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A METRICAL AND OPTIMALITY-THEORETICAL APPROACH TO GEMINATION AND EPENTHESIS IN JAPANESE LOANWOARD PHONOLOGY*

Loanword phonology is the technical term for the research project under which foreign loanwords borrowed by a language undergo phonological studies. The aim of this paper, thus, is to address certain issues and problems that arise in the phonology of foreign loanwords borrowed by Japanese. Although a lot of interesting phonological phenomena can be found in foreign loanwords in Japanese (cf. Lovins 1975), the main concern of this paper will be the issues concerning the positions of gemination and the rule of epenthesis involved in loanwords in Japanese.

More specifically, gemination which can be found in loanwords is of great interest because the position where it happens seems *prima facie* to be quite idiosyncratic and, thus, highly resistant to any systematic explanation. Consider, for example, the pronunciations of the loanwords in (1) and (2):

(1) a. tuck /tʌk/ → [takku], Tad /tad/ → [taddo], tug /tʌg/ → [taggu], tap /tap/ → [tappu], touch /tʌč/ → [tačči]

vs. tough /tʌf/ → [taΦu], tab /tʌb/ → [tabu]

b. stuff /stʌf/ → [sutaΦΦu], stub /stʌb/ → [sutabbu]
(cf. stuck /stʌk/ → [sutakku], stud /stʌd/ → [sutaddo], step /step/→ [suteppu])

c. duffle /dʌfl/ → [daΦΦuru] vs. double /dʌbl/ → [daburu]

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(2) a. miss /mis/ → [misu] vs. missing /misiŋ/ → [missiNgu]
listen /lisn/ → [rissuN] vs. listening /lisniŋ/ → [risuniNgu]
(Ono 1991)

b. pick /pik/ → [pikku], nick /nik/ → [nikku]

c. picnic /piknik/ → [pikunikku] (*[pikkunikku], *[pikkuniku])

d. necklace /neklis/ → [nekkuresu]

It has been widely held (cf. Quackenbush & Ohso 1990) that in general, the (first) consonant in the coda of a closed-syllable with a short vowel in a given foreign word always geminates.[1] (1a) shows that /Φ/ and /b/ do not geminate even in this circumstance. In fact, Quackenbush & Ohso (1990) (hereafter, O&S) and Ono (1991) treat these consonants as an exceptional consonant in terms of gemination. But, (1b) shows that they geminate if they appear in the coda of a syllable with more than one consonant in its onset. (1c) is even more complicated: /Φ/ geminates but /b/ does not if they are the first consonant of the coda which consists of more than one consonant. (2) adds a further mysterious flavor to the issue: (2) shows that, on the one hand, /s/ in *miss* does not geminate but it DOES geminate if *-ing* is attached to *miss*; on the other, /s/ in *listen* geminates but it does NOT geminate if *-ing* is attached to *listen*. Moreover, when *pick* and *nick* are pronounced as a loanword in Japanese, /k/ in the coda must geminate, as shown in (2b). But, (2c) shows that, when *picnic* is pronounced as a loanword in Japanese, the /k/ of the final syllable must geminate but /k/ of the first syllable must not geminate. (Note that there are cases where /k/ in the first syllable of a loanword with two syllables may geminate, as shown by (2d).)

At this point, one might ask whether or not we can appropriately predict the position of gemination in a given foreign loanword in a systematic way, and if we can do it, how we can formulate the rule(s) to compute the position of gemination? It is the aim of the first half of this paper to provide a satisfactory machinery to properly compute the position of gemination in loanwords in Japanese by utilizing the metrical theory developed by Halle & Vergnaud (1987) and elaborated by Idsardi (1992, 1994) and Halle & Idsardi (to appear).

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[1] As a result of borrowing, the vowel /ʌ/ becomes /a/, the consonant /f/ becomes the bilabial /Φ/, /l/ becomes the flap /r/, and so on. In section 1, we will touch on the issue concerning the sound change caused by borrowing. Besides, since Japanese does not allow C# or CC (except C*N*, where *N* is a moraic nasal consonant), an epenthesis must take place to avoid it (see Itô 1986). We will also return to this issue in section 3.

Our second aim is to scrutinize the rules of epenthesis involved in loanwords in Japanese from the viewpoint of the optimality theory, which has been recently being developed and pursued by not a few researchers (e.g., Prince & Smolensky 1993, McCarthy & Prince 1993a,b,c, Tesar & Smolensky 1993, Itô, Mester & Padgett 1993, Mester 1994, Yip 1993a,b, among many others) to explore a theory of the way that representational well-formedness determines the assignment of grammatical structure without any kind of rule. To put it a little more specifically, /u/ is inserted in most cases as an epenthesis in the environment where a CC or C# sequence appears in loanwords, but, in some cases, /i/ and /o/ are, instead, inserted in the same environment. Indeed, it is by no means difficult to pose rules for the purpose of this irregularity of Japanese loanword epenthesis. But such rules fail to capture an important fact which should be captured in Japanese phonology at large. It will be demonstrated that we can provide a natural and consistent account by working it out under the optimality theory.

This paper is organized as follows: In section 1, the theoretical background for loanword phonology in addition to a brief outline of Japanese segmental phonology will be introduced. In section 2, we will explore a systematic account of the position of gemination in loanwords in Japanese by using a theory of metrical grids. We will reach the conclusion, as a consequence of the exploration, that there are two metrical planes in Tokyo Japanese, one of which consists of metrical structures projected by morae, the other one of which consists of metrical structures projected by syllables, whereas in Osaka Japanese, there is only one metrical plane, which is projected by syllables. It will be pointed out that this is related to the fact that, whereas syllables do not bear any accent in Tokyo Japanese, they can in Osaka Japanese (*pace* Haraguchi 1977 and Shibatani 1990). In section 3, we will consider the rules of epenthesis for loanwords in Japanese under the optimality theory. It will be demonstrated that the choice of vowels for epenthesis is determined by the interaction of the ranked constraints of Japanese (loanword) phonology including the sonority hierarchy. Concluding remarks will come in section 4.

1. Introduction

In this section, after sketching out some aspects of Japanese phonology, aspects of which have some connections to our topics,[2] I will outline Silverman's (1992) approach to

[2] A concise introduction to Japanese phonology can be found in Shibatani (1990). For more minute

loanword phonology, which is adopted as the background for loanword phonology of this paper.

1.1. Relevant Aspects of Japanese Phonology

In Japanese phonology, sequences of a consonant plus a vowel play very important roles. As a manifestation of this, one might notice the fact that Japanese has no way to express any single consonant phoneme; rather, only a consonant plus a vowel can be expressed by a single letter in the Japanese orthography system. Obviously this is closely related to the fact that Japanese is a "mora-counting" language (Trubetzkoy 1939, McCawley 1968).

Interestingly, with this regard, sequences of a certain consonant plus a certain vowel cannot be found in any Japanese original word, though each phoneme can be found if it is combined with another vowel. For example, whereas the sequences like [tu], [ti], [du], and [di] do not exist in any Japanese original word, the sequences like [ta], [te], and [to], and [da], [de], and [do] abound in Japanese original words (see Itô & Mester 1993 for some relevant discussions). We will observe in §3 that the lack of some sequences of a vowel and a consonant in Japanese original words has much connection with epenthesis occurring in foreign loanwords.

Another characteristic of Japanese phonology relevant to this study is that it is a pitch-accent language with the tone system with the two-way (high-low) tone distinction. Following the hypothesis that 'stress-accent' differs phonetically from 'pitch-accent' (Sugito 1980, Beckman 1986), I assume that Japanese does not use 'stress-accent'. The topic as to the way to maintain or express 'stress-accent' (of a foreign word to be borrowed by Japanese), thus, will be addressed in §2.

1.2. Loanword Phonology

I will work out the present study to Japanese loanword phonology basically along the line outlined by Silverman (1992), which argues that there are two stages in the adoption of a foreign loanword by a given language. The first stage is the Perceptual Level, in which speakers in the language at issue detect some, but not all, aspects of the signals of the

and exhaustive descriptions of Japanese phonology, see Vance (1987).

foreign language from which the loanword is borrowed. For example, the English contrast between /r/ and /l/ which Japanese lacks is not perceived at all by the scan of this level. So the English words, *rye* [rai] and *lie* [lai], are perceived as the same as [rai].[3] But the English voicing contrast, which Cantonese lacks (Yip 1993), is perceived in Japanese. Thus, the English words, *bar* [ba:] and *par* [pa:], are both perceived as [pa:] in Cantonese, but they are perceived as [ba:] and [pa:], respectively, in Japanese.[4]

The output of the Perceptual Level is the input to the Operative Level, which is the phonology proper level, according to Silverman (1992). Silverman states,[5]

> The process which apply at the Operative Level of the [Cantonese] loanword phonology do not exist in native phonological derivations. Rather, they are process which are peculiar to the loanword phonology, applying so that nonnative forms may be realized in accordance with native constraints. Therefore, phonological process at the Operative Level of the loanword phonology exist in a separate domain from the native phonological system. Their only property common with native phonological process is that the same-language specific constraints exert an influence on the output of both systems.

Yip (1993a) argues, contra Silverman (1992), that the constraints involved in loanwords in a given language do not differ at all from those involved in original words in that language and that the constraints are ranked in terms of the optimality theory. Pace both Silverman (1992) and Yip (1993a), I will take the intermediate position between them, following Itô & Mester's (1993) claim that the less nativized an item is, the more it may tend to be exempted from the core constraints in native phonology: That is, I take it that there is no particular rule and only constraints exist at the Operative level (this confirms to Yip 1993a), but some constraints are particular to loanword phonology (this confirms to Silverman 1992). It is important, here, to note that the input to the Operative Level, in which the constraints of a given language are ranked, must be what can be perceived at the Perceptual Level by a given language.

Since it is very plausible that phonological component is essentially conservative (Yip 1993), it attempts to mimic the host language as closely as possible if it fails to fully maintain the representation of the host language. At the Perceptual Level, therefore, a phoneme phonetically most undifferentiated from the phoneme which the target language does not have is chosen among the phoneme inventory of that language as the input phoneme to the Operative Level when a foreign word with such an unknown phoneme is

[3] Notice that Japanese has /r/, but not /l/.

[4] Notice that Japanese has both /b/ and /p/, and that Cantonese has /p/, but does not have /b/.

[5] Cited from Silverman (1992: 290-291).

adopted as a loanword in that language. Thus, the distinction should be clearly made between two cases: In the case of the English word *lie* [lai], the input to the Operative Level for this word in Japanese should be /rai/, but not /lai/ or any other, because Japanese lacks /l/, and /r/ is the phonetically most undifferentiated phoneme from /l/ in the Japanese phoneme inventory.[6] In the case of the English word *two* [tu:], which becomes [ču:] as a loanword in Japanese, on the other hand, the input to the Operative Level for this word in Japanese should be /tu:/, because Japanese has /t/ as well as /u/ and, thus, they can be perceived in Japanese as the same as in English. The change of /t/ to /č/, thus, happens in the Operative Level due to a certain phonological constraint in Japanese, as will be observed in §3.

The same holds true for the process of prosodic features like stress, pitch, or tone. Among them, 'stress' and 'pitch' are tools for expressing prosodic prominence (Beckman 1986). As is well known, Japanese does not have 'stress-accent' (see Beckman 1986 and Sugito 1980 for more discussion). Then, a question arises under Silverman's theory of loanword phonology: At the time of the adoption of foreign words with 'stress-accent', how is the stress interpreted or expressed (or mimicked) in Japanese? Since Japanese does have 'pitch-accent', a metrical feature for expressing prosodic prominence, it is natural to assume that Japanese can perceive the prosodic prominence of an input word at the Perceptual Level, though they cannot express it in the same way as in the input word if it is a 'stress-accent'. Hence, the detected prosodic prominence is expressed not by stress but by other methods in Japanese. As a result, stress does not exist at the Operative Level in Japanese loanword phonology; rather, stress is replaced with some other feature that expresses prosodic prominence at the Perceptual Level. The issues as to what replaces stress and how the replacement takes place are the main issue which will be investigated in the next section.

2. Gemination in Japanese Loanword Phonology

As observed in the preface, gemination is found in some loanwords in Japanese even if the underlying form of them (i.e., their original pronunciation, or the input to the Perceptual Level) does not include gemination at all. There, we also observed that the position of

[6] According to Chomsky & Halle (1968: pp.176-177), /r/ has the same distinctive features as /l/ except that the former is [-anterior], but the latter is [+anterior].

gemination is vexatiously complicated and, hence, difficult to predict. In fact, a lot of articles tried to find the rules for computing the position of gemination in loanwords in Japanese (e.g., Akasaka 1972, Ohe 1967, Imai 1980, Quackenbush & Ohso 1990, Ono 1991, and others). The purpose of this section is to establish the empirically satisfactory rules for gemination in loanwords in Japanese by claiming that gemination is the way to express the stress that is perceived as a prosodic prominence at the Perceptual Level in Japanese loanword phonology.

2.1. Prosodic Prominence and Gemination

According to Haraguchi (1991), a distinction of the loanwords in Japanese can be made in terms of their metrical properties: Some of them respect the stress-accent in the original words, and some of them conform to the metrical rules particular to Japanese.

Under Silverman's theory of loanword phonology, this can be interpreted as follows: At the Perceptual Level, there are cases in which the stress (prosodic prominence) in a given foreign word is salient enough for Japanese to detect and respect it (though it is replaced by some metrical features other than stress at the Operative Levels, because Japanese does not have stress-accent), but in some other cases, it is not so salient that Japanese cannot respect it (though they can be perceived, as argued in §1.2 above).[7] What does it mean to say that a prosodic prominence is perceived but not respected? Let us assume that it means that, though Japanese realize the existence of an unknown prosodic prominence in a given word, but they do not comprehend where it is located within that word. Then, it is natural to assume that, when the latter cases happen, some rules apply for computing the position of the prosodic prominence in a given word. In what follows in this section, I will propose the rules for this purpose and examine their validity with various examples.

2.1.1. The Rules

Here, I propose that, unless the prosodic prominence in a given word is respected at the Perceptual Level, the following rules apply for computing the position of the prosodic

[7] I leave open the following question: In what environments can the stress in a given word be perceived and respected? See Silverman (1992) and Yip (1993) for relevant discussion in Cantonese loanword phonology.

prominence at the Perceptual Level. As I stated in the preface, these rules are based on the metrical theory recently developed by Idsardi (1992, 1994) and Halle & Idsardi (to appear) (**Simplified Bracketed Grid Theory**), which is emerged and extended from the metrical theory of Halle & Vergnaud (1987). So the rules proposed below should be interpreted under this particular metrical theory.[8]

(3) **Prominence Assignment Rules (*PARs*)**
(for Loanwords in Japanese)

Line 0:

Line 0 element projection:

(A) Project a line 0 element for each syllable head of the input word.

Line 0 parenthesis projection (I):

(B) Project RIGHT boundary in env. ____ $\overset{*}{|}$ $V_{(inserted)}$

(C) Project LEFT boundary in env. $\overset{*}{|}$ $V_{(inserted)}$ ____ $\overset{*}{|}$ $V_{(not\ inserted)}$

Headness parameter on line 0:

(D) Project the LEFT-most element of each constituent.

Line 1:

Edge marking parameter on line 1:

(E) Place a RIGHT boundary to the RIGHT of the RIGHT-most element.

Headness parameter on line 1:

(F) Project the RIGHT-most element of each constituent.

Bracket Erasure Rule (I):

(G)) → Ø / $\overset{*}{|}$ $V_{(inserted)}$ ____

Here, I assume that these rules apply after the epenthesis and the re-syllabification apply.[9] Thus, every closed-syllable in an input word has been made open by inserting a certain

[8] In this regard, we admit that there are rules in loanword phonology, contra the general claim made under the optimality theory that there is no rule in phonology at large. We must therefore admit that loanword phonology is different with this respect. But this is not inconsistent with the claim that there is no rule at the Oparative Level. So I would like to suggest that there may be rules at the Perceptual Level but no rules at the Operative Level, where all processes of native phonology.

vowel by epenthesis before the application of the rules in (3).[10] And I assume that the rule (G) applies immediately after the rule (B) in (3). More important is to note that the position of prominence is the position of the element projected to line 2.

2.1.2. Examination

Now let us apply these rules (henceforth, the PARs) to some simple examples. Consider the English monosyllabic words in (4) below:

(4) VC: up, it, edge, *etc.*
CVC: mitt, book, pack, *etc.*
CVVC: meat, leave, park, *etc.*
VVC: ark, eat, ooze, oat, etc.
CVCC: couple, tackle, kitchen, castle, duffle, *etc.*
CCVC: stub, sketch, stuff, trap, grip, *etc.*
CCVCC: snuggle, stubble, slacks, *etc.*
CCCVC: scrap, scratch, split, *etc.*
CVVCC: circle, turtle, marble, *etc.*
CCVVC: steal, please, drive, *etc.*
CCCVCC scrabble, scribble, straddle, *etc.*
V: a VV: eye CV: the CVV: car, key, *etc.*

Applying each rule of the PARs, by turns, to the monosyllabic words in (4), we derive the following outputs.[11]

(5)	a. *it* [itǫ]	b. *mitt* [mitǫ]	c. *meat* [miitǫ]	d. *eat* [iitǫ]
Line 0:	* *	* *	* *	* *
(A)	i tǫ	mi tǫ	mii tǫ	ii tǫ
	*) *	*) *	*) *	*) *
(B)	i tǫ	mi tǫ	mii tǫ	ii tǫ
(C)	not applicable	not applicable	not applicable	not applicable

[9] Hence, the conditions on epenthesis apply at the Perceptual Level. This is inconsistent with Yip's (1993a) claim that they apply at the Operative Level. I leave the issue open, here.

[10] In §3, we will directly discuss the issue concerning the epenthesis in loanwords in Japanese.

[11] Note that the input to these rules has ungergone the rules of epenthesis. Vowels inserted by epentheis are indecated by underline.

Line1:	*	*	*	*
	*) *	*) *	*) *	*) *
(D)	i to	mi to	mii to	ii to
	*)	*)	*)	*)
	*) *	*) *	*) *	*) *
(E)	i to	mi to	mii to	ii to
Line 2:	*	*	*	*
	*)	*)	*)	*)
	*) *	*) *	*) *	*) *
(F)	***i*** to	***mi*** to	***mii*** to	***ii*** to

As the result of the application of the PARs, we realize where the prosodic prominence comouted by the PARs is located in each tested monosyllabic word in (5). The position of the prominence is indicated by italicized bold face, as in the final line of (5). Notice that, if a given foreign word is monosyllabic (i.e., it consists of VC, CVC, CVVC, or VVC), the input of the PARs is [[V]$_\sigma$ [C$\underline{\text{V}}$]$_\sigma$], [[CV]$_\sigma$ [C$\underline{\text{V}}$]$_\sigma$], [[CVV]$_\sigma$ [C$\underline{\text{V}}$]$_\sigma$], or [[VV]$_\sigma$ [C$\underline{\text{V}}$]$_\sigma$], respectively, because of the result of epenthesis and re-syllabification. Therefore, the application of the PARs to a monosyllabic foreign word always results in [*[V]*$_\sigma$ [C$\underline{\text{V}}$]$_\sigma$], [*[CV]*$_\sigma$ [C$\underline{\text{V}}$]$_\sigma$], [*[CVV]*$_\sigma$ [C$\underline{\text{V}}$]$_\sigma$], or [*[VV]*$_\sigma$ [C$\underline{\text{V}}$]$_\sigma$]. That is, Japanese loanword phonology calculates, at the Perceptual Level, that the first syllable is the location of the prosodic prominence of a monosyllabic foreign word.

The next question is: How is this calculated prosodic prominence expressed phonetically? There are not a few languages that employ the rule that requires a prosodically prominent syllable be bimoraic (e.g., Italian *radoppiamento sintattico* (Kenstowicz 1993), Chamorro stressed penult lengthening (Chung 1983)). This kind of rule can be formalized as in the following manner:

(6) Weight-on-Prominence Principle (***WPP***)
If a syllable is prosodically prominent, then it is heavy.

This is obviously the converse of the Weight-to-Stress Principle (cf. Prince 1990).[12] Now, suppose that the WPP applies to Japanese loanword phonology.[13] Then the examples tested in (5), for example, must undergo the following change thanks to the WPP:

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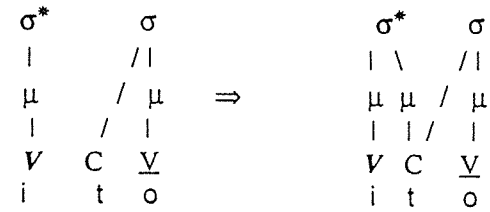
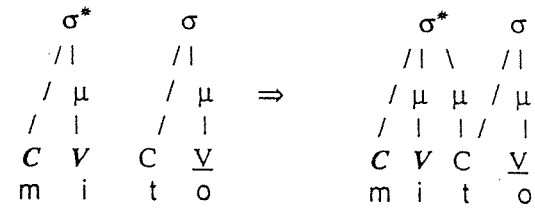
[12] Prince (1990) claims that the converse of the WTS (Weight-to-Stress) need not be stipulated on theoretical groounds. Here I leave open the possibility to reduce the WPP in (6) to the WTS.

[13] Obviously, the WPP does not apply to the core part of Japanese phonology which deals with Japanese original words. Itô & Mester (1993) argue that the domain of loanwod phonology locates in the most

(7) a. it [*i* to] → [*it* to]

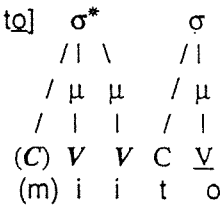


b. mittt [*mi* to] → [*mit* to]



As shown in (7), the first syllable of the form $[[\ V\ ]_{\sigma}$ $[CV]_{\sigma}]$ or $[[\ CV\ ]_{\sigma}$ $[CV]_{\sigma}]$ satisfies the WPP by dominating the mora projected by the consonant in the onset of the following syllable.[14] This results in the gemination of the consonant in the onset of the syllable immediately following the syllable with the prosodic prominence. One should notice that the first syllable of the form $[[CVV\ ]_{\sigma}$ $[CV]_{\sigma}]$ vacuously satisfies the WPP without geminating the consonant in the onset of the following syllable, because it is already bimoraic, as shown in (8).

(8) meat [*mii* to] or eat [*ii* to]



Therefore, we get the output: [itto] for *it*, [mitto] for *mitt*, [miito] for *meat*, and [iito] for *eat*. These correspond to the correct pronunciations for these words in Japanese. After all, we predict, by means of the PARs and the WPP in addition to epenthesis and resyllabification, that gemination always happen in the foreign words that originally consist of VC or CVC; that is, the input VC or CVC becomes the output *VCV* or *CVCV*.[15] On

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pheripheral place in the domain of Japanese phonology, and that the more peripheral the domian is, the more rules it contains. This means that, while the rules and principles that apply to the core always apply to the peripheral, the rules and principle that apply to the peripheral do not always apply to the core. The WPP, thus, should be regarded as the one that belongs to the latter type.

[14] The asterisk on a syllable indicates that the so-marked syllable is prosodically prominent.

[15] Double underline indicates that the so-marked element is geminated.

the other hand, we also predict that gemination never happens in the foreign words that originally consist of CVVC or VVC; that is, the input CVVC or VVC becomes the output *CVV*C$\underline{\text{V}}$ or *VV*C$\underline{\text{V}}$, but not *CVV*C$\underline{\text{C}}$V or *VV*C$\underline{\text{C}}$V. These predictions happily correspond to the fact, with some systematic and, hence predictable, exceptions to which we will return directly in §2.2. Below are the some examples:[16]

(9) a. VC → *V*C$\underline{\text{C}}$V: up [appu], at [atto], edge [eǰǰi], Yip [ippu], *etc.*

b. CVC → *CV*C$\underline{\text{C}}$V: book, [bukku], pack [pakku], hitch [hiččі], *etc.*

c. CVVC → *CVV*C$\underline{\text{V}}$: leave [riibu], park [paaku], fool [Φooru], pool [puuru], *etc.*

d. VVC → *VV*C$\underline{\text{V}}$: ark [aaku], eat [iito], ooze [uuzu], oat [ooto], *etc.*

Next, let us consider how the PARs and the WPP work if applied to the other monosyllabic foreign words, consisting of CCVC, CVCC, CCVCC, CCCVC, CVVCC, CCVVC, or CCCVCC. First, consider the words, CCVC, CVCC, and CCVCC.

(10)	a. CCVC → C$\underline{\text{V}}$CVC$\underline{\text{V}}$	b. CVCC → CVC$\underline{\text{V}}$C$\underline{\text{V}}$	c. CCVCC → C$\underline{\text{V}}$CVC$\underline{\text{V}}$C$\underline{\text{V}}$
Line 0:	* * *	* * *	* * * *
(A)	C$\underline{\text{V}}$ CV C$\underline{\text{V}}$	CV C$\underline{\text{V}}$ C$\underline{\text{V}}$	C$\underline{\text{V}}$ CV C$\underline{\text{V}}$ C$\underline{\text{V}}$
	)* *)*	*)*)*	)* *)*)*
(B)	C$\underline{\text{V}}$ CV C$\underline{\text{V}}$	CV C$\underline{\text{V}}$ C$\underline{\text{V}}$	C$\underline{\text{V}}$ CV C$\underline{\text{V}}$ C$\underline{\text{V}}$
	)* *)*	*)*}*	)* *)*}*
➨ (G)	C$\underline{\text{V}}$ CV C$\underline{\text{V}}$	CV C$\underline{\text{V}}$ C$\underline{\text{V}}$	C$\underline{\text{V}}$ CV C$\underline{\text{V}}$ C$\underline{\text{V}}$
	)*(*)*	*)* *	)*(*)* *
(C)	C$\underline{\text{V}}$ CV C$\underline{\text{V}}$	CV C$\underline{\text{V}}$ C$\underline{\text{V}}$	C$\underline{\text{V}}$ CV C$\underline{\text{V}}$ C$\underline{\text{V}}$
Line1:	*	*	*
	)*(*)*	*)* *	)*(*)* *
(D)	C$\underline{\text{V}}$ CV C$\underline{\text{V}}$	CV C$\underline{\text{V}}$ C$\underline{\text{V}}$	C$\underline{\text{V}}$ CV C$\underline{\text{V}}$ C$\underline{\text{V}}$

[16] Instead of gemination, vowel lengthening could be the other logical possibility to satisfy the WPP; that is, the form *CV*C$\underline{\text{V}}$ could satisfy the WPP by lengthening the vowel in the prominent syllable, resulting in *CVV*C$\underline{\text{V}}$. As a matter of fact, gemination always happens, and vowel lengthening never happens. Thus, something must be said about this, which I have no explanation at this time. But, in Japanese phonology at large, gemination is superior to vowel lengthening in the environment where both can apply (Itô 1986, Poser 1986, Fukui 1986).

	＊)	＊)	＊)
	)＊(＊)＊	＊)＊ ＊	)＊(＊)＊ ＊
(E)	CV CV CV	CV CV CV	CV CV CV CV
Line2:	＊	＊	＊
	＊)	＊)	＊)
	)＊(＊)＊	＊)＊ ＊	)＊(＊)＊ ＊
(F)	CV ***CV*** CV	***CV*** CV CV	CV ***CV*** CV CV

As the result of the application of epenthesis and re-syllabification before the PARs, the inputs of the rules for the form CCVC, CVCC, and CCVCC are CVCVCV, CVCVCV, and CVCVCVCV, respectively. Note that in the derivation for (10b,c), some of the right brackets inserted by the rule (B) are deleted by the Parenthesis Erasure Rule (G). As shown in the final line in (10), we get the following results: The position of the prominence for CCVC words is located in the second syllable of the re-syllabified forms for them; that for CVCC words is in the first syllable of the re-syllabified forms for them; and that for CCVCC words is in the second syllable of the re-syllabified forms for them.

Applying the WPP to these results, we finally get the outputs for CCVC, CVCC, and CCVCC words; CV***CV***CV, ***CV***CVCV, and CV***CV***CVCV, respectively. That is, we predict, by means of the PARs and the WPP, that, if we get a foreign words consisting of CCVC, CVCC, or CCVCC as an input, the last consonant geminates in the case of CCVC, the second consonant geminates in the case of CVCC, and the third consonant geminates in the case of CCVCC. This prediction is borne out by the following facts. (Though, there are systematic exceptions, again.)

(11) a. CCVC → CV***CV***CV:
stub [sutabbu], sketch [sukečči], trap [torappu], grip [gurippu], *etc.*

b. CVCC → ***CV***CVCV:
couple [kappuru], lax [rakkusu], castle [kʸassuru],
duffle [daΦΦuru], *etc.*

c. CCVCC → CV***CV***CVCV:
snaggle [sunagguru], crypt [kuripputo], stubble [sutabburu], *etc.*

Next, let us consider words consisting of CCCVC, CVVCC, CCVVC, and CCCVCC. As the result of epenthesis and re-syllabification, they become CVCVCVCV, CVVCVCV, CVCVVCV, and CVCVCVCVCV, respectively. Then, we predict with the aid of the PARs and the WPP that, whereas no gemination happens in the case of CVVCC

and CCVVC, the consonant which immediately follows the original (i.e., not inserted by epenthesis) vowel geminates in the case of CCCVC (its input to the PARs and the WPP is C<u>V</u>C<u>V</u>CVC<u>V</u> and the output is C<u>V</u>C<u>V</u>***CV***C<u>V</u>) and CCCVCC (its input: CVCVCVCVCV and the output: C<u>V</u>C<u>V</u>***CV***C<u>V</u>C<u>V</u>). This is shown in (12) below:

(12)

	a. CCCVC → C<u>V</u>C<u>V</u>CVC<u>V</u>	b. CVVCC → CVVC<u>V</u>C<u>V</u>	c. CCVVC → C<u>V</u>CVVC<u>V</u>	d. CCCVCC → C<u>V</u>C<u>V</u>CVC<u>V</u>C<u>V</u>
Line 0:	* * * *	* * *	* * *	* * * * *
(A)	C<u>V</u> C<u>V</u> CV C<u>V</u>	CVV C<u>V</u> C<u>V</u>	C<u>V</u> CVV C<u>V</u>	C<u>V</u> C<u>V</u> CV C<u>V</u> C<u>V</u>
(B)	)*)* *)* C<u>V</u> C<u>V</u> CV C<u>V</u>	*)*)* CVV C<u>V</u> C<u>V</u>	)* *)* C<u>V</u> CVV C<u>V</u>	)*)* *)*)* C<u>V</u> C<u>V</u> CV C<u>V</u> C<u>V</u>
(G)	)*}* *)* C<u>V</u> C<u>V</u> CV C<u>V</u>	*)*}* CVV C<u>V</u> C<u>V</u>	)* *)* C<u>V</u> CVV C<u>V</u>	)* }* *)*}* C<u>V</u> C<u>V</u> CV C<u>V</u> C<u>V</u>
(C)	)* *(*)* C<u>V</u> C<u>V</u> CV C<u>V</u>	*)* * CVV C<u>V</u> C<u>V</u>	)*(*)* C<u>V</u> CVV C<u>V</u>	)* *(*)* * C<u>V</u> C<u>V</u> CV C<u>V</u> C<u>V</u>
Line1:	*	*	*	*
(D)	)* *(*)* C<u>V</u> C<u>V</u> CV C<u>V</u>	*)* * CVV C<u>V</u> C<u>V</u>	)*(*)* C<u>V</u> CVV C<u>V</u>	)* *(*)* * C<u>V</u> C<u>V</u> CV C<u>V</u> C<u>V</u>
	*)	*)	*)	*)
(E)	)* *(*)* C<u>V</u> C<u>V</u> CV C<u>V</u>	*)* * CVV C<u>V</u> C<u>V</u>	)*(*)* C<u>V</u> CVV C<u>V</u>	)* *(*)* * C<u>V</u> C<u>V</u> CV C<u>V</u> C<u>V</u>
Line2:	*	*	*	*
	*)	*)	*)	*)
(F)	)* *(*)* C<u>V</u> C<u>V</u> ***CV*** C<u>V</u>	***CVV*** C<u>V</u> C<u>V</u>	)*(*)* C<u>V</u> ***CVV*** C<u>V</u>	)* *(*)* * C<u>V</u> C<u>V</u> ***CV*** C<u>V</u> C<u>V</u>
The WPP→	⇓	⇓	⇓	⇓
	C<u>V</u>C<u>V</u>***CV***C<u>V</u>	***CVV***C<u>V</u>C<u>V</u>	C<u>V</u>***CVV***C<u>V</u>	C<u>V</u>C<u>V</u>***CV***C<u>V</u>C<u>V</u>

Note that the WPP is satisfied in the case of CVVCC and CCVVC. Their outputs from the PARs are ***CVV***C<u>V</u>C<u>V</u> and C<u>V</u>***CVV***C<u>V</u>, respectively, as shown in (12); accordingly, the syllables with the prosodic prominence computed by the PARs in their outputs are bimoraic, whence no need for the consonant in the onset of the syllable following the prominent syllable to geminate.

This prediction, again, is borne out by the fact. Some examples are:[17]

(13) a. CCCVC → C<u>V</u>C<u>V</u>***CV***C<u>V</u> :
scrap [sukurappu], strap [sutorappu], split [supuritto], *etc*

b. CVVCC → ***CVV***C<u>V</u>C<u>V</u>:
circle [saakuru], turtle [taatoru], marble [maaburu], *etc.*

c. CCVVC → C<u>V</u>***CVV***C<u>V</u>:
steal [sučiiru], please [pureezu], drive [doraibu], *etc.*

d. CCCVCC → C<u>V</u>C<u>V</u>***CV***C<u>V</u>C<u>V</u>:
scrabble [sukurabburu], scribble [sukuribburu], straddle [sutoraddoru], *etc.*

At this time, one may notice that the PARs calculate that there is no prosodic prominence in the words which originally include no closed-syllables. This is because no projection is made from line 0 to line 1 in those words; for, the input forms of them to the PARs does not include any epenthetic vowel, which is responsible for the determination of the constituent of the elements in line 0. There is no constituent in line 0; hence, there is no projection to line 1. Consequently, there is no prominence computed by the PARs in the words with no closed-syllable in their original forms. Since the WPP does not apply to any form with no prominence, we predict that there happens no gemination in the words which originally include no closed-syllables. This is the right prediction, as the examples in (14) show.[18]

(14) V: a [a]; VV: eye [ai]; CV: the [za]; CVV: car [kaa], key [kii], etc.

2.1.3. Treatment of the Respected Prominence in the PARs

Thus far, we considered the cases of the monosyllabic words; thus, we can ignore the possibility of the case that the original position of the stress (or the prosodic prominence) in a given word is respected in its loanword counterpart, because there is no stress within a monosyllabic word. Before examining how the PARs and the WPP work for the words consisting of more than one syllable, we therefore need to consider how the original prosodic prominence can be respected in out system.

[17] Here, again, there are systematic exceptions. We will return to this in §2.2.

[18] But, one should note that this is true only in the case that the prosodic prominence of the original word is not respected. In §2.1.3, we will consider how and where gemination happens if the prominence of the original word is respected.

As we observed in §2.1.2, if an original word to be adopted as a loanword in Japanese has no closed-syllable, the PARs predict that no prominence is computed for that word. This is because no element is projected to line 1 in that word. Now, consider what it means that the prominence of the original word is respected with respect to the PARs. We may interpret that to mean that the element with the original prominence is projected to line 1 if it is respected. Then, the PARs can respect the stress (or prosodic prominence) of an original word by introducing the following rule into the PARs.

(15) *Line 0 parenthesis projection (III):*
(H) Project the LEFT and RIGHT boundaries of the syllable with the prosodic prominence if the prominence is respected.

And I assume that this rule applies after the rule (C) of the PARs.

Now, let us consider how this rule works. Recall, once again, that the PARs (without (15)) and the WPP predict that, if an original word to be adopted as a loanword in Japanese has no closed-syllable, the PARs predict that no prominence is computed for that word. Thus, in the examples in (16) below, there is no gemination.

(16) hipo → [hipo], logo → [rogo], polo → [poro]
copy → [kopi:], doggy → [dogi:], lobby → [robi:]
highly → [hairi:], Sahara → [sahara], philology → [firorozi:]
phenomena → [fenomena], sanitary → [saniteri], etc.

But there are exceptional cases that gemination happens in a word with no closed-syllable. Below are some examples.

(17) Mississippi /misisípi/ → [misisi**pp**i], essey /ései/ → [e**ss**ei],
macho /máčou/ → [mačč**o**], kappa /kápa/ → [ka**pp**a],
ghetto /gétou/ → [ge**tt**o:], happy /hápi:/ → [ha**pp**i:],
hippie /hípi:/ → [hi**pp**ii], buffalo /bʌ́falou/ → [baΦΦaro:],
stucco /stʌ́kou/ → [suta**kk**o], hockey /hóki:/ → [ho**kk**ei]

However, if we introduce the rule (15) and assume that the original prominence is respected in the case of the words listed in (17), the fact shown in (17) can be predicted. The rule (15) makes a syllable with the respected prominence projected to line 1, as shown in (18):

(18)
```
          *
        * ( *)  *
.... (C)V CV  CV .....
          |
   respected prominence
```

In the words with no closed-syllable, there is no syllable projected to line 1 other than the one with the respected prominence projected by the rule (15). It follows that the syllable with the respected prominence is computed to be the location of the prosodic prominence in loanwords by the PARs. Thus, the consonant that immediately follows the vowel of the syllable with the respected prominence geminates thanks to the application of the WPP. This corresponds to the fact shown in (17), in which the consonant in question geminates, as expected.[19]

2.2. Exceptions and the Bracket-Erasure Rules

As pointed out several times in the above, there are many exceptions to the rules; however, they are so systematic that we will easily predict them, as will be argued below.

2.2.1. The Bracket-Erasure Rules

Ono (1991) claims, by reporting the following observation, that the sequences /su/, /Φu/, /bu/, /ru/, /mu/, and /nu/ must be treated exceptionally in terms of gemination in loanword phonology.

(19) a. /su/: miss → [misu] (*[missu]), pass → [pasu] (*[passu]), etc.
b. /Φu/: tough → [taΦu] (*[taΦΦu]), puff → [paΦu] (*[paΦΦu]), etc.
c. /bu/: pab → [pabu] (*[pabbu]), rob → [robu] (*[robbu]), etc.
d. /ru/: null → [naru] (*[narru]), pal → [paru] (*[parru]), etc.
e. /mu/: come → [kamu] (*[kammu]), dum → [damu] (*[dammu]), etc.
f. /nu/: done → [daN][20] (*[daNN]), Ben → [beN] (*[beNN]), etc.

---

[19] In §2.3.2, we will observe more complicated cases in which the original prosodic prominence is respected at the Perceptual Level.

[20] /N/ is the nasal moraic consonant, which is regarded as forming a mora by itself (cf. Vance 1987). Though it might be possible to treat this as a gemination of /n/, namely, /nn/ = /N/ (e.g., Murata 1993), I assume, here, following Hattori (1951, 1955) and Kuroda (1965), that /N/ is an independent consonant (cf. Bloch 1950). See Vance (1987) for extensive discussion for this issue.

These examples are exceptions to the PARs, too: As we observed, the PARs (and the WPP) predicts that the original CVC words become *CV<u>C</u>V*; that is, the last consonant in the original word must geminate according to our rules.

To treat these systematic exceptions to the PARs, I propose the following bracket-erasure rules in addition to the one proposed above as the rule (G) of the PARs, which is included below:

(20) **Bracket Erasure Rules:**

```
(G)  (i):      )  →  ∅  /  *  ____
                           |
                           V(inserted)

(ii): A.  *  )  *  →  * ∅ *          B.  *  )  *  →  * ∅ *
                        |                              |
                      C1 V #                          C2 V
                       \ |                             \ |
                        \|                              \|
                        σ                               σ
                  C1 ∈ {/s/, /Φ/}                   C2 = /b/
```

The reason that we treat the set of the consonants /s/ and /Φ/ and the consonant /b/ differently in the rules in (ii) above comes from the following fact, which Ono (1991) does not discuss.

(21) a. /su/: hustle → [ha**ssu**ru], castle → [k^{y}a**ssu**ru], mascle → [ma**ssu**ru], etc.

b. /Φu/: duffle → [da**ΦΦu**ru], buffle → [ba**ΦΦu**ru], waffle → [wa**ΦΦu**ru],etc.

c. /bu/: bable → [baburu] (*[ba**bb**uru]), double → [daburu] (*[da**bb**uru]), etc.

That is to say, /s/ and /Φ/ always geminate unless it is the final consonant of a given word (compare (21a,b) with (19a,b)); on the other hand, it is not the case that /b/ always geminates even if it is not the final consonant of a given word (cf. (19c) and (21c)). This is correctly predicted by the PARs and the WPP with the aid of the bracket-erasure rules (G), formulated in (20).[21]

[21] I am still assuming that the bracket-erasure rules apply immediately after the rule (B) of the PARs.

Consider, first, the cases of (21a,b,c). (Note that the inputs of the PARs have already undergone the application of epenthesis and re-syllabification.)

(22)	a. miss → /mi sɯ/	b. puff → /pa Φɯ/	c. pab → /pa bɯ/
Line 0:	* *	* *	* *
(A)	mi sɯ	pa Φɯ	pa bɯ
	*) *	*) *	*) *
(B)	mi sɯ	pa Φɯ	pa bɯ
	*} *	*} *	*} *
(G(II))	mi sɯ	pa Φɯ	pa bɯ
(C)	not applicable	not applicable	not applicable
	* *	* *	* *
	mi sɯ	pa Φɯ	pa bɯ

As in the line of (C) in the above derivation, there is no constituent in line 0; thus, no element is projected to line 1. Since prominence is determined by a constituent in line 2, we conclude that there is no prominence computed by the PARs for these words. Consequently, the WPP does not apply; whence, there is no gemination in the loanwords whose original forms consist of (C)VC where the last C is /s/, /Φ/, or /b/.

Next, consider the contrast (21a,b) vs. (21c).

(23)	a. hustle → ha sɯ rɯ	b. duffle → da Φɯ rɯ	c. double → da bɯ rɯ
Line 0:	* * *	* * *	* * *
(A)	ha sɯ rɯ	da Φɯ rɯ	da bɯ rɯ
	*) *) *	*) *) *	*) *) *
(B)	ha sɯ rɯ	da Φɯ rɯ	da bɯ rɯ
	*) *} *	*) *} *	*) *} *
(G(I))	ha sɯ rɯ	da Φɯ rɯ	da bɯ rɯ
➨ (G(II))	(not applicable)	(not applicable)	
	*) * *	*) * *	*} * *
	ha sɯ rɯ	da Φɯ rɯ	da bɯ rɯ

(C)	not applicable	not applicable	not applicable
Line1:	*	*	
	*) * *	*) * *	* * *
(D)	ha sɯ rɯ	da Φɯ rɯ	da bɯ rɯ
Line 2:	*	*	
	*)	*)	
	*) * *	*) * *	* * *
(E&F)	***ha*** sɯ rɯ	***da*** Φɯ rɯ	da bɯ rɯ
The WPP→	⇓	⇓	not applicable
	hassɯrɯ	daΦΦɯrɯ	dabɯrɯ

Notice that the rule (II) of the bracket-erasure rules apply to *double* /daburu/, but not to *hassle* /hasuru/ and *duffle* /daΦuru/. This difference results in their outputs of the PARs: The first syllables of /hasuru/ and /daΦuru/ has a prominence, but there is no prominence computed in /daburu/. Thus, the WPP applies to the former cases, but not to the latter, resulting in the gemination in the former, but not in the latter.

Notwithstanding the difference between /b/ and the set of /Φ/ and /s/ discussed above, /b/ as well as /s/ and /Φ/ geminates in the following environment: CCV__. Examples are: *stub* → [suta**bb**u], *snob* → [suno**bb**u], etc. Thus, we get the following complex contrast:

(24)	a. /bu/	b. /Φu/
CVC:	tab → [tabu] (*[ta**bb**u])	tough → [taΦu] (*[taΦΦu])
CVCC:	double → [daburu] (*[da**bb**uru])	duffle → [daΦΦuru]
CCVC:	stub → [suta**bb**u]	stuff → [sutaΦΦu]

The PARs and the WPP with the aid of the bracket-erasure rules, however, correctly predict this. We have already observed that they correctly predict the cases of CVC and CVCC: Let us consider the CCVC case.

(25)	a. stub →	b. stuff →
	sɯ ta bɯ	sɯ ta Φɯ
Line 0:	* * *	* * *
(A)	sɯ ta bɯ	sɯ ta Φɯ

	) * *) *	) * *) *
(B)	sɯ ta bɯ	sɯ ta Φɯ
	) * *) *	) * *) *
(G(II))	sɯ ta bɯ	sɯ ta Φɯ
	) * (* *	) * (* *
(C)	sɯ ta bɯ	sɯ ta Φɯ
Line1:	*	*
	) * (* *	) * (* *
(D)	sɯ ta bɯ	sɯ ta Φɯ
Line 2:	*	*
	*)	*)
	) * (* *	) * (* *
(E&F)	sɯ ***ta*** bɯ	sɯ ***ta*** Φɯ
The WPP→	⇓	⇓
	sutaⁿbbɯ	sutaΦΦɯ

One should notice that the leftmost grid of a constituent is projected to line 1 because the head-parameter of line 0 constituent is LEFT. This is the correct prediction.

More complex examples involving the gemination of /b/ are predictable, as well. The fact is: *stubble* → [suta**bb**uru], *stuborn* → [suta**bb**ooN], *scrabble* → [sukura**bb**uru].

(26)a. stuble →		b. stubborn →		b. scrabble →	
sɯ ta bɯ ru		sɯ ta booN		sɯ kɯ ra bɯ ru	
Line 0:	* * * *	* * *		* * * * *	
(A)	sɯ ta bɯ ru	sɯ ta booN		sɯ kɯ ra bɯ ru	
	) * *) *) *	) * *) *		) *) * *) *) *	
(B)	sɯ ta bɯ ru	sɯ ta booN		sɯ kɯ ra bɯ ru	
	) * *) * *	) * *) *		) * * * *) * *	
(G(I))	sɯ ta bɯ ru	sɯ ta booN		sɯ kɯ ra bɯ ru	
	) * * * * *	) * * *		) * * * * * *	
(G(II))	sɯ ta bɯ ru	sɯ ta booN		sɯ kɯ ra bɯ ru	
	) * (* * *	) * (* *		) * * (* * *	
(C)	sɯ ta bɯ ru	sɯ ta booN		sɯ kɯ ra bɯ ru	

Line 1:	*	*	*
	)*(* * *	)*(* *	)* *(* * *
(D)	sμ ta bμ rμ	sμ ta booN	sμ kμ ra bμ rμ
Line 2:	*	*	*
	*)	*)	*)
	)*(* * *	)*(* *	)* *(* * *
(E&F)	sμ ***ta*** bμ rμ	sμ ***ta*** booN	sμ kμ ***ra*** bμ rμ
The WPP→	⇓	⇓	⇓
	sutabburu	sutabbooN	sukurabburu

Note that the rule (A) requires that each syllable, not mora, project; hence, the syllable *boon* in (26b) projects a single grid.[22] As shown in (26), our theory correctly predict the complex fact about the gemination of /b/ in loanwords in Japanese.

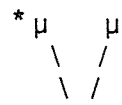
In this subsection, we observed that the introduction of the bracket-erasure rules help us to predict the complex fact about the gemination of /s/ and /Φ/, on the one hand, and the more complicated fact about the gemination of /b/, on the other.

2.2.2. Consonants Permanently Resistant to Gemination

As observed above, /r/, /m/, and /n/ in addition to /s/, /Φ/, and /b/ never geminate if they are the final consonant of a given word consisting of CVC (→ (19d,e,f)). Furthermore, /r/, /m/, and /n/, unlike the other exceptional consonants, never geminate wherever they may occur.[23]

This may reflect the fact that these consonants can very rarely geminate in Japanese phonology at large (cf. Murata 1993). Then, I propose the following condition:

(27) **Avoid Gemination Condition (*AGC*)**



C ∈ {/r/, /m/, /n/}

[22] We discuss the issue concerning the projections of mora and syllable in §2.4.

[23] As far as I can see by consulting the two dictionaries of loanwords in Japanese, Aarakawa (1977) and Miura (1979), this statement is true: I could not find any example with the gemination of /r/, /m/, or /n/.

If we assume, further, that the AGC is highly ranked more than the WPP with respect to optimality, the fact follows that /r/, /m/, and /n/ never geminate. Take the English word *pal*, for example. It consists of CVC originally, though the input to the PARs for this word is $[[pa]_{\sigma}\ [ru]_{\sigma}]$. Then, as we observed in §2.1, the PARs predict that the syllable *pa* has the prominence (→ (5b) and (9b)). If the WPP would apply to this, the result would be [parru]. But this violates the AGC, though it satisfies the WPP. See the following tableau:[24]

(28)	AGC	WPP
☞ paru	✔	*
parru	*!	✔

Given the order AGC >> WPP, [paru] is correctly selected, though the WPP is violated. But, in the case of *mitt*, this approach still correctly predicts that [mitto], but not [mito], is selected.

(29)	AGC	WPP
mito	✔	*!
☞ mitto	✔	✔

2.3. More Data

2.3.1. Uniqueness of Gemination

Now, let us consider how the PARs and the WPP work if applied to the words consisting of two syllables, each of which can involve gemination if it appears as a single word. As was pointed out in the preface, something strange in terms of gemination happens in the case of the words which originally consist of CVCCVC like *picnic* and *piglet*. Consider (30):

(30) a. pick /pik/ → [pikku], nick /nik/ → [nikku]
picnic /piknik/ → [pikunikku] (cf. *[pikkunikku], *[pikkuniku])

b. pig /pig/ → [piggu], let → [retto]
piglet /piglet/ → [piguretto] (cf. *[pigguretto], *[piggureto])

[24] We will discuss the optimality theory in §3. We touched upon its general conception very briefly in the preface of this paper. For more general and extensive discussion and its technical notations, see the reference cited therein.

Take (30b), for example. /g/ in of *pig* and /t/ of *let* geminate if they are adopted as an independent loanword, but only /t/ geminates if they are combined as a single word.

(31)	a. /pig/ → /pigu/	b. /let/ → /reto/	c. /piglet/ → pigureto	d. CVCCVC → CVCVCVCV
Line 0:	* *	* *	* * * *	* * * *
(A)	pi gu	re to	pi gu re to	CV CV CV CV
	*) *	*) *	*) * *) *	*) * *) *
(B)	pi gu	re to	pi gu re to	CV CV CV CV
	*) *	*) *	*) * (*) *	*) * (*) *
(C)	pi gu	re to	pi gu re to	CV CV CV CV
	*	*	* *	* *
	*) *	*) *	*) * (*) *	*) * (*) *
(D)	pi gu	re to	pi gu re to	CV CV CV CV
Line 1:	*)	*)	* *)	* *)
	*) *	*) *	*) * (*) *	*) * (*) *
(E)	pi gu	re to	pi gu re to	CV CV CV CV
	*	*	*	*
	*)	*)	* *)	* *)
	*) *	*) *	*) * (*) *	*) * (*) *
(F)	***pi*** gu	***re*** to	pi gu ***re*** to	CV CV ***CV*** CV
The WPP→	⇓	⇓	⇓	⇓
	[piggu]	[retto]	[pigureto]	CVCV***CV***CV

As shown in (31), the PARs and the WPP correctly predict the seemingly irregular pattern of gemination found in the loanwords who originally consist of CVCCVC.

2.3.2. Interaction of the Respected Prominence and the PARs

In §2.1.3, we considered the case in which the stress of a given word is respected at the Perceptual Level, and proposed the rule (15), which is repeated below:

(15) *Line 0 parenthesis projection (III):*
(H) Project the LEFT and RIGHT boundaries of the syllable with the prosodic prominence if the prominence is respected.

There we merely observed words with no closed-syllable in their original form. In this subsection, let us examine the PARs and the WPP by taking into consideration words with closed-syllables whose original prosodic prominence is respected at the Perceptual Level.

Consider the examples below:

(32) Bacchus /bákas/ → [ba**kk**asu], passive /pásiv/ → [pa**ss**ibu],
massive /másiv/ → [ma**ss**ibu], jakal /ǰákæl/ → [ǰa**kk**aru], etc.

Without (15), we fail to correctly predict the positions of the gemination found in these examples, as illustrated in (33) with *Bacchus* and *passive* cases.

(33)

	a. Bacchus →	b. passive →
	ba ka sɯ	pa si bɯ
Line 0:	* * *	* * *
(A)	ba ka sɯ	pa si bɯ
	* *) *	* *) *
(B)	ba ka sɯ	pa si bɯ
	* * } *	* * } *
(G)	ba ka sɯ	pa si bɯ
(C)	not applicable	not applicable
Line 1:		
	* * *	* * *
(D)	ba ka sɯ	pa si bɯ
	* * *	* * *
(E&F)	ba ka sɯ	pa si bɯ
The WPP →	not applicable	not applicable
	*[bakasɯ]	*[pasibɯ]

The incorporation of (15) into (33) yields the correct forms for *Bacchus* and *passive* as well as the others, as shown in (34). (Recall that the rule (H) in (15) applies immediately after the rule (C).)

(34)

	a. Bacchus →	b. passive →
	ba ka sɯ	**pa** si bɯ

Line 0:	* * *	* * *
(A)	**ba** ka sʊ	**pa** si bʊ
	* *) *	* *) *
(B)	**ba** ka sʊ	**pa** si bʊ
	* * } *	* * } *
(G)	**ba** ka sʊ	**pa** si bʊ
(C)	not applicable	not applicable
	(*) * *	(*) * *
(H)	**ba** ka sʊ	**pa** si bʊ
Line 1:	*	*
	(*) * *	(*) * *
(D)	**ba** ka sʊ	**pa** si bʊ
Line 2:	*	*
	*)	*)
	(*) * *	(*) * *
(E&F)	***ba*** ka sʊ	***pa*** si bʊ
The WPP →	⇓	⇓
	ok[bakkasʊ]	ok[passibʊ]

As is evident from (34), the computed position of the prominence goes on the last syllable of **CVCVCV** if the rule (G) does not apply to the last consonant, resulting in the gemination of that consonant thanks to the WPP. This is borne out by the following examples.

(35) rocket /rókit/ → [roke**tt**o], ticket /tíkit/ → [čike**tt**o],
target /tá:git/ → [ta:ge**tt**o], topic /tópik/ → [topi**kk**ʊ],
Lappish /lápiš/ → [rapi**šš**ʊ], bishop /bíšop/ → [bišo**pp**ʊ], etc.

(36)

	a. rocket →	b. target →	c. bishop →
	ro ke to	**taa** ge to	**bi** šo pʊ
Line 0:	* * *	* * *	* * *
(A)	**ro** ke to	**taa** ge to	**bi** šo pʊ
	* *) *	* *) *	* *) *
(B)	**ro** ke to	**taa** ge to	**bi** šo pʊ

(G)	not applicable	not applicable	not apllicable
(C)	not applicable	not applicable	not apllicable
	(*) *) *	(*) *) *	(*) *) *
(H)	**ro** ke to	**taa** ge to	**bi** šo pu
Line 1:	* *	* *	* *
	(*) *) *	(*) *) *	(*) *) *
(D)	**ro** ke to	**taa** ge to	**bi** šo pu
Line 2:	*	*	*
	* *)	* *)	* *)
	(*) *) *	(*) *) *	(*) *) *
(E&F)	ro ***ke*** to	taa ***ge*** to	bi ***šo*** pu
The WPP→	⇓	⇓	⇓
	[roketto]	[taagetto]	[bišoppu]

2.3.3. Residual Exceptions

Thus far, we observed that the PARs and the WPP correctly predict the positions of gemination found in loanwords in Japanese, with some systematic exceptions that can be handled by means of the additional rules. But there still remains a kind of exception: It comes from very long words.

Since the PARs are made to project only one grid to line 2 and the prominence goes on the syllable that projects its grid to line 2, our theory predicts that there is only one gemination occurring in a given word. However, there are a few loanwords in Japanese which have two geminations, which are exemplified by (37).

(37) McIntosh → [ma**kk**iNtoš**š**u], Hottentot → [ho**tt**eNto**tt**o],
Quackenbush → [ka**kk**eNbuš**š**u],
Wissenschaft (German)→ [bi**ss**eNšaΦΦuto]

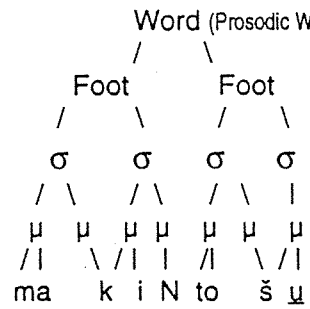
Note that loanwords such as listed in (38) do not count, because it is safe to say that they virtually consist of two prosodically independent words or morphemes. The PARs apply to each prosodically independent word.

(38) hot dog → [hotto doggu], Kit-cut → [kitto katto],
pick up → [pikku appu], hip pocket → [hippu poketto],
mudflap → [maddo furappu], Kniker-bocker → [nikka: bokka:], etc.

One should notice that when the pronunciation of the loanwords listed in (38), an interval of sounds is inserted between prosodically independent words, which is expressed by space in (38). This interval may be considered a manifestation of a gap of a prosodic constituency.

Returning to the examples in (37), we realize that all these examples include /N/ in the midst of them. More precisely, the nasal moraic consonant /N/ appears as the forth mora of them, and it counts as the coda of the second syllable. The prosodically hierarchical construction of them are illustrated in (39):[25]

(39)



Now, I propose that the PARs apply not to an entire morphological word, but to each foot of the word if the first foot ends /N/ at the time of the input of the PARs.[26] Then, we can correctly predict the position of the gemination of the exceptional loanwords in (37), as illustrated in (40):

(40) McIntosh /mákintoš/ → **ma** kiN to šu → **ma** kiN ^ to šu

Line 0: * * ^ * *
(A) **ma** kiN ^ to šu
(* * ^ *) *
(B) **ma** kiN ^ to šu
(G&C) not applicable

[25] See Mccarthy & Prince (1990, 1993a), Itô (1990), and, especially, Itô & Mester (1992) for discussion on the theory of prosodic hierarchy (in Japanese).

[26] Itô (1990) and Itô & Mester (1992) argue that each foot in Japanese consists of two syllable.

```
          (* ) *  ^  *) *
(H)       ma kiN ^ to  šu
Line 1:   *      ^  *
          (* ) *  ^  *) *
(D)       ma kiN ^ to  šu
Line 2:   *      ^  *
          * )    ^  *)
          (* ) *  ^  *) *
(E&F)     ma kiN ^ to  šu
```

The WPP → ⇓ ⇓

[makkiN] [toššu] ⇨ [makkiN toššu]

2.3.4. Addendum to Section 2.2

Among the complex but interesting examples raised in the preface, only the examples in (2a), which are repaeted below, remain unexplained:[27]

(2) a. miss /mis/ → [misu] vs. missing /misiŋ/ → [missiNgu]
listen /lisn/ → [rissuN] vs. listening /lisniŋ/ → [risuniNgu]

That is, /s/ in *miss* does not geminate but it DOES geminate if *-ing* is attached to *miss*; on the other, /s/ in *listen* geminates but it does NOT geminate if *-ing* is attached to *listen*.

As expected, the PARs and the WPP provide the correct prediction for these examples, too, as illustrated by (41).[28]

(41)	a. miss → mi su	b. missing → mi siN gu	c. listen → li suN	d. listening → li su niN gu
Line 0: (A)	* * mi su	* * * mi siN gu	* * li suN	* * * * li su niN gu
(B)	*) * mi su	* *) * mi siN gu	*) * li suN	*) * *) * li su niN gu
(G)	*) * mi su	not applicable	not applicable	not applicable
(C)	not applicable	not applicable	not applicable	*) * (*) * li su niN gu

[27] I owe this interesting observation to Ono (1991).

[28] I assume that no original prosodic prominece of these four loanwords is respected.

Line 1:		*	*	* *
	* *	* *) *	*) *	*) * (*) *
(D)	mi sɯ	mi siN gɯ	li sɯN	li sɯ niN gɯ
Line 2:		*	*	*
		*)	*)	* *)
	* *	* *) *	*) *	*) * (*) *
(D)	mi sɯ	***mi*** siN gɯ	***li*** sɯN	li sɯ ***niN*** gɯ
The WPP→	⇓	⇓	⇓	⇓
	[misɯ]	[missiNgɯ]	[lissɯN]	[lisuniNgɯ]

It is important to notice that the WPP is satisfied in the case of (41d), lisɯ***niN***gɯ, without making the consonant in the onset of the syllable that immediately follows the syllable with the computed prominence. This is so because in this case, the syllable ***niN*** is already bimoraic, satisfying the WPP.

2.4. Syllable- and Mora-Based Metrical Planes and Dialect Variation

Thus far, we observed that the PARs in combination with the WPP give us a satisfactory machinery to compute the position of gemination found in loanwords in Japanese. Recall that the metrical structures for the PARs are projected by syllables, not by morae. In this sense, the metrical plane for the prosodic prominence computed by the PARs is a syllable-based one.

On the other hand, Japanese is often said to be a 'mora-counting' tonal language. Since Haraguchi (1977) revealed the mechanism of the association between H-tone and a pitch-accent bearing unit in Japanese under an autosegmental framework, the issue has been discussed as to how the position of the pitch-accent of a given word can be computed. Under the metrical theory of Halle & Vergnaud (1987), researchers reach a consensus on the claim that the metrical structure for the computation of the position of pitch-accent in Tokyo Japanese is projected by morae, not by syllables (e.g., Kubo 1990, Yamada 1990, Haraguchi 1991, Watanabe 1991). Thus, there are two distinct metrical planes in Tokyo Japanese: One is a syllable-based plane and the other a mora-based plane, and the former plane is for the computation of the prosodic prominence which is responsible for gemination in loanwords and the latter plane is for the computation of the pitch-accent which is responsible for tone-association. Therefore, there may be cases where the

position of the prosodic prominence computed by the PARs differs from that of the pitch-accent in a word. Take the English word *saccharine*, for example. According to Haraguchi (1991), the pitch-accent of a loanword tends to go on the antepenultimate mora. Then, we get the pitch-accent and tone-pattern of *saccharine* as in the (42a):[29] On the other hand, we get (42b) as the result of the application of the PARs to *saccharine*. (Note that *saccharine* has the original stress in its first syllable which is respected at the Perceptual Level.)[30]

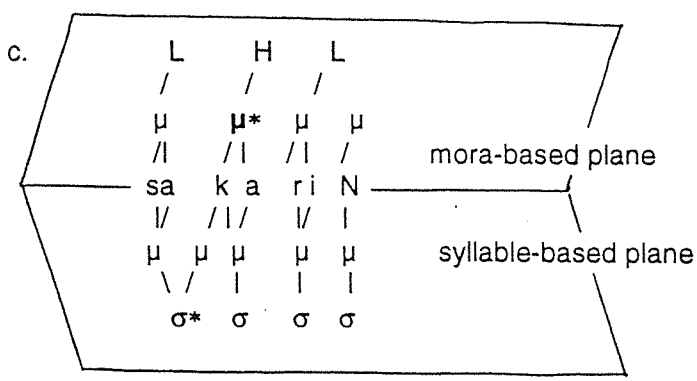
(42) a.

```
L   H    L
|   |    | \
sa  ka   ri N
```

b.

```
sa  ka  riN
(*) *   *      line 0
 *)             line 1
 *              line 2
```

c.



It is not so strange that there are more than one metrical plane which is associated with a given central line of phonemes. In fact, Rappaport (1984) claims, contra Prince (1983), that it is necessary to postulate two distinct metrical planes to capture the fact in Tiberian Hebrew (cf. Halle & Vergnaud 1987).

[29] I omit citing the rules for the computation of pitch-accent in Tokyo Japanese. See Yamada (1990), Watanabe (1991) and Haraguchi (1991), among others. But a brief sketch concerning tone-association may be helpful: A high-tone is associated to the mora with pich-accent and, then, spread leftward. If a given word consists of more than three morae, then the first mora may be initially assigned a low tone.

[30] The asterisk assigned to a mora indicates that the so-marked mora bears a pitch-accent, on the analogy of the usage of the asterisk assigned to a syllable with a prosodic prominence.

It is reasonable to ask the reason why Tokyo Japanese does not utilize the prosodic prominence computed by the PARs for the purpose of the computation of pitch-accent. Very interestingly, in Osaka (or Kansai) Japanese, the dialect most prevalent in western Japan, the position of the prosodic prominence computed by the PARs perfectly corresponds to the position of the pitch-accent: That is to say, Osaka Japanese has only one metrical plane which undertakes the computation of the position of pitch-accent in addition to the prosodic prominence of loanwords.

As noted above, the metrical plane in which the PARs are operative is syllable-based. This means that in Osaka Japanese, the computation of the position of pitch-accent is accomplished on the syllable-based plane. This conforms to the fact that syllables can bear a pitch-accent in Osaka Japanese. In contrast, only morae can bear a pitch accent in Tokyo Japanese. Consider (43).

(43)

Tokyo	*Osaka*
suutto	suutto
karatto	karatto
supotto	supotto
sokkusu	sokkusu

(Haraguchi 1977)

Whereas the high-tone continues on the first x-slot of the geminating consonant in Osaka Japanese, it cannot in Tokyo Japanese. This can be captured by assuming that, while syllables can bear pitch-accent in Osaka Japanese, they cannot in Tokyo Japanese.[31] This, in turn, gives an answer to the reason that the PARs and the rules for computing the position of pitch-accent are operative in the same metrical plane in Osaka Japanese, but they are separately accomplished in two distinct metrical planes in Tokyo Japanese: Since the prosodic prominence computed by the PARs is syllable-based, Tokyo Japanese cannot utilize (or compute) it prosodically because it is defective in the way to express prosodic prominence by using syllables. In contrast, Osaka Japanese has it; accordingly, it can prosodically utilize the prosodic prominence computed by the PARs.

[31] In fact, Haraguchi (1977) and Shibatani (1990) maintain that the accent-bearing unit is a mora in Osaka Japanese, by observing some facts which they allege to be in favor of their claim. But, see Nishigauchi (1982) (and, also, Takahashi 1992) for arguments against their claim and in favor of our analysis on empirical and theoretical grounds that syllables are an accent-bearing unit in Osaka Japanese.

3. Epenthesis in Loanword Phonology

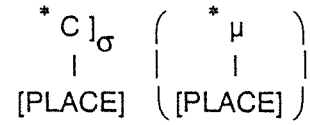
In the previous sections, we considered the seemingly vexatious problem of the position of gemination in Japanese loanword phonology. It is evident from the examples we looked at so far that epenthesis happens in most loanwords. In this section we will take the issue of epenthesis in Japanese loanword phonology and provide an optimality-theoretic analysis both of the position where epenthesis happens and of the value of the vowel inserted by epenthesis.

3.1. The Position of Epenthesis in Loanwords

First, let us consider where epenthesis (must) happen in loanwords in Japanese. As was pointed out elsewhere in this paper, this is deeply concerned with the fact that Japanese does not allow any closed-syllable unless the closed-syllable has /N/ in its coda. In other words, Japanese does not allow any sequence of consonants except that /N/ is the last consonant of the sequence.

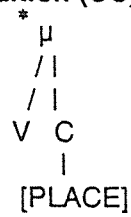
This fact can be captured by postulating the condition as stated in (44):

(44) Coda Place Condition (Itô 1986, 1989)



Modifying (44) in order to fit Japanese loanword phonology, I propose the following condition:

(45) **Coda Condition (CC)**



This modification is imperative because the condition (44) is strong enough to incorrectly precludes gemination. [puttɷ] (the pronunciation of the English word *put*), for example, is ruled out by (44). But the condition (45) (hereafter, we will abbreviate it as CC) rules it in, because [puttɷ] is $[[[pu]_{\mu}\ [t]_{\mu}\ ]_{\sigma}\ [[tɷ]_{\mu}\ ]_{\sigma}\ ]$.

Another crucial condition for loanword phonology is the condition called FAITHFULNESS. This condition plays a crucial role in the optimality theory, but its use here is somewhat different from the one in the other works; rather, I follow Yip's (1993) interpretation of it under loanword phonology, which is cited as in the following:

(46) Condition of Conservatism (FAITHFULNESS)
FAITHFULNESS: "Do not alter underlying form." (Yip 1993)

These two conditions (CC and FAITHFULNESS (henceforth, FF)) provide a correct prediction of the position where epenthesis must take place and the position of where it must not take place, if we CC is more highly ranked than FF. Let us consider some examples.

(47) a. **kiss:** [kisu̲]

	CC	FF
kis	*!	✔
☞ kis❑	✔	*
kiz	*!	*
kiz❑	✔	**!

b. **tact:** [takuto̲]

	CC	FF
takt	*!	✔
tak❑t	*!	*
takt❑	*!	*
☞ tak❑t❑	✔	**

c. **son:** [saN]

	CC	FF
☞ saN	✔	✔
saN❑	✔	*!

There is another constraint on sequences of segments in Japanese. As argued by Itô & Mester (1993) in some extent, Japanese does not allow the sequences listed in (48) in general.

(48) *[tu], *[ti],
*[du], *[di],
*[ču], *[če],
*[ǰu], *[ǰe],
*[si]

Then, we may postulate the following condition:

(49) **Avoid Illicit Sequence Condition (AISC)**
Avoid a sequence of segments if it is listed in (48).

The condition (49), AISC, gives a way to provide a correct prediction of examples such as *geratine* /ǰeratin/ → [zeraciN] in combination with FF. As shown in (50), we have to rank AISC higher than FF.

(50) **geratin** /ǰeratin/: → [zeraciN] (cf. *[ǰeratiN], *[ǰeraciN], or *[zeratiN])

	AISC	FF
☞ zeraciN	✓	✳✳
ǰeratiN	✳✳!	✓
ǰeraciN	✳!	✳
zeratiN	✳!	✳

In fact, we can correctly predict, by using the optimality theory with the aid of these conditions, where epenthesis must happen and where it must not happen in loanwords. But, without any further proviso, this kind of approach for epenthesis under the optimality theory can hardly predict which vowel is inserted in the position for epenthesis. For instance, the English word *tab* is pronounced as [tabu] in Japanese. It is true that the position of epenthesis is correctly predicted by CC and FF, just as in the case of *kiss* in (47a) above, but it is totally unclear under this approach why /u/, but not any other vowels in Japanese, is inserted to that position. As shown in (51), all forms should be equally optimal as far as the relevant conditions are concerned.[32]

[32] I have no argument for the ranking of CC and AISC. It may be the case that AISC is ranked higher than CC, as opposed to the ranking shown in (51), where CC is ranked higher than AISC. I tentatively assume, throughout this paper, that CC is superior to AISC. But it should be noted that it does not at all affect the arguments that follow whether or not AISC is superior to CC. Incidentally, a black hand means that the form with it has a possibility to be selected as the optimal form as far as the relevant tableau is concerned.

(51) **tab**: [tabu̲]

	CC	AISC	FF
tab	*!	✔	✔
☞tab(a)	✔	✔	*
☞tab(e)	✔	✔	*
☞tab(i)	✔	✔	*
☞tab(o)	✔	✔	*
☞tab(u)	✔	✔	*

We have no way to choose [tabu] among those equally possible candidates; hence, we need to devise some mechanism for that purpose.

3.2. The Choice of Epenthetic Vowels

The fact concerning the value of epenthetic vowels involved in loanwords in Japanese is as follows: In general, /u/ is inserted; however, after /t/ and /d/; /o/ is inserted, and, after /č/ and /ǰ/, /i/ is inserted.

(52) a. tab → [tabu̲], tuck → [takku̲], tough → [taΦu̲],
tug → [taggu̲], Dell → [deru̲], ram → [ramu̲], top → [toppu̲],
toss → [tosu̲], mesh → [mešše̲], lods → [rozzu̲]

b. bet → [betto̲], get → [getto̲], yacht → [jotto̲], set → [setto̲]
bed → [bedde̲], wood → [udde̲], good → [gudde̲], bird → [ba:de̲]

c. touch → [tačči̲], match → [mačči̲], scratch → [sukuračči̲]
badge → [baǰi̲], bridge → [buriǰi̲], fudge → [ΦaǰǰI]

To capture this fact under the optimality theory, I propose to introduce the Sonority Hierarchy Condition as a relevant condition, the condition which has been well-motivated in the literature (see Selkirk 1982, Clements 1990, Goldsmith 1990, Kenstowicz 1993, among others). As far as vowels are concerned, they are ranked in the sonority hierarchy as in the following manner:

(53) **Sonority Hierarchy:**

high-V		mid-V		low-V	
/u/		/o/			
/i/	<<	/e/	<<	/a/	(Selkerk 1984)
minimum				*maximum*	

Then, the Sonority Hierarchy Condition is defined as follows:

(54) **Sonority Hierarchy Condition (SHC):**
If two or more candidates are equal in terms of the relevant constraints, the optimal one is the one with the epenthetic vowel which is ranked minimum in the sonority hierarchy.

It is obvious that this condition sort out candidates with /u/ or /i/ as an optimal one from the others.[33] Introducing this condition into (51), we get the tableau in (55):

(55) **tab**: [tabu]

	CC	AISC	FF	SHC
tab	*!	✔	✔	
tab(a)	✔	✔	*	3!
tab(e)	✔	✔	*	2!
☛tab(i)	✔	✔	*	1
tab(o)	✔	✔	*	2!
☛tab(u)	✔	✔	*	1

Notwithstanding, we need another device to select [tabu] over [tabi]. Then, I propose to introduce the following condition:

(56) **"Backness" Condition (BC):**
If two or more candidates are equal in terms of the relevant constraints and the Sonority Hierarchy Condition, the optimal one is the one which has the epenthetic vowel with [+back].

This condition is made to select /u/ over /i/ (and /o/ over /e/).[34] With this condition in addition to the others, we get the correct prediction of *tab*, as shown in (57):

[33] The fact that in Panapean, /u/ or /i/ is inserted as an epenthetic vowel for loanwords (Itô 1989) may lend support to the introduction of SHC.

[34] This is a languages-specific rule. The parameter between [+back] and [-back] seems to be set dif-

(57) **tab**: [tabu]

	CC	AISC	FF	SHC	BC
tab	*!	✔	✔		
tab(a)	✔	✔	*	3!	✔
tab(e)	✔	✔	*	2!	*
tab(i)	✔	✔	*	1	*!
tab(o)	✔	✔	*	2!	✔
☞tab(u)	✔	✔	*	1	✔

At this point, one might conjecture that the introduction of SHC and BC seems very ad hoc and that they seem necessary for us only to explain the case of the epenthetic /u/ alone. On the contrary, these two conditions together with the others provide a very neat explanation of the cases of the other epenthetic vowels without any further stipulation: That is, we can satisfactorily account for the fact that /i/ is inserted after /č/ and /ǰ/ and /o/ is inserted after /t/ and /d/, which is shown in (58) and (59).

(58) **beech**: [biič], **merge** [maaǰi].

	CC	AISC	FF	SHC	BC
biič	*!	✔	✔		
biič(a)	✔	✔	*	3!	✔
biič(e)	✔	*!	*	2	*
☞ biič(i)	✔	✔	*	1	*
biič(o)	✔	✔	*	2!	✔
biič(u)	✔	*!	*	1	✔

ferently from language to language. For example, in Cairene and Iraqi, /i/, instead of /u/, is inserted as a default epenthetic vowel (Itô 1989).

(59) **try**: [tɹ̥rai], **dry**: [dɹ̥rai]

	CC	AISC	FF	SHC	BC
trai	*!	✓	✓		
t(a)rai	✓	✓	*	3!	✓
t(e)rai	✓	✓	*	2	*!
t(i)rai	✓	*!	*	1	*
☞t(o)rai	✓	✓	*	2	✓
t(u)rai	✓	*!	*	1	✓

This, in turn, points to the correctness of the introduction of these conditions.

4. Conclusion

In the first part of this paper we explored a mechanism for the computation of the position of gemination in foreign loanwords in Japanese. Although, as we observed, there are not a few complicated examples involved, the proposed account under Simplified Bracketed Grid Theory (Idsardi (1992, 1994) and Halle & Idsardi (to appear)) provided a satisfactory account of the phenomena. In the latter part we considered the issue as to what kind of phoneme should be inserted as an epenthesis to avoid an illicit CC or C# sequence in Japanese loanword phonology. It was demonstrated that the Avoid Illicit Sequence Condition (AISC) and the Sonority Hierarchy, both of which have their own motivations in elsewhere in Japanese phonology, play a crucial role in the optimality competence to select the value of the epenthetic vowel. This paper is merely an attempt to approach those issues in Japanese loanword phonology, which has attracted less interest in the literature. But it is quite certain that loanword phonology has great possibilities of making large contributions to phonology in general. Thus I hope this attempt will be a small guiding light on the future studies on any relevant topic.

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