japanese listeners perceive *-Cl* clusters not as clusters, but as a consonant followed by another syllable. In final *-Cl* clusters, [l] is syllabic in English. I assume that it enters the Japanese phonology as the syllable /ɯ/. If we posit that these clusters are considered to be a consonant followed by a syllable, the C in *-Cl* is not word-final. Thus



we expect the gemination pattern to be the same as in word-medial gemination. And indeed that seems to be the case. In (18), we have seen that voiced stops do not geminate. It was also shown that the CG in *-Cl* clusters seems to be affected by the English orthography. Thus *-Cl* clusters can be accounted for by the **TONIC SYLLABLE** constraint:

(30) apple → [appɯɾɯ]

	Align	Tonic	Fill
á.pɯ.ɾɯ		*!	*
ᵃp.pɯ.ɾɯ			**

Both candidates satisfy **ALIGN**, since the word-edge of the input is assumed to be /ɾɯ/. The second candidate is preferred over the first one, since it satisfies **TONIC SYLLABLE**. CG of *-Cl* clusters does not occur when the C is a voiced stop, due to the constraint **\*VOICED [-CONT] GEMINATES**. Consider the following:

(31) struggle → [swɯtoragɯɾɯ]

	*Voiced [-ct] Gem	Tonic	Fill
ᵃsw.to.ra.gɯ.ɾɯ		*	***
sw.to.rag.gɯ.ɾɯ	*!		****

The form with a geminate is not the surface form contrary to (30), since it violates **\*VOICED [-CONT] GEMINATES**, which ranks higher than **TONIC SYLLABLE**.

As for the [-tl] cluster, which does not show CG, I assume that flapping is blocking the gemination. Note that in the word 'bottle', for example, the [t] becomes a flap, which is a voiced continuant. I assume that gemination does not occur, due to **\*VOICED [+CONT] GEMINATES**, which is undominated.

*-Cs* clusters do not show the characteristics of the word-medial CG, unlike *-Cl* clusters. The vowel preceding the C does not need to be stressed. The C can be orthographically a single consonant. It seems that they should be treated as word-final CG cases. But then, it is not clear why *-Cs* clusters show CG while other consonant clusters do not. It might be the case that the English orthography is playing a role here. The [ks] clusters which is spelled with a single *x* may be treated as a single segment, resulting in CG. For other *-Cs* clusters, morphological information may be related. Many words with final *-Cs* clusters seem to be polymorphemic words, such as plural forms. In those cases, the C in *-Cs* clusters may be treated as the word-final consonant, yielding the gemination. Further

investigation is necessary, however, to determine the relationship between the English orthography and CG.

## 5.6 Constraints Ranking

In (32), I give all constraints that we have seen:

### (32) Ranking of Constraints in Loanword Phonology

Undominated	No Place in Coda, *Superheavy syllable - C, One Geminate, Loanword Correspondence, *Voiced [+cont] Geminate, Consecutive Unfilled Position »
Dominated	Align » *Voiced [-cont] Geminate » Tonic Syllable » Fill

Obviously, **LOANWORD CORRESPONDENCE**, **ALIGN** and **TONIC SYLLABLE** do not exist in the native phonology and are loanword phonology specific. All other constraints are well-formedness conditions in Japanese and exist in the native lexicon. **FILL** and **\*VOICED [-CONT] GEMINATE** are undominated in the native lexicon (Zec 1994), but relaxed in loanword phonology. Other well-formedness constraints are undominated both in the native phonology and loanword phonology.

## 6. Conclusion

In this paper, an analysis of Consonant Gemination in English loans in Japanese was proposed, using Optimality Theory. The analysis shows that well-formedness conditions in Japanese are not sufficient to account for the realization of obstruents in loanwords. What is also called for is a set of constraints requiring that output forms be faithful to the foreign input. These constraints are loanword-specific.

As Yip (1993) argues, loanword phonology has two objectives: the first is to obey the well-formedness conditions in the core lexicon and the second is to mimic the foreign input as closely as possible. Although it has been claimed that a new constraint or a stronger version of an existing constraint is not added in loanword phonology (Itô and Mester 1993), it seems natural that loanword phonology is subject to a set of identity conditions, since the output form must mimic the properties of foreign input as closely as possible.

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