Place asymmetry and markedness of labials in Japanese
Evidence from loanwords

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The terms 'marked' and 'unmarked' can be interpreted in many different ways. One interpretation is that markedness is induced from 'phonetic knowledge'. Hayes & Steriade (2004) argue that this is the driving force for the cross-linguistic patterns. Another interpretation of the term is based on textual frequency in a particular language; the more frequent a segment, the less marked it is. A gemination process in loanwords in Japanese provides evidence that goes against the predictions made by both of these notions of markedness. I propose that another perspective from which to understand markedness is a consequence of the structure of the language, i.e., structural markedness.

1. Introduction

There are several aspects in the notions of 'markedness' or 'being marked/unmarked' in phonology. One way of looking at markedness is that it is induced from phonetic knowledge. Based on facts regarding articulatory and perceptual difficulties, Hayes & Steriade (2004) argue that markedness based on phonetic knowledge is the driving force for the sound patterns found cross-linguistically. Another interpretation of the term 'marked/unmarked' is based on textual frequency in a particular language. Under this interpretation, the most frequent segments are viewed as 'unmarked' in that language. To put it another way, the less frequent segments are regarded as more 'marked' than the other segments in the inventory. We then would predict those less frequent segments show marked behaviour in the language. In this paper, I will propose that the patterns that Japanese shows in a loanword gemination process argue against the predictions made by both of these notions of markedness. I propose that another perspective we can take to understand markedness is to see it as related to the structure of a particular language, that is, a representational approach.

The paper is organized as follows. I first introduce the notion of markedness as deduced from phonetic knowledge, as discussed in Hayes & Steriade (2004) (§2). My particular focus is voicing in obstruents. Then I introduce the place asymmetry found in voiced geminates in loanwords in Japanese to show that the patterns there do not meet the prediction that the phonetic knowledge hypothesis makes (§3). I then look at frequency of segments in the Japanese native vocabulary and show that the textual frequency does not explain the observed

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patterns in loanwords either (§4). I lastly propose an analysis that ties the observed patterns to the underlying representations of Japanese obstruents (§5). I conclude the paper with a brief summary (§6).

2. Cross-linguistic implicational relations as generated by phonetics

Hayes & Steriade (2004) argue that implicational relations found cross-linguistically are the reflections of universal grammar that is ultimately based on phonetics. Since they look at cross-linguistic voicing patterns, which are relevant in examining the patterns in gemination in loanwords in Japanese, I will present their arguments and examples in detail here. Their hypothesis states (Hayes & Steriade 2004:1):

> The hypothesis shared by many writers in this volume is that phonological constraints can be rooted in *phonetic knowledge* (Kingston and Diehl 1994), the speakers' partial understanding of the physical conditions under which speech is produced and perceived. The source of markedness constraints as components of grammar is this knowledge. The effect phonetic knowledge has on the typology of the world's sound systems stems from the fact that certain basic conditions governing speech perception and production are necessarily shared by all languages, experienced by all speakers and implicitly known by all. This shared knowledge leads learners to postulate independently similar constraints. The activity of similar constraints is a source of systematic similarities among grammars and generates a structured phonological typology.

Hayes & Steriade (2004) assume four logical steps. First, there are the facts about phonetics. Second, speakers have implicit knowledge about these phonetic facts. Third, grammatical constraints are induced from this knowledge. Last, reflecting the activity of these constraints, are the sound patterns that we observe in languages. They say that the first and last steps, i.e., facts about phonetics and the observed sound patterns, are accessible in principle, but the two intermediate steps have to be guessed at with regard to their contents.

The particular linguistic phenomenon that they study to test their hypothesis is that of voicing contrasts in obstruents. First, they state the facts of the phonetic difficulty of voicing obstruents. These involve the aerodynamics of voicing, particularly in two dimensions — length and place of articulation. In terms of length, voicing is hard to sustain in general. It follows from this that, other things being equal, it is more difficult to sustain voicing in geminates than in singletons. As for place, voicing is harder to sustain at the back of the mouth than at the front. The consequence of the interaction of these facts is the scale of difficulty in sustaining voicing in obstruents as in (1).

(1) Scale of difficulty in sustaining voicing in obstruents (from Hayes & Steriade (5))
*[+voice]: { g: < d:< b: < g < d < b} ('<' denotes 'worse than')

The scale states that the feature [voice] is hardest to realize in [g:], next hardest in [d:], and so on, and easiest to realize in [b]. This knowledge of markedness, viewed as phonetic knowledge, is reflected in the grammar as a set of Markedness constraints in (2).[1] The ranking there is assumed to be universal.

(2) The set of Markedness constraints according to the phonetic difficulty of the segments that they ban
*gg » * dd » *bb » *g » *d » *b

Following the discussion of the markedness hierarchy, Hayes & Steriade look at the inventories of voiced obstruents in selected languages (3) to show that the fine-graded constraints set like (2) can explain the sound patterns that we observe there. The variations in inventories of voiced obstruents in these languages respect each of the cut-off points in the constraint set in (2).

(3) A typology of voiced stops in selected languages (from Hayes and Steriade 2004:11)

(The original title given to their table is "Illustration of patterns of selective voicing neutralization, on a scale like (2)". I replaced their unshaded cells by check marks. Check marks indicate that the voiced obstruent in the column header occurs.)

	b	d	g	b:	d:	g:
a. Delaware (Maddieson 1984)						
b. Dakota (Maddieson 1984)	✓					
c. Khasi (Maddieson 1984)	✓	✓				
d. Various (citations under (1)[a?] above)	✓	✓	✓			
e. Kadugli (Abdalla 1973), Sudan Nubian (derived environments; Bell 1971)	✓	✓	✓	✓		
f. Coshin Malayalam (Nair 1979), Udaiyar Tamil (Williams & Jayapaul 1977), Sudan Nubian (root-internal only: Bell 1971)	✓	✓	✓	✓	✓	
g. Fula (Maddieson 1984)	✓	✓	✓	✓	✓	✓

This cross-linguistic tendency may be explained in this way. However, when we look at the patterns of voiced geminates in Japanese loanwords, the predictions made by (2) are not supported. I now turn to this issue.

3. Voiced geminates in loanwords in Japanese

In the adaptation of loanwords, geminates are created under certain conditions.[2] Some examples are given in (4). Voiced stop geminates are in bold face. I will examine them in detail.

[1] In the article by Hayes & Steriade (2004:9), the segments are expressed in feature bundles. Thus, the constraints set (2) looks like: *[-son, +long, +dorsal, +voice] 'no voiced long dorsal obstruents' >> *[-son, +long, +coronal, +voice] 'no voiced long coronal obstruents' >> … >> *[-son, -long, +labial, +voice] 'no voiced short labial obstruents'.

[2] The motivation of geminates is a very interesting topic to pursue. However, it is beyond the scope of this paper. See Kawagoe & Arai (2002) and references therein for discussion.

(4)Gemination in loanwords

English (spelling)	>	Japanese	
hip	>	[hippu]	(Quackenbush and Ohso 1990:38)
mitt	>	[mitto]	(Quackenbush and Ohso 1990:38)
kick	>	[kikku]	(Quackenbush and Ohso 1990:38)
pitch	>	[pittʃi]	(Quackenbush and Ohso 1990:38)
cats	>	[kʲattsu]	
knob	>	**[nobbu]**	(Quackenbush and Ohso 1990:40)
head	>	**[heddo]**	(Quackenbush and Ohso 1990:40)
dog	>	**[doggu]**	(Quackenbush and Ohso 1990:40)
edge	>	[eddʒi]	(Quackenbush and Ohso 1990:40)
kids	>	[kiddzu]	(Quackenbush and Ohso 1990:40)
fish	>	[ɸiʃʃu]	(Quackenbush and Ohso 1990:38)
apple	>	[appuru]	(Quackenbush and Ohso 1990:48)
buckle	>	[bakkuru]	(Quackenbush and Ohso 1990:48)
waffle	>	[waɸɸuru]	(Katayama 1998:80)[3]
castle	>	[kʲassuru]	(Quackenbush and Ohso 1990:48)
wax	>	[wakkusu]	(Quackenbush and Ohso 1990:48)
happy	>	[happii]	(Katayama 1998:75)
cotton	>	[kottoɴ]	(Katayama 1998:75)
cookie	>	[kukkii]	(Katayama 1998:75)

Focusing on loanwords with final oral stops in the source language, *p, t, k, b, d, g*, the following points are relevant: Voiceless stops (*p, t, k*) undergo gemination almost all the time, regardless of the place of articulation. In Kawagoe & Arai (2002), citing the results of Maruta (2001), the percentages of gemination for *p, t* and *k* are 98 percent (67 out of 68), 99 percent (202 out of 203 (204)), and 98 percent (188 out of 191), respectively. Shirai's (2001) survey also shows more than 90 percent of gemination for all of these voiceless stops.

In contrast to this, in voiced stops *b, d, g*, although gemination does occur, geminates are unstable, and a place asymmetry is found. The gemination rate is low in the labial *b*, high in the coronal *d* and around fifty percent in the dorsal *g*, as in (5).

(5) Gemination rates (Numbers in parentheses indicate the total number of words that meet the structural description for word-final gemination.)

	b low,	*d* high,	*g* around 50%
My dictionary survey:	*b* 15% (27),	*d* 83% (41),	*g* 42% (36)
Shirai (2001):	*b* 11% (9),	*d* 58% (36),	*g* 55% (22)
Maruta, in Kawagoe & Arai (2002):	*b* 23% (22),	*d* 71% (35 (36)),	*g* 55% (36)

I give some example words in (6) from my dictionary survey.

[3] I replaced her [f] with [ɸ].

(6)

English	Japanese	
mob	mobbu	
World Wide Web	waarudo-waidouebbu	
knob	nobbu	nobu
tab		tabu
tub		tabu
hub		habu

English	Japanese	
pub		pabu
rib		ribu
wood	uddo	
kid	kiddo	
head	heddo	
red	reddo	
rod	roddo	
period		piriodo
ad: [advertisement]		ado
wig	uiggu	
egg	eggu	
fog	ɸoggu	
leg	reggu	
tag	taggu	tagu
mug		magu
lag		ragu
rug		ragu
log		rogu

In sum, based on the gemination rates, we find the scale as in (7).

(7) Observed scale in loanwords in Japanese based on gemination rates
*bb » *gg » *dd

Notice that the Japanese scale here does not meet the prediction made based on the aerodynamics of voicing. Consider specifically the unexpected position of labials in the scale. From the scale in (2), we would expect labial [b:] to be the most frequent in gemination in loanwords, since labial is the place of articulation for which it is easiest to sustain voicing. However, in Japanese, labials resist gemination the most. Thus, aerodynamics of voicing fails to predict the Japanese facts.[4]

[4] A reviewer points out that there is another phonetic account to be considered: an acoustic/perceptual approach along the lines of Steriade's P-map model. Specifically examining place asymmetry, the reviewer suggests that a potential account for the Japanese facts could be that labial stops have the weakest release burst of the three places of articulation (here the release burst being the cue for stop place identification) and this makes the labial hard to hear. Additionally, voicing for long periods is articulatorily difficult, and these two factors together make voiced labial geminate [bb] especially difficult to perceive. Its failure to geminate in loanwords would thus be driven by perceptual factors.

4. Frequency in text

Can the observed scale in voiced geminates in loanwords be explained by the language-internal frequency? From this viewpoint of markedness, "[t]he unmarked member of an opposition occurs more frequently than the marked member" (Hyman 1975:145). Or, a segment can be unmarked if it has greater lexical (i.e., in morphemes) and textual frequency than other segments in the particular language (Hyman 1975:146). If we interpret markedness as determined in terms of textual frequency, we might expect labial geminates to be lower in frequency in Japanese native vocabulary than other geminates.

If there exists a correlation between the observed scale in loanwords and the textual frequency of these segments in Japanese, then one might argue that frequency explains the patterns. In other words, if the voiced geminates *bb, dd* and *gg* have the frequency scale of *bb* < *gg* < *dd* outside the loanword vocabulary in Japanese, the pattern in the loanwords could be argued to be ascribed to a frequency effect. In investigating this possibility, however, we encounter a problem. Japanese does not have underlying voiced geminates outside the

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I would like to present two points that make this approach unconvincing as an account for the Japanese facts. First, it is not clear if the place asymmetry with regard to the strength of release burst also holds in voiced stops. Second, it is unclear whether the facts about production apply directly to perception. Since there has been limited research done on the perception of place identification in discussion, further study is needed to include the perceptual facts. I explain these two points in detail below.

The reviewer correctly states that sustaining voicing for a long duration is difficult because of the aerodynamics of voicing in production (see §2 for this). The difficulty of sustaining voicing does not distinguish place of articulation, however. The strength of stop release burst at different places of articulation is therefore critical. However, burst may not present a clear picture in voiced stops. I will begin by looking at voiceless stops. The intraoral pressure after the release decreases more rapidly in labials than in velars (the alveolar stops are located somewhere in between) (Stevens 2000:323ff). Thus, the rapid decrease in pressure after the release burst of labial stops makes their burst relatively 'weaker'; the average pressure after the burst is smaller. Furthermore, if the 'strength' of the release burst is correlated with VOT values, i.e., the duration of burst, (that is, weaker release burst correlates with lesser VOT), labials are also relatively 'weaker'. It is known that labial stops have the smallest VOT of the three major places of articulation cross-linguistically, with VOT increasing as the place of articulation goes from the front to the back of the mouth (Lisker & Abramson 1964 for initial position). Homma (1981) found that this is true in voiceless singleton stops [p, t, k] in Japanese both in initial and medial positions.

However, in order for the account suggested by the reviewer to work, the above described place asymmetry in strength of release burst must hold for voiced stop singletons. In terms of the intraoral pressure after the release, the pressure is calculated to be less for voiced stops in general than for voiceless stops (Stevens 2000:468ff). I am not certain if, after this overall decrease in pressure, the place asymmetry of the kind found for voiceless stops is significant in voiced stops. The VOT values do not support the hypothesis that the labial stops have the weakest burst, at least not for Japanese. There are two pieces of evidence for this. First, in Japanese, voiced stops are in general voiced phonetically (Homma 1980:9). Homma 1981:276 found that "VOT … was very rare in single voiced stops, except for /g/ at word initial position". Thus, in word medial positions, there is nothing that makes singleton voiced labial stops particularly 'weak' among the three places of articulation. Second, there is an allophonic lenition process reported for voiced labials and voiced velars in medial position in Japanese (Kawakami 1977). The underlying voiced stops do not even involve burst in the surface forms, because they are realized as continuants. Therefore, in acoustic terms, it is not clear if labial stops have the weakest release burst in voiced series in Japanese. These considerations do not speak directly to geminates, and further work is required to examine if voiced geminates are in fact perceptually weaker than voiced geminates of other places of articulation.

Another consideration to make in advocating the perceptual account concerns place of articulation identification. I am unaware of any experiment that tests the confusability of place differences in Japanese. It would be interesting to test if there are any significant differences in confusability at different places of articulation.

loanwords, at least in the Tokyo dialect. Given this distributional restriction, there is nothing that I can count to make a direct comparison with the voiced geminates in loanwords.

However, one might expect to see a correlation between the observed gemination scale and textual frequencies of singletons, *b, d* and *g* in the native vocabulary. The results show that the frequency scales do not correlate with the geminates scale. I illustrate this below.

If there is a correlation between the loanword gemination patterns and the textual frequency of singletons in Japanese, we would find a scale of textual frequency as in (8). Since markedness as defined by frequency interprets the least frequent segment to be the most marked in the system, *b* should occur least frequently; it shows the marked behaviour in loanwords in that it resists gemination the most.

(8) $b < g < d$

To count the frequency of singletons *b, d* and *g*, I used the written corpus complied from the ninety magazines published in 1956 (Kokuritu Kokugo Kenkyujo (The National Institute for Japanese Language) 1997). This corpus has a total number of 39,997 items in type and 438,712 items in token. Sino-Japanese items and proper names (and, of course, loanwords) were then excluded; I include the Yamato (native Japanese) items and the mimetics. The corpus then has 11,152 items in type (221,351 in token).[5]

First, I counted the frequency of *b, d, g* in the word-initial position. The results are given in (9).

(9) Frequencies of initial voiced obstruents in the native items (The numbers in the parentheses indicate token frequency and the numbers without them type frequency.)
g 109 (837), *b* 119 (890), *d* 187 (4657)

We do not find the scale (8) here. For example, the dorsal *g*, not the labial *b*, occurs least frequently.

Next, I counted the frequencies in word-medial position. Here, I counted onset consonants in the second syllable, i.e., C_2 in $(C_1)VC_2V\ldots$ forms. Forms with a coda nasal preceding C_2, i.e., $(C_1)VNC_2V\ldots$, were not included in the counting.[6] The results are given in (10).

(10) Frequencies of word-medial voiced obstruents in the native items
d 344 (4425), *b* 467 (3448), *g* 550 (6238)

Here, again, we do not find the scale (8). *d* occurs least frequently in terms of type frequency in this position, with the occurrence of 344 times in the corpus; *b* (467) and *g* (550) are more frequent. If we look at the token frequency, the least frequent segment is not *d*. Instead, *b*

[5] The categorization of the vocabulary items, i.e., Yamato, Sino-Japanese, etc., is theirs; the words are labeled in the corpus according to their categorizations.

[6] I did not include coda consonants in counting because they are irrelevant. In Japanese, surface coda consonants are limited to either to a nasal, e.g., *tombo* 'dragonfly', or the first half of the geminate. The coda nasal is ignored because I was counting voiced oral stops. Regarding the first half of geminates, Japanese has no (underlying) voiced geminates outside of loanwords.

occurs least frequently; it occurs 3448 times, while *d* (4425) and *g* (6238) occurs more. However, again, the frequency scale does not totally coincide with the scale in (8).[7, 8]

To conclude, we do not find a correlation between segmental frequency in text and the frequency in the loanword geminates overall.

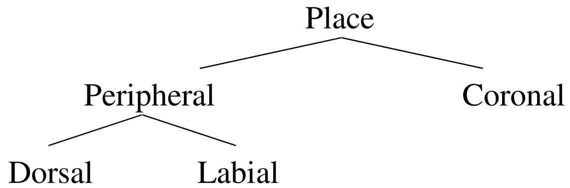
5. Structural markedness

I propose that the patterning of the voiced geminates in loanwords and the 'marked' behaviour of labials as being the most resistant to gemination are a consequence of the underlying representations of the segments in question. In other words, the structural differences among places are the driving force for the observed gemination rates for different places.

5.1. Markedness and place structure of Japanese

The theory in which I work in this paper views markedness as being represented structurally in the underlying representation (http://www.chass.utoronto.ca/~contrast/; e.g., Avery & Rice 1989, Dresher & Rice 1993, Dresher, Piggott & Rice 1994, Rice & Avery 1993, 2004). To be more marked means to have more structure, i.e., more features. I assume privativity of features and feature geometry (Clements & Hume 1995). I also assume contrastive specification; features are underlyingly minimally specified as much as the contrasts in a particular system are sufficiently made (see reference above). An unspecified feature is inert in phonological processes. Feature specifications are language-specific: underlying representations are so analyzed as the phonological processes of the particular language suggest. The exhaustive feature geometry for Place in a three-way contrast system is assumed to be in (11).

(11) Full geometry for Place for consonants — a three-way contrast system (from Avery and Rice 1989)



[7] The discrepancy between the token frequency scale and type frequency scale comes from the fact that there is a small number of words of great frequency (occurring more than 200 hundred times) and they have either *d* or *g* in C_2; there are no such words with *b* in C_2. If we exclude these super high frequency words, the scale $d < b < g$, the same scale as we get from the type frequency, holds, with the occurrences of 2846 for *d*, 3448 for *b* and 4876 for *g*.

[8] The very frequent items are the followings. N, V and Adv denote noun, verb and adverb respectively.
g: *sigoto* (N, 'work') 244 times, *tugi* (N, 'next') 277, *migoro* (N, 'be at one's best') 349, *age-ru* (V, 'give, raise, deep-fry') 284, *sugu* (Adv, 'immediately') 208
d: *kodomo* (N, 'children') 333, *hodo* (N, degree, extent, limit) 445, *kudasar-u* (V, 'give', honorific form) 255, *tada* (Adv, 'simply, merely') 274, *mada* (Adv, 'still, yet,') 272

Compare: The most frequent word with *b* in C_2 in the corpus is *yob-u* (V, 'call'), with 158 times of occurrence.

Keeping in mind the minimal specification of features outlined in the paragraph above, I propose that the structures for individual places of articulation in Japanese are as follows. Labials have a more complex structure than do the other places of articulation (12a). Coronals are the least complex, i.e., unmarked (12b). Dorsals are in the middle (12c). It is as the result of the reflection of this difference in complexity that we observe the different gemination rates in different places of articulation in loanwords.

(12) Japanese places of articulation: contrastive specification

a. Labial	b. Coronal	c. Dorsal
b	*d*	*g*
|	|	|
Place	Place	Place
|		|
Peripheral		Peripheral
|		
Labial		

In the next section, I show this in detail, i.e., how the structure in (12) can explain the observed pattern in loanwords. I situate gemination in loanwords as a whole in the context of Japanese phonology first.

5.2. Length contrast in Japanese

The key to understanding the instability of geminates in voiced obstruents in loanwords lies in the fact that voiced obstruents are new to the system of Japanese; the length contrast is introduced with them (Rice 2004). I first look at this aspect. If we look at words that are not loanwords, a length contrast exists in the voiceless obstruents, while it does not in the voiced obstruents. The presence/absence of contrast provides the base on which the loanwords appear differently between the voiceless geminates (fairly stable) and voiced ones (relatively unstable). I show this below.

With voiceless obstruents, there are some forms that exhibit lexical geminates. For example, Japanese uses lengthening for emphasis (e.g., *yahari* 'as expected' → *yappari* emphatic). However, there are some words that are historically emphatic forms, but have displaced the unemphatic form over time (Vance 1987:43, citing Hamada 1955), with the result that only the emphatic forms are in use in contemporary standard Japanese. Vance gives *mattaku* 'completely' as an example, for which a form without the geminate *[mataku] is not in use. Thus, given forms are analyzable, in the synchronic terms, as having underlying geminates.

Another set of data that suggest underlying voiceless obstruent geminates comes from Sino-Japanese words. Although Sino-Japanese words may mostly be analyzed as compounds that consist of two root morphemes, it may not be so clear for some 'compounds' whether their 'roots' can be separable in modern Tokyo Japanese. An example word is *sekkaku* 'with much trouble, kindly'. I am not certain if any Japanese speakers would analyze this word to be anything but monomorphemic.

As for voiced obstruents, in contrast, there are no underlying geminates. First, surface voiced geminates, unlike voiceless geminates, are very rare, a point that Itô & Mester 1995:819 generalize:

(13) *DD: Geminate obstruents must be voiceless in Yamato, Mimetic and Sino-Japanese

In gemination processes such as intensified adverbs in mimetic vocabulary (Kuroda 1979, McCawley 1968), verb morphology, and verb+verb compounds, the morphologically derived geminates are either long voiceless obstruents or prenasalized stops. If a voiceless obstruent undergoes the gemination rule, it results in a voiceless obstruent geminate. If a voiced obstruent undergoes the rule, it does not derive a voiced obstruent geminate, but it takes the form of prenasalized stop. So, in these processes, we do not find voiced obstruent geminates in the derived contexts. I summarize the patterns in (14).

(14) Coda consonant in certain gemination processes in native grammar

If the following segment is:	then the mora consonant is realized as:
Voiceless obstruent	→ the voiceless mora obstruent (voiceless geminate)
Voiced obstruent	→ the mora nasal

In other cases, surface voiced obstruent geminates are found. Vance (1987:42) notes that standard speakers do lengthen voiced obstruents for emphasis. Kawahara (p.c. 2004) notes that prenasalization and gemination of voiced obstruents are variants for emphasis (e.g., *subarasi-i* 'gorgeous, wonderful, awesome, etc.' → *suNbarasii* ~ *subbarasii*). However, these are derived forms; voiced geminates are not contrastive lexically. Therefore, I conclude that there is no underlying length contrast in voiced obstruents.

If we turn to loanwords, the difference in the underlying length contrast between voiceless and voiced obstruents — presence of a contrast in voiceless obstruents and the absence in voiced obstruents — explains the difference in the degree of gemination between them. The robust gemination of loanwords with voiceless obstruents is made possible by the support of existing underlying geminates. On the other hand, the absence of a contrast in length makes the voiced geminates in loanwords rather unstable. Then, through the adaptation process of gemination, the geminate sites create the place where we find the dynamics.

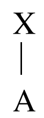
With this as the baseline, the place asymmetry that we are observing in the unstability of voiced geminates is the emergence of structural complexity of (12). Formally, this is expressed as discussed below.

5.3. The place asymmetry in loanword gemination

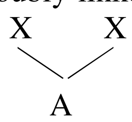
Structurally, geminates are more complex than singletons (15).

(15) Complexity: *b* is more complex than *a*

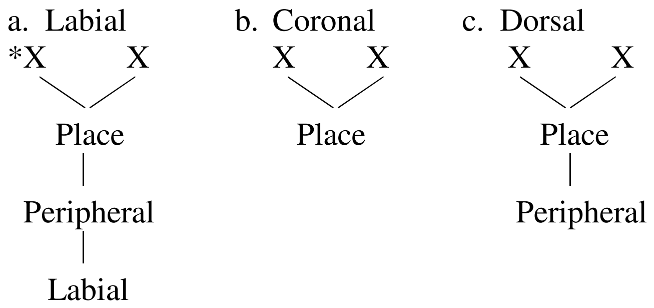
a. Singleton position



b. Doubly-linked position, i.e., geminates



Voiced labials, being the most complex, hardly geminate, since complex segments are not well-licensed in complex position (16a), unlike the other places of articulation (16b for coronal and 16c for dorsal). My use of "well-licensed" reflects the non-categorical nature of this phenomenon; [bb] sequences are not absolutely banned, but are less preferred than [dd] or [gg] sequences which are themselves variable.

(16)


One might wonder why we do not find the structural complexity effects in the voiceless series in loanword gemination; the gemination rates do not show a place asymmetry for *p, t, k*, and they all geminate almost all the time. Recall that geminates are lexically present in voiceless obstruents outside of loanwords (§5.2). Thus, categoricity of gemination in loanwords is expected with voiceless obstruents, and there is no reason to expect instability for these items.

For the proposed place structure (12), there exists independent evidence. First, the special nature of labials is recognized outside loans. Singleton [p] is prohibited in Yamato items and has restricted distribution in Sino-Japanese items, while singletons [t] and [k] are found. Itô & Mester 1995:819 express this with a constraint against single [p]:

(17) *P: Yamato and Sino-Japanese forms tolerate /p/ only in a geminated or at least partially geminated form. The *P-constraint governs neither mimetics nor foreign items. [Author's note: examples are omitted.]

Second, independent evidence also exits for coronal place being unmarked. In the Sino-Japanese assimilation/gemination process, voiceless coronal *t*'s are the target of assimilation/gemination, which suggests that the coronals are unmarked for place in obstruents in this language (Itô & Mester 1996, McCawley 1968; Kurisu 2000 for summary). In contrast, the dorsal *k*'s are the target in the same process only when the next consonant is identical, i.e., *k*. Representationally, this suggests that *k* is more marked than *t*.

6. Conclusions

In this paper, we observed a place of articulation asymmetry in the patterns of voiced obstruent geminates in loanwords in Japanese. Specifically, the special behaviour of labials was recognized — they resist gemination to a greater degree than do the other places of articulation. I argued that the structure of place of articulation, and not the aerodynamics of voicing or textual frequency, accounts for this place asymmetry. This structural markedness, which is independently motivated by other processes, accounts for the marked pattern of labials in loanword geminations in Japanese.

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