Place asymmetry and markedness of labials in Japanese

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The voiceless labial stop has been recognized to be a marked segment in Japanese phonology. For instance, singleton [p] does not occur in Yamato items, and it exhibits a restricted distribution in the Sino-Japanese items. However, less attention has been paid to the place asymmetry in loanwords. In this paper, I explore loanwords and show that special characteristics of labials are indeed found there, too. I furthermore attempt to capture and formalize this property of labials, as compared to the other places of articulation, in the Japanese system as a whole.

0. Introduction

Markedness of the voiceless labial stop has long been recognized to be a feature in the Yamato and Sino-Japanese vocabularies in Japanese. In these lexical strata, singleton [p] is prohibited (McCawley 1968). In Itô and Mester 1995, this absence is expressed as a constraint against single [p], *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…” (page 819). The last sentence suggests that singleton [p] occurs freely in mimetics and recent borrowings. Is singleton /p/ unmarked in these vocabularies?

Nasu 1999 looks at mimetic vocabulary and argues that [p] is marked there: singleton [p] does not occur freely and the environment in which it occurs is restricted in mimetics, too.¹ This leaves us with a question about the markedness of [p] in loanwords. Is it totally

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¹ An earlier version of this paper was my Generals Paper, defended in November 2004. In this paper, I will be posing many questions that have been raised throughout my work on the Generals Paper. I would like to thank Professor B. Elan Dresher and Professor Keren Rice for guiding me through each stage of my Generals Paper. I am also grateful to Professor Peter Avery for posing insightful questions in the defense.

¹ I summarize his argument here. In mimetics, there are a number of stem pairs which differ in terms of voicing of obstruents, as in pata- vs. bata-, saku- vs. zaku-. Following Mester and Itô 1989 and Hamano 1998, Nasu 1999 argues that in those C₁V₁C₂V₂ stems, the voiced obstruent in C₁ (e.g., bata-) is the result of voicing from a voiceless C₁ (e.g., pata-). The voicing is semantic in nature more than anything else; both voiceless and voiced forms exist at the surface, e.g., patapata and batabata, but the forms with voiced obstruents are analyzed to be derived from the forms with voiceless counterparts in the same position with the result of bringing with the voiced forms “a negative connotation (‘bulky, violent, inelegant’)” (Mester and Itô 1989:284, citing Hamano’s 1996 work). Mester and Itô 1989 analyze this process to involve an autosegmental voicing morpheme docking on a certain segment. There are two properties of this voicing that are of interest here. One
unrestricted in these items? This paper addresses this question. I will show that [p], and also
the voiced labial b, indeed have a marked pattern in loanwords compared to the other places
of articulation. For the analysis, I tie this fact to the representational complexity of labial
segments relative to the other places.

The paper is organized as follows. In section 1, I set up the theoretical framework in
which I work. In section 2, I review the markedness of the voiceless labial found in the non-
loanword vocabulary and formalize it. In section 3, I look at loanwords intensively. I take up
geminates to show that labials, both voiced and voiceless, are marked. I propose that this
marked pattern is found because labials have more complex structure in their representation
than the other places. Section 4 discusses some issues raised by the representations I
propose. Section 5 concludes the paper with a brief summary.

1. Theoretical assumptions

This section describes the theoretical framework in which I work (http://www.chass.utoronto.ca/~contrast/; e.g., Avery and Rice 1989, Dresher 2001, 2003,
Dresher and van der Hulst 1993, 1998, Dresher and Rice 1993, Dresher, Piggott and Rice
1994, Rice and Avery 1993, 2004). I assume privativity of features and feature geometry
(Clements and Hume 1995). I also assume contrastive specification; features are
underlingly minimally specified as much as the contrasts in a particular system are
sufficiently made. An unspecified feature is inert in phonological processes. Feature
specifications are language-specific: underlying representations are analyzed as the
phonological processes of the particular language suggest (more to come about this below, in
the last part of this section).

Features are not just specified in a random order but are organized hierarchically, and
contribute to the relative complexity of representations of the segments. If a segment is

is that it occurs in the leftmost obstruent of the stem, C. The other is that it occurs once per stem. Nasu found
that, in the appendix of Hamano 1998, 69.8 percent of 159 items whose C1V1C2V2 stems contain a voiced
obstruent show these two properties, while the rest do not. He asks why some words do not have these
characteristics.

First, he looks at forms which do not satisfy the alignment condition, that is, forms with the voiced
obstruent in C2 rather than the expected C1. He notices that these contain two groups. One group includes
stems whose C1 is sonorant (e.g., mozi-). In these cases, he argues, since a sonorant is already voiced, voicing
cannot occur there and has to shift to C2 (page 54). The other group includes forms whose C3 is claimed to be
underlying voiced because they originate in a native Yamato word (e.g., toge- ‘thorn’, nobi- ‘stretching’): in
Yamato morphemes, there is a constraint on the distribution of voiced obstruents that they do not occur
morpheme-initially (page 55). (This does not hold for bound morphemes like particles. Furthermore, there are
words with morpheme-initial voiced obstruents which have historically lost their word-initial vowel and the
following voiced obstruent stands in word-initial position; consequently, e.g., ide-ru, idas-u > de-ru, das-u ‘go
out’, ‘put out’ (Ito and Mester 2003:33). Also, in a written corpus gathering words from magazines published in
1956 (Kokurita Kokugo Kenkyujo 1997), we find words tagged as Yamato that begin with either b, d, g or z,
e.g., bane ‘spring’, dashi ‘broth’, gara ‘patterns’, zaru ‘sift’.)

Second, he looks at stems that do not satisfy the condition that voicing is allowed no more than once per
stem. In other words, both C1 and C2 are voiced obstruents in these stems. Among these, three have non-[b] in
C2, and they are analyzed as having a voiced obstruent underlyingly because, again, they originate in a Yamato
vocabulary item (e.g., kiza- (NB: the word ‘kiza’ is obsolete)→ gizagiza). They are analyzed to have C1 voiced
through voicing. The rest, seventeen stems, all have [b] in C2. Nasu argues that in these morphemes, neither C1
nor C2 is a voiced obstruent underlyingly, and that the surface [b] in C2 is rather derived from underlying /p/
through voicing (e.g. tapo→ dabodabo). This voicing, Nasu claims, occurs to avoid deriving a surface
singleton [p]. Thus, in mimetics, singleton [p] does not occur totally freely; rather, its occurrence is partially
restricted. Therefore, Nasu concludes that singleton [p] is marked in mimetics, like in Yamato items.
found to be more marked than the other(s) in a phonological process, this markedness is encoded in the geometry in such a way that the more marked segment has more structure. Having more structure is to be more complex representationally/structurally than other segments in the same dimension, for example, for a place node. Formally expressed, a node has complexity if it branches whereas other nodes of the same type do not branch (1a). Or, a node is more complex relative to other nodes if it has an intermediate dependent when others do not (1b) (Dresher and van der Hulst 1993:2). The unmarked segment has the simplest structure.

(1) Complexity; \( i \) is more complex than \( ii \)

\[
\begin{align*}
\text{a)} & \text{ Branching (i) vs. non-branching (ii) } \\
\text{b)} & \text{ Having the dependent (i) vs. not having it (ii) }
\end{align*}
\]

\[
\begin{array}{c|c}
\text{i.} & \text{A} \\
\text{B} \\
\text{C} \\
\end{array}
\begin{array}{c|c}
\text{i.} & \text{A} \\
\text{A} \\
\text{B} \\
\end{array}
\]

There is a notion of dependencies between features in addition to the assumptions of contrastive specification as described thus far. This comes from the geometry: a non-contrastive feature must be specified if a contrastive feature that depends on it is specified. Consider the illustration in (1), where A and B are features. Suppose that feature A is not contrastive for the two representations (1a) and (1b), and the contrastive feature here is B. However, feature B is a dependent of feature A, thus feature A must be specified if the contrastive feature B is specified. This notion is termed Node Activation Condition in Avery and Rice 1989:

(2) Node Activation Condition (Avery and Rice 1989: 183)

If a secondary content node is the sole distinguishing feature between two segments, then the primary feature is activated for the segments distinguished. Active nodes must be present in underlying representation.

The theory that I work in incorporates contrasts in the hierarchical structure of the feature geometry in that contrast drives the amount of structure that is present in a representation (Modified Contrasrative Specification in, e.g., Dresher, Piggott and Rice 1994). For example, if a language has only one place for, say, an obstruent series, then an obstruent has the minimum representation for place as in (3a). If a language has two places, the introduction of contrast for place creates representations as in (3b). In the illustration of (3b), the unmarked segment is assumed to be coronal and the marked one is non-coronal, namely Peripheral (more about features for place will follow below), which should be suggested by a phonological process (i.e., coronal segments should be inert in a diagnostic process in this language). Since the Peripheral node is a dependent of the Place node, the node Place is activated and is specified in the segments in their underlying representations.
(3) Representations in Modified Contrastive Specification

a. One-way contrast

\[ \text{X} \]

b. Two-way contrast

\[ \begin{array}{c}
\text{X} \\
\text{Place} \\
\text{Peripheral}
\end{array} \quad \begin{array}{c}
\text{X} \\
\text{Place} \\
\text{Peripheral}
\end{array} \]


(4) Geometry for Place for consonant—a three-way contrast system (from Avery and Rice 1989)

```
Place
   Peripheral
     Dorsal
        Labial
      Coronal
```

Here, the three places are not organized symmetrically, but the geometry has the node Coronal as the sister of non-coronal, namely Peripheral, a constituent that dominates Dorsal and Labial as its dependents. Rice 1994 argues for the class of Peripheral to give a proper account for (i) patterns in which labials and dorsals form a class to the exclusion of coronals, and also (ii) the asymmetry between labials and dorsals found in languages.

In earlier work like Rice and Avery 1993, Coronal and Labial are proposed to be unmarked for the Place node and Peripheral node, respectively, unless there is a contrast under that node; for example, more contrast within Coronal, where Coronal must be specified in the segments (Node Activation Condition). In other words, the node Coronal is argued to be underlyingly absent in general (i.e., for Place node), and so is the feature Labial for Peripheral node. A system with a three-way contrast at labial, coronal and dorsal places thus has the representations in (5).

(5) The representation for Place for the system of a three-way contrast at labial, coronal and dorsal (Rice 1994:192)

```
Coronal
Place

Labial
Place

Dorsal
Place

Peripheral
Peripheral

Dorsal
```

In their recent work, Rice and Avery 2004 keep the hierarchical relationship between Coronal and Peripheral places, but let the unmarked value between daughter dependents be chosen on a language-specific basis, allowing for variability between languages. Indeed, in this paper, I propose that Labial, not Dorsal, be specified underlyingly in Japanese.

Lastly, a word needs to be said about redundant features. Consider how the theory described so far, Modified Contrastive Specification (MCS), sees redundant features. In
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MCS, underlying representations involve specifications such that the contrasts are sufficiently—not overly—made with no redundancy. An algorithm for determining the contrastive specifications for an inventory is the Successive Division Algorithm (SDA, Dresher 2003 and references therein).

(6) Successive Division Algorithm (Dresher 2003:56)

a. In the initial state, all tokens in inventory I are assumed to be variants of a single member. Set I = S, the set of all members.
   b. i) If S is found to have more than one member, proceed to (c).
      ii) Otherwise, stop. If a member, M, has not been designated contrastive with respect to a feature, G, then G is redundant for M.
   c. Select a new n-ary feature, F, from the set of distinctive features. F splits members of the input set, S, into n sets, F₁ – Fₙ, depending on what value of F is true of each member of S.
   d. i) If all but one of F₁ – Fₙ is empty, then loop
      ii) Otherwise, F is contrastive for all members of S. Back to (c).
   e. For each set Fᵢ, loop back to (b), replacing S by Fᵢ.

The SDA incorporates the phonology of the specific language in the underlying specifications; the natural classes evidenced in the phonological processes in that language determine what features are present in the underlying representations. Thus, the order of division, or the scope that one feature takes over another depends on the specific language and also may differ from one language to another. The algorithm ensures that the representations are minimal and do not contain redundancy.

The view of Clements 2001 can be compared to the one expressed above with regard to redundant features. Clements 2001 develops an algorithm that determines lexical representations. This algorithm also gives contrastive specifications for the inventory, but it is different from the SDA in that the feature ranking there is set universally; given a certain inventory, the fixed universal hierarchy will guide what feature(s) are present in the lexical representations for the members of the inventory. Furthermore, in this theory, there is a separate level after the lexical specifications are determined by the algorithm. After the lexical representations, phonological patterns (phonotactic patterns and alternations) may refer to redundant features or feature values. It is then proposed that whenever those redundant features are required for the statement of the phonological patterns, they may be inserted, or ‘activated’ in Clements’ 2001 terms. I do not follow the algorithm developed in Clements 2001, but the concept that a redundant feature may be called for upon the requirement by phonology will be important later in this paper (§3.2).

2. Contrast and markedness of labials—outside loanwords

This section reviews the markedness of labials in the native grammar. Singleton [p] is prohibited there at the surface. But the prohibition of singleton [p] is a phonetic matter and a voiceless labial stop exists phonologically as the voiceless counterpart of the voiced labial /b/. I illustrate this by looking at alternations. They suggest that there is an underlying voiceless counterpart of voiced labial obstruent /b/ in modern standard (Tokyo) Japanese. Of course this is not a new discovery and linguists have described the alternations (e.g., Martin 1952) and have analyzed the native vocabulary of Japanese along these lines. For example, McCawley 1968 gives an underlying /p/ for the inventories of the Yamato, Sino-Japanese, Onomatopoeia and Foreign strata. I will take up those alternations from the literature (§2.1)
and formalize the markedness of the voiceless labial obstruent of Japanese (§2.2). I also examine the relative complexity between places in assimilation/gemination processes in Sino-Japanese compounds (§2.3).

2.1 Singleton [p]

Japanese has a voicing distinction in obstruents, as Ito and Mester (2003:32ff) and many others show. Words in (7) show contrastive voicing in native morphemes, both word-initially (7a) and word-medially (7b).

(7) Contrastive obstruent voicing in native morphemes (examples are all from Ito and Mester 2003:32, 33)

a. CV forms

<table>
<thead>
<tr>
<th>Voiceless</th>
<th>Voiced</th>
</tr>
</thead>
<tbody>
<tr>
<td>ha ‘tooth’</td>
<td>-ba Conditional marker</td>
</tr>
<tr>
<td>ta ‘rice field’</td>
<td>-da copula marker</td>
</tr>
<tr>
<td>-ka Question marker</td>
<td>-ga Nominative marker</td>
</tr>
<tr>
<td>su ‘vinegar’</td>
<td>-zu Negation marker</td>
</tr>
</tbody>
</table>

b. VCV forms

<table>
<thead>
<tr>
<th>Voiceless</th>
<th>Voiced</th>
</tr>
</thead>
<tbody>
<tr>
<td>oto-(ru) ‘be inferior’</td>
<td>odo-(ru) ‘to dance’</td>
</tr>
<tr>
<td>aka ‘red’</td>
<td>age ‘fried tofu’</td>
</tr>
<tr>
<td>asa ‘morning’</td>
<td>aza ‘bruise’</td>
</tr>
</tbody>
</table>

Now, consider the following alternations in the morphophonological process of Rendaku. This is a process by which the initial consonant of the second member of certain compounds becomes voiced (Ito and Mester 1986, 2003, Lyman 1894, Martin 1952, McCawley 1968; see Vance 1989:133 for summary). Some examples are given in (8), with examples of reduplication in (8b). We see $h$ becomes [b], $t$ becomes [d], $k$ becomes [g] and $s$ becomes [z].

(8) Rendaku (examples are all from Ito and Mester (2003:Appendix))

a. warai + hanasi → waraihanasi ‘laugh-story, funny story’
   kaza-mi + tori → kazamitori ‘wind-see-bird, weather vane bird’
   uzi + kami → uzigami ‘family-god, guardian god’
   ume + su → umezu ‘plum vinegar’

b. hito → hitohito ‘man-man, people’
   toki → tokidoki ‘time-time, sometimes’
   kami → kamigami ‘god-god, gods’
   suki → sukiguki ‘like-like, likes and dislikes, matter of taste’

The resultant segments of $h$, $t$, $k$ and $s$ that underwent Rendaku, $b$, $d$, $g$ and $z$, are structure-preserving and are members of the inventory, as we saw in (7). Indeed, their surface values are the same as those from underlying $b$, $d$, $g$ and $z$. It would follow from this that the underlying voiced counterparts of $h$, $t$, $k$ and $s$ are $b$, $d$, $g$ and $z$, respectively. I give the

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2 There are restrictions on Rendaku. For example, syntactic structure of the compounds has to be properly met in order to undergo the process. See Ito and Mester (2003) and Sato (1989) for overview of these conditions.
inventory of obstruents in the native grammar in (9). I call the phonemic entity that is the counterpart of /b/ /P/.

(9) Inventory of native obstruents—phonemic (cf. McCawley 1968)

\[
\begin{array}{cccc}
  P & t & k \\
  s & b & d & g \\
  z & \\
\end{array}
\]

Of particular interest here is the phonetics of /P/. This is a fricative as a singleton. Compare this with its voiced counterpart, which is pronounced as a bilabial stop [b]. In other words, singleton [p] is non-existent here. The surface values of the (modern standard Tokyo) Japanese obstruents are given in (10).

(10) Phonetics of obstruents in word-initial position (non-Rendaku environment) (NB: Affricates are not included. Optional phones are not included.)

\[
\begin{array}{cccc}
  h & : & [ç] / _i, & [ϕ] / _u, & [h] / elsewhere, i.e., before vowels a, e, o \\
  b & : & [b] & \\
  d & : & [(d)z] / _i, & [(d)z] / _u, & [d] / elsewhere \\
  k & : & [k] & \\
  g & : & [g] & \\
  s & : & [s] / _i, & [s] / elsewhere \\
  z & : & [(d)z] / _i, & [(d)z] / elsewhere \\
\end{array}
\]

However, when we look at gemination processes, geminated /P/ is pronounced as a long voiceless bilabial stop, [pp]. I give a number of such processes in native grammar, where we find the alternation \(h \sim pp\). These morphophonological alternations occur in certain affixations and word-formations.

The first example of derived geminates comes from intensive affixation (Kuroda 1979, McCawley 1968, Martin 1952; see Vance 1987:44-47 for a summary). Intensive affixation is a process whereby a kind of intensifier affix attaches to the stem. There are two such affixes. One is a prefix and the other is an infix. I treat the prefix first. When prefixes such as \(ma\)- and \(su\)- attach to a stem beginning with a voiceless obstruent, gemination occurs with the surface mora obstruent, hence alternations \(h \sim pp\), \(t \sim tt\), \(k \sim kk\), \(s \sim ss\) (11a). Notice that the geminated /P/ is a bilabial stop [pp] and not fricative [hh]. Outside voiceless obstruents, Martin 1952 only finds examples with nasals (11b). N indicates a nasal whose place assimilates to the place of the following segment if it is a non-glide consonant.

(11) Prefixation \(ma\)-, \(su\)-

a. \(ma\) + hadaka ‘naked’ \(>\) mappadaka ‘stark naked’ (Martin 1952:71)
   \(ma\) + hiruma ‘day’ \(>\) mappiruma ‘broad daylight’ (Martin 1952:71)
   \(ma\) + huta ‘two’ (< NUMERAL huta- + COUNTER –tu) \(>\) mapputatu ‘pair’ (Martin 1952:71)\(^3\)

\(^3\) Martin gives ‘pair’ for the meaning of this word, mapputatu. An example usage may help to understand the sense of the word:

\[\text{mapputatu-ni kir-u} \]
\[\text{pair-in cut} \]
The other intensive affixation is with an infix, called impressionistic adverbs by Martin (1952:68ff) and intensified adverbs by Kuroda (1979: 205-206). The stems are said to belong to the mimetic vocabulary of Japanese. The surface forms of these adverbs are four-syllable words with –ri at the end, schematically shown as $(C_1)V_1C_0C_2V_2$-ri, with $C_0$ being the moraic consonant. The moraic consonant is an obstruent before a voiceless segment (12a) and a nasal before all other non-vowels (12b).

(12) Intensified adverbs

a.  su$p$pori ‘(cover one’s head) completely’ (Kuroda 1979:205)
   yuttari ‘easy; comfortable, comfortably’(Kuroda 1979:205)
   battari ‘with a bang; suddenly’ (Martin 1952:69)
   hakkiri ‘clearly, exactly’ (Martin 1952:69)
   hakkiri ‘just, sharp’ (Kuroda 1979:205)
   nikkori ‘smiling’ (Martin 1952:69)
   bassari ‘drastically’ (Kuroda 1979:205)
   hossori ‘slender, delicate’ (Martin 1952:69)

b.  no$N$biri ‘relieved, at ease; postponed’ (Martin 1952:68)
   sjo$N$biri ‘dejected, sad’ (Kuroda 1979:205, Martin 1952:68)
   ko$N$gari ‘(toast) brown’ (Kuroda 1979:205)
   ma$N$ziri ‘(with) a wink (of sleep)’ (Kuroda 1979:205, Martin 1952:68)
   si$N$miri ‘softly; intimately’ (Kuroda 1979:205, Martin 1952:68)
   ge$N$wari ‘quite unnerved, disappointed’ (Kuroda 1979: 205)
   ho$N$wori ‘slightly, faintly’ (Martin 1952:68)
   ya$N$wari ‘gently, softly’ (Kuroda 1979:205, Martin 1952:68)
   bo$N$yari ‘dimly, vaguely, absent-minded’ (Kuroda 1979:205)

MaCawley 1968 provides the derivation in (13). His example for illustrating the derivation is no$N$biri, but I add two more words to show the cases for stems whose last consonant is a voiceless obstruent: nikkori (stem niko), and a sonorant, bo$N$yari (stem boya). The infix consists of a feature bundle of obstruent consonant. It is affixed to the stem, and regressive assimilation occurs. After this, nasalization occurs in which the infix is nasalized if the following consonant in the stem is voiced, that is, is a sonorant or voiced obstruent.4

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4‘to cut (something) right in two’

4The analyses by Kuroda (1979:212) and Vance (1987:46) also involve two rules, nasalization and regressive assimilation. However, the order may not be the same. Vance puts nasalization first, then assimilation next. Kuroda gives both derivations, saying either order would be equally economical. Since examining the rule orders is in not the scope of this paper, I will not pursue the question further.
(13) Intensified infixation

<table>
<thead>
<tr>
<th>Underlying Representation</th>
<th>niko + C + ri</th>
<th>nobi + C + ri</th>
<th>boya + C + ri</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infliction</td>
<td>ni C ko ri</td>
<td>no C bi ri</td>
<td>bo C ya ri</td>
</tr>
<tr>
<td>Assimilation</td>
<td>ni k ko ri</td>
<td>no b bi ri</td>
<td>bo y ya ri</td>
</tr>
</tbody>
</table>

Nasalization:

<table>
<thead>
<tr>
<th>C → nasal / __ C[voice]</th>
<th>no N bi ri</th>
<th>bo N ya ri</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface form</td>
<td>nikkori</td>
<td>noNbiri</td>
</tr>
</tbody>
</table>

Before introducing more gemination sites, let me summarize the patterns here. The underlying voiceless obstruents have the surface mora obstruents in geminates, \( h \sim pp \), \( t \sim tt \), \( k \sim kk \), \( s \sim ss \), and the underlying voiced obstruents have the surface mora nasal, \( b \sim Nb \), \( d \sim Nd \), \( g \sim Ng \), \( z \sim Nz \).\(^5\)

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

If the following segment is:

- Voiceless obstruent \( \rightarrow \) the voiceless mora obstruent (voiceless geminate)
- Voiced obstruent \( \rightarrow \) the mora nasal (NB: f.n.5)

(15) introduces another gemination process, verb+verb compounds in Yamato vocabularies (Itô and Mester 1996, Martin 1952). Here, once more, the singleton \( P \) (\( h \)) geminates to surface \[ pp \].

(15) Gemination in native verbal root compounding (Examples are all from Itô and Mester 1996:24; italics are mine.)

- but ‘strike’ + hanas-u ‘let go’ \( \rightarrow \) buppanasu ‘fire (a bullet)’
- hik ‘pull’ + har-u ‘tighten’ \( \rightarrow \) hipparu ‘pull, jerk’
- but + toos-u ‘pass’ \( \rightarrow \) buttoosu ‘continue non-stop’
- but + koros-u ‘kill’ \( \rightarrow \) bukkorosu ‘kill violently’
- hik + kak-u ‘scratch’ \( \rightarrow \) hikkaku ‘scratch violently’
- hik + sak-u ‘tear’ \( \rightarrow \) hissaku ‘tear apart forcefully’
- but + nagur-u ‘beat’ \( \rightarrow \) buNnageru ‘beat forcefully’\(^6\)
- hik + muk-u ‘peal’ \( \rightarrow \) hiNmuku ‘peal off violently’\(^7\)

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\(^5\) In the contemporary standard Tokyo accent, voiced geminates are possible as the result of intensification. There, for the intensification and emphasis, we do observe surface voiced geminates (Vance 1987:42-43, Kawahara, personal communication) as variants of the prenasalized geminates:

- a) Surface voiced geminates in emphatic expressions are possible
  - kudaranai (Adj.) ‘trivial’ \( \rightarrow \) kuddaranai (Vance 1987:42) \( \sim kuNdaranai \)
  - sugoi (Adj.) ‘wonderful, great’ \( \rightarrow \) suggoi (Vance 1987:42) \( \sim suNgooi \)
  - sugoku (Adv.) ‘very’ \( \rightarrow \) sugogoku (Takebayashi 1996:143, f.n.29) \( \sim suNgoku \)
  - subarasi (Adj.) ‘wonderful, splendid, gorgeous’ \( \rightarrow \) subharasii \( \sim suNharasii \)

This suggests that for some speakers of this dialect, although there is no underlying length contrast in voiced obstruents, voiced geminates are licensed in the derived environments.

\(^6\) I replaced \( n \) with \( N \).

\(^7\) I replaced \( m \) with \( N \).
The next example of derived geminates comes from another type of verb morphology. When a verb whose stem ends in a consonant is followed by a suffix that begins with a consonant such as the past-tense suffix –ta/da and gerundive –te/de, gemination occurs. I give examples with the past suffix –ta/da in (16). Here, we find the expected pattern only partially, in stem-final t and b. t appears as geminate and b with pre-nasalization. P and d do not occur in the stem-final position for verbs in modern standard Tokyo Japanese.\[8\] As for k, g and s, there involve insertion of the vowel i and deletion of the underlying /k, g/.

\[
(16) \quad \text{stem} + \quad \text{-ta/da PAST} \\
yob ‘call’ \rightarrow yoNda \\
kat ‘win’ \rightarrow katta \\
kak ‘write’ \rightarrow kaita \\
kag ‘sniff’ \rightarrow kaida \\
kas ‘lend’ \rightarrow kasita
\]

Lastly, I would like to introduce another place where Japanese has a voiceless bilabial [p]. (17) illustrates that /P/ is the voiceless bilabial stop [p] after the mora nasal in the “innermost constituent” of Sino-Japanese compounds (17a.iii, b.ii) but a fricative h otherwise (17a.i, a.ii, b.i) (McCawley 1968:77-78).

\[
(17) \quad \text{Sino-Japanese compounds} \\
a. \quad \text{hitu} \sim [p]itu \\
   i. \quad \text{hitu dan} \quad \text{‘pen conversing; conversation by writing’} \\
   ii. \quad [(maN neN] \text{hitu} \quad ‘[ten thousand years] pen’; fountain pen’ (McCawley 1968:78) \\
   iii. \quad eN [p]itu \quad \text{‘lead pen; pencil’}
\]

b. \quad \text{huku} \sim [p]uku \\
   i. \quad \text{huku siki} \quad \text{‘stomach style; abdominal’} \\
   ii. \quad maN [p]uku \quad \text{‘full stomach’}

In sum, in the native gemination processes, Japanese shows voiceless geminates for voiceless obstruents and prenasalization for consonantal voiced segments (but c.f. f.n. 5). In the voiceless series, the phoneme /P/ is phonetically a fricative h in singletons but a bilabial stop [p] in geminates. In other words, the segment P has the positional allophones: a fricative h when it is singly-linked to the skeletal slot (18a), and voiceless labial stop [p] when it is doubly-linked to the slot (18b).

---

\[8\] McCawley 1968 has verbs with stem-final /p/, e.g., warap ‘laugh’ (page 94). However, this exemplifies a case of postulating a very abstract underlying form that lacks evidence from alternations. At the surface, the stem-final consonant either does not appear, e.g., wara-eba (provisional form), or appears as the glide w, e.g., waraw-azu (Negative), waraw-arer-u (Passive). (/w/ is an independent phoneme in Japanese as we can see at the beginning of the stem, and McCawley has /w/ in the inventory). In other words, the stem-final /p/ in McCawley never appears as [p] or [h] or [pp]. For McCawley, postulating stem-final /p/ for verbs was possible because he assumes a glottal stop phoneme /ʔ/ and has rules that derive a surface /ʔ/ from underlying stem-final /p/; a rule turns the /p/ to h and this feeds another rule that yields the derived h to ? See Kiparsky 1982 for discussion about the problem of positing an underlying segment in the absence of surface allomorphs.
(18) \( h (\{c, \phi, h\}) \) and \( [pp] \) as positional allophones in alternations
   a. \( h \) in a singly-linked position
   \[
   \begin{array}{c}
   X \downarrow \\
   h
   \end{array}
   \]
   b. \([p]\) in a doubly-linked position
   \[
   \begin{array}{c}
   X \downarrow \\
   h \\
   \end{array}
   \]

A doubly-linked position is also found after the mora nasal within a certain constituent in Sino-Japanese compounds (17) (i.e., “innermost layer of the compounding” in McCawley 1968:77-78; root-root compounds in Ito and Mester 2003). Since the mora nasal assimilates to the following consonant for place, this is a situation of partial linking at the place node. Thus, we can say that \([p]\) occurs when it is doubly-linked, whether partially at the place node or fully at the root node. How can we formalize this property of \(/P/\)? This is the question that I take up in the next section.

2.2 Representations of \(/P/\) and other obstruents—native inventory

   I propose that \(/P/\) has the feature Labial underlingly as the dependent of the node Peripheral (see section 2 for the features) and this feature delinks in the singly-linked position (19a), while, in the doubly-linked position, it is retained (19b).

(19) Labial in different positions
   a. Singly linked—Labial delinks
   \[
   \begin{array}{c}
   X \downarrow \\
   P[c, \phi, h] \\
   \end{array}
   \]
   b. Doubly linked—Labial stays
   \[
   \begin{array}{c}
   X \downarrow \\
   P[c, \phi, h] \\
   \end{array}
   \]

If, on the other hand, \(/P/\) does not have a labial feature underlingly, then \(P\) would get the labial feature inserted in the doubly-linked position. The problem with this hypothesis is: from where does the labiality come/spread only when it is doubly-linked? The answer would be from nowhere, unless it is the default value for this language. In fact, if we consider the representations for all obstruents and take into consideration the contrastive specification as defined in MCS and the Successive Division Algorithm (§2), the theory can lead to the conclusion that \(/P/\) does not have Labial, because this feature in \(/P/\) creates redundancy in the inventory, as I explain in a moment. However, if \(/P/\) does not have the feature Labial underlingly, it requires a derivation for Rendaku that is complicated and non-structure-preserving, as I will also explain shortly. Based on these considerations, I would take a part of the theory proposed by Clements 2001 and propose to allow redundancy in the inventory by positing the feature Labial in \(/P/\).

In order to understand the feature redundancy in a system, we need to consider the underlying representations of the obstruents in the native inventory \(/P, t, k, s, b, d, g, z/\). First, I look at the manner node. Consider the inventory for voiced obstruents \(b, d, g, z\). There is a stop versus fricative contrast only for coronals there. In other words, there is no contrast at the labial and dorsal places with respect to manner. It follows that either \(d\) or \(z\) is
marked with a feature for the manner node, and that $b$ and $g$ are unspecified for this node. I propose that there is a feature Stop specified on $d$ and the fricative $z$ is unspecified.

Phonetic implementation for the voiced stops $b$, $d$ and $g$ supports this analysis, as opposed to an analysis of the fricative $z$ having a marked feature and $d$ being unspecified. Kawakami (1977:32, 37) observes that Japanese $b$ and $g$ are spirantized to $[\beta]$ and $[\gamma]$, respectively, in non-word-initial positions. In my observation, they are rather approximants $[\beta, \gamma]$ than fricatives, but, in any case, the point is that $b$ and $g$ lenite intervocically. However, Kawakami does not mention such a lenition for the coronal $d$. If this means that the coronal $d$ does not lenite, this asymmetry between $d$ and $b, g$ can be derived as the phonetic implementation of the representation of these segments: coronal $d$ has the feature Stop under the manner node, so would not lenite, while $b$ and $g$ do not have it, which allows lenition for them.\(^9\)

What about the representations for the manner dimension for the voiceless series? The inventory again suggests that there is a contrast only among coronals, between $t$ and $s$. I do not have native phonological evidence to tell what feature (i.e., Stop or Continuant) is specified on which segment. I assume the same values as for the voiced counterparts. Carrying the values from the voiced series, then, voiceless coronal $t$ has the feature Stop and $s$ is underspecified for manner (20). The Manner feature is specified in all segments because its dependent feature Stop is specified (Node Activation Condition).

(20) Representations for manner

\[
\begin{array}{c|c|c|c|c}
P, b & t, d & k, g & s, z \\ \hline
\text{Man} & \text{Man} & \text{Man} & \text{Man} \\
\text{Stop} & & & \\
\end{array}
\]

Second, I look at the place node. The specifications for $b, d$ and $g$ given in (21) are based on loanwords, discussed in section 4.1. Labial $b$ has the most complex place structure, $d$ is unmarked for this node, and $g$ has only Peripheral. $z$ is a coronal sound, thus the representation of $d$ applies here. These representations for place for the voiced series are carried over to the voiceless series, $P, t, k$ and $s$, because they are voiceless counterparts of $b, d, g$ and $z$, respectively. Note in passing that we will find independent evidence for these place representations when we look at the gemination/assimilation process in Sino-Japanese compounds in section 2.3.

\(^9\) Kawahara 2004b reports a high rate of spirantization for dorsal singletons in his acoustic study (three females in their twenties participated in his experiment), but he does not make a parallel comment for labials and coronals. He (personal communication 2004) finds that one of his subjects had spirantization for coronals. However, I am not certain if this comment was on the voiced $d$, although it certainly includes voiceless [t] there. In Kawahara 2004b, the acoustic measurements for the closure of stops was to look at the contrast between singletons and geminates, so, the spirantization was not the main point of his discussion (it was mentioned to report that the spirantization rate was so high for dorsals that they had to be excluded from the analysis). The place asymmetry in lenition processes definitely deserves further study.
I now turn to the representations of the laryngeal node. There is an OCP effect for Voice in the Yamato items, where lexical forms respect OCP for Voice and a stem does not contain more than one voiced obstruent (Itô and Mester 1995, 2003):

(22) OCP on Voice in Yamato items

*[^C… C…]stem

where C is obstructed

Voice Voice

This OCP restriction is respected in the phonological process of Rendaku, which mainly governs the Yamato vocabulary. Recall that Rendaku is a process by which the initial consonant of the second member of certain compounds becomes voiced (8). According to Itô and Mester (1986, 2003), Rendaku is triggered by the insertion of a compound morpheme which consists of the feature Voice. However, Rendaku is blocked if the second member of a compound contains a voiced obstruent, as illustrated in (23). This is known as Lyman’s Law (Itô and Mester 1986, 1995).

(23) Rendaku, blocked by Lyman’s Law

onna + kotoba \rightarrow onnakotoba *onnagotoba

Thus, the blocking can be analyzed as an avoidance of creating the structure as the result of the affixation of a stem having two Voice features within a stem as in (22). This OCP violation triggers the Lyman’s Law effect. Since Rendaku is a lexical process (i.e., it is structure-preserving) what the blocking effect suggests about the underlying representations of the voiced obstruents is that they have a feature Voice, possibly under the Laryngeal node, as opposed to voiceless obstruents, which are unmarked (see also Avery and Idsardi (2001, 2002)).

It is interesting that Lyman (1894) originally includes the segment p in the list of segments that block Rendaku, although this has yet to be confirmed by careful examination of Rendaku data. (NB: Lyman does not give examples of p blocking Rendaku; he lists one word amagappa (< ame + kappa) as the only exception to this generalization.) If this is true, then the segment P behaves like voiced obstruents in that it blocks Rendaku. Representationally, this suggests that P has a feature under the Laryngeal node that voiced obstruents have but the other voiceless obstruents do not have. In other words, P, b, d, g and z all have the same feature, which I call Glottal. I propose that Glottal is a node that has the feature Voice as its dependent. The domain for P to block Rendaku is the node Glottal (not Voice. The node Voice is the domain for the OCP on Yamato morpheme structure constraints and Rendaku blocking that involves voiced obstruents b, d, g, z):

---

10 Thanks to Peter Avery and Keren Rice for drawing my attention to this original article by Lyman.
(24) OCP on Glottal

\*\{C… C…\}stem

where \(C\) is obstruent

The feature Glottal is like Peripheral (or Coronal, depending on the language) for the Place node in that it is the marked feature for the node. It indicates a segment that has marking in the laryngeal dimension, as opposed to no marking, and thus plays a role in the processes. In this sense, the proposed Glottal specification is understood as a dimension as proposed in Avery and Idsardi 2001 for laryngeal structure. \textit{Dimensions}, in their terms, are what bear the primary contrastive burden in obstruents.

I give the representations that we have reached thus far in (25).

(25) Representations for obstruents

These representations explain the derivation of \textit{Rendaku}. In \textit{Rendaku}, as we saw earlier, the initial consonant of the second member of certain compounds becomes voiced: \(P\) becomes \([b]\), \(t\) becomes \([d]\), \(k\) becomes \([g]\) and \(s\) becomes \([z]\). Following Itô and Mester (1986, 2003), \textit{Rendaku} is triggered by the \textit{Rendaku} morpheme consisting of the feature Voice, and it docks onto the voiceless obstruent at the beginning of the non-initial morpheme of certain compounds. Let me show the derivation with \(P\) first. The \textit{Rendaku} morpheme attaches to the form and the feature Voice docks on to \(P\) (26a). The result is the structure that the segment \(b\)
has in (25). \( P \) that underwent *Rendaku* like this is pronounced [b], the same surface value as from underlying \( b \).

(26) *Rendaku*

a. \( h \sim b \)

\[
\begin{array}{c}
\text{Lar} \\
\text{Pl} \\
\text{Man} \\
\text{Gl} \\
\text{Per} \\
\text{Voice} \\
\text{Lab}
\end{array}
\]

b. \( t \sim d, s \sim z, k \sim g \)

\[
\begin{array}{c}
\text{Lar} \\
\text{Pl} \\
\text{Man} \\
\text{Gl} \\
\text{Stop} \\
\text{Voice}
\end{array}
\quad
\begin{array}{c}
\text{Lar} \\
\text{Pl} \\
\text{Man} \\
\text{Gl} \\
\text{Voice}
\end{array}
\quad
\begin{array}{c}
\text{Lar} \\
\text{Pl} \\
\text{Man} \\
\text{Gl} \\
\text{Per}
\end{array}
\]

For the other voiceless segments, the process can be shown in (26b). The feature *Voice* of the *Rendaku* morpheme attaches to the Laryngeal node of \( t \), \( s \) and \( k \). *Voice* is a dependent of Glottal. Therefore, attaching *Voice* will project the Glottal node. The structures thus derived are the same as from underlying /\( b, d, g, z \)/ in (25).

Now, I turn to the question of other possibilities of the representation for /\( P \)/, the question with which I opened up this section. This involves not positing the feature Labial for this phoneme. Consider the representations proposed in (25). These representations cannot be generated if we assume the theory of MCS as defined in section 2. Given the features I have proposed, no feature hierarchy with SDA can generate the representations as proposed in (25), because the proposed representations include redundancy; the segments are ‘over specified’ in (25) and are not minimally contrastive overall. If, for instance, the phoneme /\( P \)/ did not have the Labial feature, either having the Place node only or the Place and Peripheral nodes, while keeping all other features as proposed, the representations would not include redundancy any more. A representation without the feature labial on /\( P \)/ is thus a possibility, but when we consider the derivation for *Rendaku*, it might not be so straightforward. I illustrate this.

Let us assume that /\( P \)/ has Peripheral and Place as in (27a). If we keep the analysis that *Rendaku* involves adding the feature *Voice* (27b), /\( P \)/ merges into \( g \) (see (25) for the representation of \( g \)), which is not correct empirically; \( P \) must become \( b \) instead.\(^{11}\)

---

\(^{11}\) If we assume only a Place node for /\( P \)/, things do not go better. It would merge into \( z \) after the [voice] is added to it.
(27) Hypothetical \( P \) with Peripheral and Place, and *Rendaku* derivations

\[
\begin{array}{ccc}
\text{a. } & \text{b. } & \text{c. } \\
\text{Lar} & \text{Pl} & \text{Man} \\
\text{Gl} & \text{Per} & \text{Lab} \\
\text{Voice} & & \text{Lab}
\end{array}
\]

There can be a roundabout derivation. By the time *Rendaku* applies, the feature Labial is inserted onto \( P \) (27c). Then, *Rendaku* inserts Voice (27d). The problem with this analysis is twofold. One is that the insertion of Labial in this way does not seem to be well-motivated. At a later stage of derivation, items that do not undergo *Rendaku* have to get the labial to delink in order to be realized as \( h \).\(^{12}\) Thus, the feature Labial in those cases would show no trace in the surface forms; Labial is inserted at some point and delinked. This derivation would be fine logically, but we have no way to prove it. The other problem concerns the notion of structure-preservation (Kiparsky 1982; summary in Pulleyblank 1986:7). Being structure-preserving is one of the characteristics of a lexical process, and *Rendaku* is structure-preserving in the sense that it does not create a novel segment in the system. It follows that the operation of Labial insertion (27c) is also lexical as it precedes *Rendaku*. However, the structure (27c) is not structure-preserving in that it is novel to the system; there is no segment that has this structure in the inventory ((25) with the representation of /P/ replaced by (27a)). The feature Labial itself is not new since it is distinctively used somewhere else in the system, in the voiced labial \( b \). But, if we accept the notion of structure-preservation as involving feature combinations, then insertion of Labial as in (27c) violates the structure-preservation constraints.

After all, *Rendaku* involves alternations in the laryngeal dimension between segments which have the same place of articulation, at least in alternations other than \( P–b \): \( t–d, k–g, s–z \). Since the labial \( b \) is analyzed to have the feature Labial on independent grounds to be discussed in section 3, as soon as we discard Labial from /P/, we are left with different place structures for /P/ and /b/, which leads to the roundabout derivation and encounters the problem concerning structure-preservation as described above.

From these considerations, I propose that /P/ has Labial in underlying representation. This means that the proposed underlying representations in (25) include some redundancy. However, the features presented there in /P/ are not randomly chosen but have grounds in phonology; Labial is needed in order not to have a roundabout derivation for *Rendaku* and Glottal is also needed in *Rendaku* as it shows the ‘Lyman’s Law effect’ like voiced segments. Thus, motivated by this part of Japanese phonology, I follow a theory that redundancy is allowed as far as it is needed (Clements 2001). With specific regard to the representation of /P/, then, I propose (19), repeated here in (28). /P/ has Labial underlyingly as the dependent of Peripheral. It delinks in a singly-linked position (28a) and is retained in doubly-linked position (28b).\(^{13}\)

---

\(^{12}\) For the conditions on *Rendaku* application, see the notes in footnote 2.

\(^{13}\) Professor Keren Rice suggests to posit both /p/ and /h/, as opposed to only /P/, in the inventory as I do for loanword inventory in (47). In this way, the problems discussed above can be solved. First, the problem of delinking Labial at a later stage of derivation for some items disappears, since they need not be analyzed to have the same phoneme as those items that do show *Rendaku* voicing. Some apparent non-*Rendaku*-undergoers (e.g., *himo* ‘string’: ago ‘jaw’ + *himo* \( \rightarrow *agohimo \) ([ago himo])) can be explained to have underlying /h/ (e.g., *himo* is /himo/), as opposed to /p/. On the contrary, items that do show *Rendaku* voicing (e.g., *humi* ‘letter’: koi
(28) (= (19))

a. Singly linked—labial delinks

\[
\begin{array}{c}
\text{Labial} \\
\text{Peripheral} \\
\text{Place}
\end{array}
\]

\[
\begin{array}{c}
P[\varsigma, \phi, h] \\
\text{Place}
\end{array}
\]

\[
\begin{array}{c}
\text{Labial}
\end{array}
\]

b. Doubly linked—labial stays

\[
\begin{array}{c}
\text{Labial} \\
\text{Peripheral} \\
\text{Place}
\end{array}
\]

\[
\begin{array}{c}
P[p] \\
\text{Place}
\end{array}
\]

\[
\begin{array}{c}
\text{Labial}
\end{array}
\]

Digressing slightly from the main argument of this section, it is interesting to consider which node delinks. In other words: what is the representation of \( h \)? There are three possibilities: delinking (i) Labial (29a), with the resultant structure having Peripheral and Place, (ii) Peripheral, leaving the Place node (29b), or (iii) Place, and becoming ‘placeless’ (29c).

(29) Possible representations of \( h \) (place only)

a. Labial delinks

\[
\begin{array}{c}
\text{Labial}
\end{array}
\]

\[
\begin{array}{c}
\text{Peripheral} \\
\text{Place}
\end{array}
\]

\[
\begin{array}{c}
P[p] \\
\text{Place}
\end{array}
\]

b. Peripheral delinks

\[
\begin{array}{c}
\text{Peripheral}
\end{array}
\]

\[
\begin{array}{c}
\text{Place} \\
\text{Labial}
\end{array}
\]

\[
\begin{array}{c}
P[p] \\
\text{Labial}
\end{array}
\]

c. Place delinks

\[
\begin{array}{c}
\text{Place}
\end{array}
\]

\[
\begin{array}{c}
\text{Peripheral} \\
\text{Labial}
\end{array}
\]

\[
\begin{array}{c}
P[p] \\
\text{Labial}
\end{array}
\]

Any one of these analyses is possible, and theories on representations do not point one way or another, since they do not place restrictions on delinking in general.\(^{14}\) I look at the results of each of these three possibilities, specifically by comparing the resultant representations of place with those of other obstruents, and also by considering possible accounts for allophonics of \( h \). I show that none of the analyses in (29) is logically banned although they are not the necessary ones, either.

If the feature Labial delinks (29a), the resultant structure for place becomes the same as velar \( k, g \). (See (25) above for representation of dorsals.) However, when we take into account the representation of the other dimensions, this would not result in the same representation as dorsal \( k \). As discussed in later sections, the facts about devoicing of voiced geminates (and perhaps also \textit{Rendaku} as we saw early in this section) suggest that the voiceless labial has a feature under the Laryngeal node that the other voiceless obstruents do

\[^{14}\text{That this is an important theoretical problem was pointed out by Professor Peter Avery.}\]
not have. This feature logically assures that $P$ with Peripheral (and Place) is not merged with the dorsal stop [k].

There is a piece of evidence from optional allophonics of singleton $P$ that suggests a glottal-velar grouping in Japanese. Kawakami (1977:50) observes that [x] is alternatively used for $h$ when it is pronounced strongly, mainly before the vowels $a$ and $o$ and rarely before $u$ and $e$. This suggests that singleton $P$ is not placeless but has some feature that collapses together with, and thus can be implemented as, peripheral. However, if this is an optional pronunciation for particular occasions, Peripheral need not be specified as a stable feature but can be inserted afterwards for that purpose. Thus, having Peripheral is not necessarily required for $h$.

There is another piece of evidence that suggests that $P$ can be peripheral, involving one of the allophonic rules, where singleton $P$ is bilabial [ɸ] before the vowel $u$ (for the allophonic rules of singleton $P$, see (10)). However, another analysis is possible to explain this allophony. The peripherality may be assigned by the following vowel and may not originate in the consonant. Since allophonic rules apply in the post-lexical domain, by the time they apply, the vowel may have the feature specified for place, whether underlying or by default, and this feature can spread to the consonant. If this is the case, then, the source of surface peripherality of the consonant need not be ascribed to the consonant.

If the Peripheral node delinks (29b), then the resultant place becomes the same as the coronals $t$, $s$. (See (25) above for the representation of coronals.) The underlying representation of coronals for place is analyzed on independent grounds from gemination/assimilation processes as discussed later in section 3.3. However, again, the same argument as with the delinking of Labial holds. There is a feature under the Laryngeal node on $P$ and this assures that the singleton $P$ is not merged with a coronal sound. Thus, having Place is not an impossible analysis. There is one piece of evidence that suggests that $P$ can be coronal, and that is, again, one of the allophonic rules, where singleton $P$ is palatal [ç] before the vowel $i$ (see (10) for the allophonics). However, once more, in parallel to the arguments in the last paragraph, the palatality may be spread from the vowel $i$. So, having Place is possible but not necessary for $h$.

If delinking is at the Place node, then singleton $P$ becomes placeless. This would predict that it is inert in processes. As discussed in section 5, singleton $P$ shows a marked behaviour, but I argue there that this behaviour has something to do with the laryngeal dimension, not with the place dimension: as far as Place is concerned, it is inert. Delinking Place would not result in merging with an other segment with regard to place, either. So, delinking at the Place node is also a possible analysis. Again, allophonics of singleton $P$ can be analyzed as place spreading from the following vowel. Thus, a ‘placeless’ representation for $h$ is also possible in this regard.

There is another consideration which may support the ‘placeless’ representation for $h$, although the evidence is negative, rather than positive, in the sense that delinking other places than the Place node is not very convincing. To be more concrete, if we look at the representations of the singleton $P$ and a segment minimally contrastive to it in its entirety (i.e., including other nodes than place) and consider the meaning of the distinctive feature in the pair, one may not be very convinced with an analysis that $h$ has the same representation in place as the other segments. (29a, b) (Dresher p.c. 2004).

For example, let us consider the possibility of delinking Labial, leaving Peripheral and Place nodes (29a). If we compare this representation of $h$, which I give in (30a), with that of the dorsal stop $k$, given in (31), the contrastive feature for this minimally distinctive pair is the one in the laryngeal dimension; the rest is the same. The simplest interpretation of this would be that these two segments share the same place and are different from each other.
with regard to some kind of laryngeal gesture. In phonetics, at least, this is not likely in Japanese. (NB: one treatment of optional velar [x] for h is discussed above.) Unless there is phonological evidence that suggests singleton P and dorsal k form a class in Japanese, it might be less plausible to claim that h has the same place structure as k and has Peripheral.\(^{15}\)

\[
\begin{array}{ccc}
\text{(30) a. } h & \text{with Peripheral and Place} & \text{b. } h & \text{with Place} & \text{c. } h & \text{with no place} \\
\text{P} & \text{Lar} & \text{Pl} & \text{Man} & \text{Lar} & \text{Pl} & \text{Man} & \text{Lar} & \text{Man} \\
\text{Gl} & \text{Per} & \text{Gl} & \text{Per} & \text{Gl} & \text{Per} \\
\end{array}
\]

(31) Representations of /s/ and /k/ (from (25))

\[
\begin{array}{ccc}
\text{P} & \text{Lar} & \text{Pl} & \text{Man} \\
\text{Gl} & \text{Per} & \text{Gl} & \text{Per} \\
\end{array}
\]

The parallel argument can be made for the representation of h with the Place node (30b). A minimally contrastive segment to it is s in (31), which shares all features but one in the laryngeal dimension. Phonetically, s is a coronal sound, whereas h is not. (NB: the palatal allophone [ç] of h and its possible analysis that it comes from the following vowel is discussed above.) Unless there is evidence that s and h form a class in Japanese, it may not be convincing to say that h has the same place structure as s. These considerations leave us with the possibility of the ‘placeless’ structure for h (30c).

However, consider the meaning of having a complete placeless structure (30c) in the system. Now, Place is contrastive in the inventory, creating a four-way contrast in the place dimension. What is the consequence of this? More careful investigation on the native grammar is needed about this possibility, which I will leave for future study.

To summarize, it is clear that Labial is not present in the representation of singleton P, or [h]. However, more work is needed on details of the representation of the vowels and phonology of Japanese singleton [h] to be certain about its representation. In this paper, I assume that h has Peripheral specification for place as in (29a) and (30a), because this obviates the need for creating another distinctive feature Place for the system, which is redundant in terms of MCS and SDA, and also because of the possible grouping of [h] with [x] in Japanese.

2.3. Place asymmetry in gemination/assimilation in Sino-Japanese compounds

There is still another place beside the loanwords where Japanese has geminates. It is in certain Sino-Japanese compounds, the same type of compounds that I introduced in (17), or the root-root compounds. I look at them because we see place asymmetry in terms of the degree to which the segments geminate; the patterns suggest the relative complexity relationship between coronal t and dorsal k. I consider the complexity of labial relative to them, too.

\(^{15}\) The representations McCawley 1968 proposes for h and k (for Foreign stratum) are similar to this. There, the distinctive feature for this pair is [continuant].
Sino-Japanese root morphemes are of two to four segments in length (Itô and Mester 1996; McCawley 1968; Kurisu 2000 for summary). The relevant case here is when the morpheme is four segments long, where the third and fourth segments can only be /ki, ku, ti, tu/ (McCawley 1968: 110, Martin 1952:24-26). When these morphemes (i.e., \(C_1 V_1 C_2 V_2\), with \(C_2\) being either \(t\) or \(k\)) are followed by another root morpheme which begins with a voiceless consonant, gemination can occur, with the second vowel \(V_2\) being deleted. This is schematically shown as: \(C_1 V_1 C_2 V_2 + C_2 V_3 \rightarrow C_1 V_1 C_2 C_3 V_3\). However, whether gemination occurs or not depends on the quality of the second consonant, \(C_2\). If it is coronal \(t\), gemination occurs regardless of the place of the following consonant (32a), showing regressive assimilation of the place. If \(C_2\) is dorsal \(k\), in contrast, gemination/assimilation may occur only when the second morpheme begins with the voiceless dorsal \(k\) (32b).


a. \(C_2\) is \(t\): assimilation occurs
   
   \(\text{te} + \text{Poo} > [\text{teppoo}]\) ‘gun’
   
   \(\text{te} + \text{too} > [\text{tattoo}]\) ‘steel tower’
   
   \(\text{zi} + \text{syoo} > [\text{zissyoo}]\) ‘actual proof, evidence’
   
   \(\text{zi} + \text{keN} > [\text{zikkeN}]\) ‘experiment’

b. \(C_2\) is \(k\): assimilation blocked
   
   \(\text{gaku} + \text{koo} > [\text{gakkoo}]\) ‘school, educational institution’
   
   \(\text{ko} + \text{ka} > [\text{kokka}]\) ‘national anthem’
   
   \(\text{gaku} + \text{Pa} > [\text{gakua}]\) *(\(gappaj\)) ‘school, sect’
   
   \(\text{gaku} + \text{too} > [\text{gakutoo}]\) *(\(gattoo\)) ‘school lineage?’
   
   \(\text{gaku} + \text{sei} > [\text{gakusei}]\) *(\(gassei\)) ‘student’

How the consonants in \(C_2\) behave suggests their relative markedness. \(k\) is more marked than \(t\), since it resists assimilation/gemination more than \(t\) does. Indeed, \(t\) does not resist it at all. Representationally, this suggests that \(k\) is more complex than \(t\), possibly for the place dimension.

What about the labial? The gemination/assimilation patterns above do not say anything about the complexity of labial relative to coronal \(t\) and dorsal \(k\), because there is no instance of a voiceless labial occurring in \(C_2\). The fact that voiceless labial does not occur in \(C_2\) itself could suggest that the labial is more marked compared to the other places (Dresher p.c. 2004). In other words, position \(C_2\) in Sino-Japanese compounds is a position that allows only structurally simpler segments to occur. In the synchronic grammar of contemporary Japanese, the absence of labial in \(C_2\) in those Sino-Japanese morphemes is a result of diachronic deletion. Although the system that Japanese had at the time of adaptation from Chinese is not directly relevant to the contemporary system that I am investigating in this

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16 If the second morpheme begins with a voiced obstruent, gemination does not occur, and \(V_2\) does not delete. In Itô and Mester 1996, the Sino-Japanese roots are underlyingly \(C_1 V_1 C_2\), and not \(C_1 V_1 C_2 V_2\). \(V_2\) is an epenthetic vowel for them.

17 I use square brackets, which Nasu does not use, to indicate surface forms.

18 I replaced his \(p\) by \(P\), according to the notation that I employ in this paper.

19 [\(sy\)] is alveolo-palatal consonant \([e]\). I replaced his raised ‘\(y\)’ by a normal-sized ‘\(y\)’.

20 Itô and Mester (1993:208, f.n. 9, 1996) analyze this in terms of underspecification of coronal \(t\) for the place node. Kurisu 2000 compares the underspecification analysis and OT analysis, the latter of which derives the apparent underspecification from markedness considerations.
paper, the facts may be illuminating, since they indeed suggest that labials were the most marked in that period.

According to Vance (1987:156), the Chinese syllable-final /p/, that is, /p/ in C₂ position, in most morphemes became /ʔu/ in Japanese. In the course of diachronic change, the voiceless bilabial is lost intervocally, and subsequent assimilations of contiguous vowels have produced long vowels in modern standard Japanese. One example given in Vance (page 156) is the morpheme /kyoo/ ‘cooperation’ (modern Cantonese /hip/), whose change is given as /keʔu/ > /keu/ > /kyoo/ (page 156). In modern standard Tokyo speech, this morpheme is always kyoo whether it is followed by /t/, /k/ or /s/ (33).

(33) /kyoo/ ‘cooperation’ (all examples are from Vance 1987:156)
kyoo + kai ‘association’  
kyoo + tei ‘pact’  
kyoo + san ‘mutual aid’  
kyoo + doo ‘collaboration’  
kyoo + wa ‘harmony’

The absence of gemination before k, t and s in the contemporary Japanese may suggest that when they were borrowed, P was at least as complex as k. Recall that k triggers gemination nowhere but before k (32b) among the following voiceless consonants.²¹ We have observed a parallel pattern to this for P partially; it did not trigger gemination before the non-homorganic voiceless consonants. The question is, then, whether gemination occurred when it was followed by the homo-organic P. If it did, this suggests that P was as marked as k since the pattern is exactly parallel to that of k in that it only triggered gemination before an identical segment. If it did not, then, that suggests that P was more marked than k since it resists gemination even before the homorganic P. I have not found a word that consists of the morpheme /kyoo/ ‘cooperation’ followed by another morpheme that begins with a P. Nor does Vance give an example. However, this may be an accidental gap unique to this morpheme; there is a Sino-Japanese morpheme /kyoo/ in modern standard Japanese meaning ‘threaten(ing)’ (cf. modern Cantonese /hip/)²² which makes a compound with a morpheme Paku (34), where we do not find gemination.

(34) /kyoo/ ‘threat’
kyoo + P[h]aku 豊迫 ‘threat, intimidation’
    cf. kiN+P[p]aku 緊迫 ‘tensions’
kyoo + kaku 豊恐 ‘threat’
kyoo + syoo 豊従 ‘threat (somebody) to make (him/her) obey’
kyoo + i 豊威 ‘threat, menace’

P did not trigger gemination even before P. This can suggest that the labial obstruent, the ancestor of modern /P/, was more marked than dorsal /k/. Incorporating the fact that /k/ is more marked than coronal /t/, we get the scale from transitivity: P > k > t, where A > B reads that A is more marked than B. Generalizing this for place, the scale is translated into: Labial > Dorsal > Coronal. The same scale will be found in loanwords for the voiced obstruents, to be discussed in section 4.

²¹ There are exceptional words. See Nasu 1996 for an OT analysis that attempts to explain these words.
²² Thanks to Mike Barrie for helping me to look for the modern Cantonese pronunciation for this morpheme.
Now, the argument that puts labial in the scale as the most marked may be an illusion if the compounds with $P$ at the beginning of the second morpheme were made after the intervocalic loss of (the ancestor of) $P$: the argument holds only if these compounds were made when the voiceless labial obstruent was still there in the intervocalic position $C_2$ in the morphemes in question. After all, these considerations do not contribute directly to the investigation of complexity of labial in the synchronic grammar. Nonetheless, it would be worth noting that there is a possible scenario that labial was the most marked, and that this does not contradict what recent loanwords suggest, discussed in section 4.23

3. Gemination in loanwords—labial is marked

With the knowledge from the previous section that labial is marked in the voiceless series in native grammar, I now turn to loanwords. The process I look at is gemination. We will find a place asymmetry, specifically with the marked pattern of labials. I first describe the asymmetry, and then review the literature for accounts for it, and lastly present my analysis which takes a representational approach.

3.1. Gemination in loanwords and place asymmetry


23 Vance (1987) states that the Chinese syllable-final /p/ “in a few morphemes” has become geminate before all voiceless obstruents in two-morpheme Sino-Japanese words, and that they have the standard allomorphs ending with /tu/ or /ti/. This is the pattern that we expect with the original Chinese syllable-final /t/. Vance regards these few cases as Japanese listeners’ having misheard Chinese syllable-final /p/ as /t/. In a few other cases, they have allomorphs either with a long vowel or with geminate or with neither of them (i.e., with the epenthetic vowel). Vance says that those with a long vowel should probably be treated as a separate morpheme from the other two. If this is true, then, it seems to me that these morphemes show once more a case of syllable-final /p/ misheard as /t/. There is another morpheme meaning ‘ten’ that behaves somewhat between /t/ and /p/. It triggers gemination before all voiceless obstruents (Vance:157) like for the original Chinese syllable-final /t/, but appears with long vowel and not with the epenthetic vowel (Vace:157) like for /p/. These facts may suggest some sort of auditory licensing problem that Japanese speakers have in distinguishing between [p] and [t], a problem that they do not have between the other places, at least in syllable-final position. Interestingly, when Japanese speakers produce [p] and [t] in English, they are sometimes not heard as intended and confused with each other.

24 The vowel must be a lax one, and not a tense vowel or a diphthong. For example, English hit is adapted as [hit.to] in Japanese with a geminate (the dot ‘.’ indicates a syllable boundary), but English heat and light are adapted as [hii.to] and [rai.to], respectively, without a geminate. The motivation of gemination in loanwords has been discussed in the literature (e.g., Kawagoe 1995, Katayama 1998, Lovins 1975), and I will briefly introduce those suggested by Katayama and Lovins later as far as they help us understand these authors’ suggestions about place asymmetry. Notice that, whether the words are adapted with a geminate [hit.to] or with a long vowel [hiito]/diphthong [raito], the adapted forms have the syllable structure of heavy (bimoraic) syllable followed by light (monomoraic) syllable. This is a structure that Japanese favours in processes such as word formation in Motherese, zuzya-go (the secret language of jazz musicians) and in some sporadic shortenings (Kubozono 2003, p.c. 2004). The motivation for gemination in loanwords is a very interesting topic to pursue. I leave it for a future study.
(35) Gemination in loanwords

<table>
<thead>
<tr>
<th>English (spelling)</th>
<th>Japanese</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>hip</td>
<td>[hippu]</td>
<td>(Quackenbush and Ohso 1990: 38)</td>
</tr>
<tr>
<td>mitt</td>
<td>[mitto]</td>
<td>(Quackenbush and Ohso 1990: 38)</td>
</tr>
<tr>
<td>kick</td>
<td>[kikku]</td>
<td>(Quackenbush and Ohso 1990: 38)</td>
</tr>
<tr>
<td>pitch</td>
<td>[pittʃi]</td>
<td>(Quackenbush and Ohso 1990: 38)</td>
</tr>
<tr>
<td>cats</td>
<td>[kjattsu]</td>
<td>(Quackenbush and Ohso 1990: 40)</td>
</tr>
<tr>
<td>knob</td>
<td>[nobbu]</td>
<td>(Quackenbush and Ohso 1990: 40)</td>
</tr>
<tr>
<td>head</td>
<td>[heddo]</td>
<td>(Quackenbush and Ohso 1990: 40)</td>
</tr>
<tr>
<td>dog</td>
<td>[doggu]</td>
<td>(Quackenbush and Ohso 1990: 40)</td>
</tr>
<tr>
<td>edge</td>
<td>[eddʒi]</td>
<td>(Quackenbush and Ohso 1990: 40)</td>
</tr>
<tr>
<td>kids</td>
<td>[kiddu]</td>
<td>(Quackenbush and Ohso 1990: 40)</td>
</tr>
<tr>
<td>fish</td>
<td>[fiʃu]</td>
<td>(Quackenbush and Ohso 1990: 38)</td>
</tr>
<tr>
<td>apple</td>
<td>[appuru]</td>
<td>(Quackenbush and Ohso 1990: 48)</td>
</tr>
<tr>
<td>buckle</td>
<td>[bakkuru]</td>
<td>(Quackenbush and Ohso 1990: 48)</td>
</tr>
<tr>
<td>waffle</td>
<td>[waɸuru]</td>
<td>(Katayama 1998: 80)</td>
</tr>
<tr>
<td>castle</td>
<td>[kjassuru]</td>
<td>(Quackenbush and Ohso 1990: 48)</td>
</tr>
<tr>
<td>wax</td>
<td>[wakkusu]</td>
<td>(Quackenbush and Ohso 1990: 48)</td>
</tr>
<tr>
<td>happy</td>
<td>[happii]</td>
<td>(Katayama 1998: 75)</td>
</tr>
<tr>
<td>cotton</td>
<td>[kotton]</td>
<td>(Katayama 1998: 75)</td>
</tr>
<tr>
<td>cookie</td>
<td>[kukkii]</td>
<td>(Katayama 1998: 75)</td>
</tr>
</tbody>
</table>

It has been found, however, that gemination does not occur whenever the structural conditions are met, and that the degree of gemination varies depending on the position in the word and also on the manner and voicing status of the segment. For instance, although gemination can occur both from the source word-final position and from the source medial position, with everything else being equal, gemination is more stable in the former position than in the latter (Kawagoe and Arai 2002:55). In words from source word-final singletons, voiceless stops almost always geminate while voiced ones may or may not (Kawagoe and Arai 2002:55). Among fricatives, the post-alveolar fricative [ʃ] regularly geminates while [s] and [ʃ] normally do not geminate (Kawagoe and Arai 2002:55). Kawagoe and Arai 2002:55 do not mention affricates, but the frequencies in the table that they provide (Table 1) show that [ʃʃ] and [dʒ] geminate all the time (39 items and 18 items, respectively). As for [ts], four of twelve items geminate, but the total number of tokens seems to be too small to make a generalization for this segment. They also talk about gemination in words with source word-final consonant clusters (pages 55-56) and those with source word-medial singletons and consonant clusters as well (pages 56-57). Although they themselves are interesting to look at to investigate the motivation of gemination in loanwords, I do not go in to them simply because it is beyond the focus of this paper.

In this paper, I focus on word-final voiced singleton stops, because this is the place where we see a clear place asymmetry. To compare them with voiceless segments in the same environment, voiceless stops geminate almost all the time. In Kawagoe and 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 voiceless stops. However, if we look at voiced segments, b, d and g, geminates are not stable

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25 I replaced her [f] with [ʃ].
here (while I mark the forms with geminates as ungrammatical in (36), see below for further discussion):

(36) Not all voiced geminates are stable

\[
pabu \text{ } *\text{pabu} \quad < \quad \textquote{\text{pub}}
\]
\[
gyagu \text{ } *\text{gyaggu} \quad < \quad \textquote{\text{gag}}
\]

Moreover, within voiced stops, we find a decrease in percentage from the coronal \(d\) to velar \(g\) and further to labial \(b\). In Kawagoe and Arai (2002), the gemination percentages are 71 percent, 55 percent, and 23 percent for \(d\), \(g\) and \(b\) in this order, and in Shirai (2001), they are 58 percent, 55 percent, and 11 percent, respectively. Other researchers also observe a place asymmetry in voiced geminates fully for the three places or partially (e.g., Katayama 1998, Kawagoe 1995, Kawahara 2004, Lovins 1975). See Appendix I for examples. There, I give words from my dictionary survey. It shows the same scale as in the previous studies (the gemination rates for \(d\), \(g\), \(b\) are 83 percent, 42 percent and 15 percent, respectively). In sum, the scale is shown in (37): labial fails to geminate the most.

(37) The observed scale: \( *\text{bb} \text{ } *\text{gg} \text{ } *\text{dd} \)

In the next section, I review the accounts for this scale proposed in the literature. I show that none of them is fully convincing.

3.1.1. Previous accounts for the place asymmetry of voiced geminates

3.1.1.1. Lovins 1975

Lovins (1975:86) observes, although she says it is no more than her impression, that “degemination is most likely after labials and velars, which regularly take paragoge \(/u/\)” As the citation indicates, she pays attention to the epenthetic vowel that each place takes in explaining the different degrees of gemination. The epenthetic vowel is \([o]\) after coronal stops and \([\text{uu}]\) after labial and velar stops in Japanese loanword adaptation. Her account then crucially does not explain the difference between \(b\) and \(g\), both of which take the same epenthetic vowel \([\text{u}]\). Let us review her argument in detail.

In proposing the motivation for gemination, Lovins (1975:84ff) accepts the explanation by Ohso (1971), who says gemination is “the result of an attempt to keep the original closed syllable” (cited in Lovins 1975:84). Lovins (page 85) then claims that the addition of a mora obstructive through gemination has the effect of lengthening the syllable (as well as closing it), without changing the length of the vowel, and “[t]his increases the prominence of the syllable so added to; in the case of final /CVC/s, gemination preserves the balance between this syllable and the one created after it by paragoge, as the source vowel but not the paragoge one is highlighted” (page 85). To put it plainly, gemination has the effect of putting more prominence on the syllable that is carried from the source syllable than on the syllable that has been newly created in Japanese by epentheses. With this syllabic prominence hypothesis, she suggests the motivation for more failure of gemination on labials/velars than on coronals as follows:

“since /u/ is shorter than /o/ , there would be less need for gemination before it in order to preserve the relative prominence of the previous syllable ….” (page 86)

What she means is probably this. Because \(u\) is shorter than \(o\), the prominence of the first syllable in CV(C)Cu would be larger than that in CV(C)Co. Then, when the epenthetic
vowel is \(u\), gemination would be called for to a lesser degree than when it is \(o\), since the prominence balance between the first and second syllable is comparatively better there than with epenthetic \(o\).

However, to ascribe the gemination scale to the length, and ultimately to the quality, of epenthetic vowels does not explain the gemination scale (37). Vowels would be more likely to undergo gemination in labial than dorsal, because the bilabials are more sonorous than stops. She claims that because of this difference, fricatives, but not stops, are syllabified as the syllabic nucleus, and that this syllabification blocks fricatives from gemination.\(^{26}\) Japanese \(b\) and \(g\) undergo weakening intervocically, to be spirantized to voiced fricatives \([b]\) and \([y]\), respectively (Kawakami 1977), whereas \(d\) does not weaken in parallel fashion. She argues that, since voiced fricatives do not geminate, the resistance of \(b\) and \(g\) to the gemination process could be attributed to this spirantization process that they undergo. However, this account, again like that by Lovins (1975), does not explain the difference between \(b\) and \(g\). There is a greater extent of failure of gemination in labial \(b\) than in dorsal \(g\), which she herself observes. In order for her to account for this difference between them, she would have needed to do so in terms of the weakening process.

The other suggestion that Katayama (1998:127-128, f.n.13) gives draws attention to the closure duration of stops. Her claim is that “[t]he shorter the segment is, the easier it is to geminate” (page 128). She argues that, since the alveolar stops are the shortest, they are easiest to geminate. Referring to Walker (1998), she says “[p] is longer than [k], which suggests that [b] is harder to geminate than [g]. Single [b] itself is already long, and it would require extra effort to make it even longer” (page 128). These duration differences have been verified by Homma (1981) who reports her measurements of Japanese stops—both singletons and geminates, voiced and voiceless, and finds that the closure duration of bilabials is the longest among the three places. However, Katayama’s hypothesis that relates the inherent closure length of singletons to the articulatory ease in making geminates is doubtful. Alexei Kochetov (personal communication 2004) confirms this, saying that, from an articulatory point of view, “a longer constriction is not in any way ‘harder’ to maintain than a shorter one. … Further, if this was true, we would expect the inherently short taps and flaps to be more likely to geminate cross-linguistically than other consonants. The same would be expected with voiced obstruents compared to voiceless obstruents, and high vowels /i/ and /u/ compared to non-high vowels….” To conclude, inherent length from an articulatory point of view may not explain the gemination scale (37).

3.1.1.3. Aerodynamics of voicing (Hayes and Steriade 2004)

The gemination scale observed in Japanese (37) is not explained from an aerodynamic point of view, either. Hayes and Steriade (2004) give a scale based on the difficulty in

\(^{26}\) She has an account for the different behaviour of post-alveolar fricative \([j]\) from the other fricatives.
sustaining voicing in obstruents to argue that observed cross-linguistic sound patterns can be explained by hypothesizing a universal markedness constraint set based on the aerodynamics of voicing. From this viewpoint, voicing in bilabial [b] should be the easiest to maintain among the three places of articulation, and yet, in Japanese, labial [b] resists gemination to a greater degree than coronal [d] and velar [g]. Let us follow Hayes and Steriade’s (2004) argumentation step by step. First they establish that, based on the aerodynamics of voicing (e.g., Westbury and Keating 1986), it is hard to maintain voicing production in obstruents. They claim that this is the rationale for the markedness law that “[t]he presence of a voiced obstruent geminate in a given language implies, in any context, that of the corresponding voiceless geminate”. The same principle establishes that it is more difficult to sustain production of voicing in a long obstruent than in a short obstruent at the same place of articulation. Then, they look at the aerodynamics of voicing with regard to place differences, which gives the asymmetry in singletons: [g] implies [d] which implies [b]. In other words, it is easier to sustain voicing at the front than at the back. Citing Ohala (1983), they state that this scale applies to geminates. Finally, then, they incorporate the aerodynamics of voicing for length (i.e., singletons and geminates) and place (i.e., three places of articulation) to establish a single scale as in (38).

(38) Scale of difficulty in sustaining voicing based on the aerodynamics of voicing (from hardest to easiest)
* [+voice]: \{g: < d: < b: < g < d < b\} (Hayes and Steriade (2004) (5))

(38) states that [+voice] is hardest to realize in the velar geminate [g:], next hardest in alveolar [d:], and so on, and easiest to realize in the labial singleton [b]. Hayes and Steriade propose a set of markedness constraints based on the scale (38) and argue that this can account for observed sound patterns.

Of particular interest to us is the fact that this scale (38) (partially \*gg > *dd > *bb) does not explain the Japanese data. Consider specifically the place of labial \*bb in the scale. According to the aerodynamics of voicing (38), \*bb should be the easiest to sustain voicing in, hence, we would expect to find geminate \*bb to be produced most frequently; but in the Japanese scale (37), labials resist gemination the most.

These considerations suggest that the Japanese loanword scale may not be due to universal phonetics, but to Japanese grammar that somehow marks labial \*b more than the other places.

3.1.2. Place asymmetry of word-final voiced geminates—a representational account

I will propose an account for the scale (37) (\*bb > \*gg > \*dd) from the representation of Japanese voiced obstruents.\(^27\) Recall that there is a three-way contrast for place of articulation in voiced obstruents. In our theory, which incorporates contrastive specification (and so underspecification), this suggests that one of them is unmarked, thus unspecified under the place node, and the other two are marked. Between the two marked segments, the more marked one is more complex representationally than the other one. Being more complex is to have more structure (see section 2). The asymmetrical patterns that \*b, \*d, \*g exhibit in gemination in loanwords (37) can be analyzed as showing their underlying relative complexity for Place. Labial \*b has the most complex structure, that is, the most marked (39a). Coronal \*d has the least complex structure, thus is unmarked, with no dependent under

\(^{27}\) The concept of complexity for explanation was originally inspired by a conversation with Professor Keren Rice.
Labials in Japanese

the place node (39b). Dorsal g has more structure than coronal d but less than labial b (39c). Labial is the marked feature for the node Peripheral and distinguishes b from g. Peripheral distinguishes peripheral segments b and g from coronal s. Coronal is the unmarked value for Place, and the contrast drives the node Place to be present in the underlying representation of these three segments. The Place node is not contrastive in these segments, but must be specified in this way (Node Activation Condition).

(39) Place asymmetry—labial is most marked, dorsal next marked, and coronal unmarked

<table>
<thead>
<tr>
<th></th>
<th>a. Labial</th>
<th>b. Coronal</th>
<th>c. Dorsal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Place</td>
<td>b</td>
<td>d</td>
<td>g</td>
</tr>
<tr>
<td>Peripheral</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labial</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note that we do not see a place asymmetry of any sort for singletons b, d and g in loanword adaptation. Voiced geminates are new to the system in Japanese. Recall from discussions in section 3 that Japanese does not have voiced geminates underlyingly outside loanwords, and the length contrast in voiced obstruents is introduced with loanwords. Therefore, this particular environment creates a place where things are rather unstable. Geminates are structurally complex in that they are doubly linked to the skeletal slot (see the structure (1a) in section 2). Thence, in this complex position, labial b, being the most complex, is not well-licensed (40a), which result in their resistance to the gemination process most, relative to the less complex ones (40b, c) (See also Hirayama forthcoming for discussion).

(40) a. Labial      b. Coronal      c. Dorsal
    X X          X X          X X
    Place       Place       Place
    Peripheral  Peripheral  Peripheral

To conclude and repeat, we find that the labial is the most marked, thus the most complex, segment, the possibility that we reached from Sino-Japanese gemination/assimilation processes as well in section 3.3.
3.2. Gemination and devoicing in loanwords—[p] patterns with voiced obstruents

Recall that the original statement of markedness of labial in native grammar was for voiceless [p], as described in section 3, and as expressed as *P in Itô and Mester 1995 or in the study about mimetics in Nasu 1999. I turn to loanwords for voiceless obstruents now. The relevant process is again gemination. I will show that labial p is indeed marked there. I propose that representationally, this is a markedness for the laryngeal node.

3.2.1. Devoicing of geminates in loanwords and laryngeal specifications

I will show that the segment p patterns with voiced obstruents. The evidence comes from gemination of voiced geminates again. The instability of voiced geminates yields to, beside failure to geminate (§4.1), optional devoicing of the geminates (Haraguchi forthcoming, Lovins 1975, Kawahara 2004a, b, Nishimura 2002, Rice 2004). Example words are given in (41).

(41) Variation between voiced and devoiced geminates

<table>
<thead>
<tr>
<th>English</th>
<th>Voiced geminate</th>
<th>~</th>
<th>Devoicing</th>
</tr>
</thead>
<tbody>
<tr>
<td>bag</td>
<td>baggu</td>
<td>~</td>
<td>bakku</td>
</tr>
<tr>
<td>bed</td>
<td>beddo</td>
<td>~</td>
<td>betto</td>
</tr>
<tr>
<td>hottogu</td>
<td>hottodoggu</td>
<td>~</td>
<td>hottodokku</td>
</tr>
</tbody>
</table>

Nishimura 2002 claims that this optional devoicing occurs to avoid having two voiced obstruents within a stem; thus, this is a kind of OCP effect. I illustrate this in (42) and (43). For more words, see Appendix II. Words in (42) have another voiced obstruent in the word, while those in (43) do not. When we compare devoicing rates between the two groups, we can see that the OCP effect is operative here. The percentages for words in (42) are relatively higher than those for words in (43). In fact, the rates in (43) are significantly low, almost zero.

---

28 Note that these are not strategies found in native grammar, where the repair strategy for deriving a surface voiced geminate is prenasalization or lengthening, and not devoicing or non-gemination as we saw in §2.1. Indeed, devoicing is not found in any other part of Japanese grammar (Itô and Mester 2003:158ff). Although this is beyond the scope of this paper, I propose that this is because geminates in loanwords are not derived from underlying representation but created in the adaptation process. Inserting a feature [nasal] is not something that Japanese would do in the adaptation, because it has no existence in the original input.

29 NB: The number of words is very small for labials. This is because labials hardly geminate in the first place, as we saw in §3.1.

30 In (42), we can also observe that the devoicing is an optional process. The rates show that it is not categorical.
(42) OCP violated (data from Nishimura 2004, p.c.)

<table>
<thead>
<tr>
<th>Source word</th>
<th>Japanese with voiced geminate</th>
<th>% of devoicing</th>
<th>Total N</th>
</tr>
</thead>
<tbody>
<tr>
<td>bag</td>
<td>baggu</td>
<td>31%</td>
<td>122397</td>
</tr>
<tr>
<td>dog</td>
<td>doggu</td>
<td>28%</td>
<td>51996</td>
</tr>
<tr>
<td>big</td>
<td>biggu</td>
<td>19%</td>
<td>58595</td>
</tr>
<tr>
<td>Baghdad</td>
<td>bakudaddo</td>
<td>38%</td>
<td>1972</td>
</tr>
<tr>
<td>bed</td>
<td>beddo</td>
<td>21%</td>
<td>112606</td>
</tr>
<tr>
<td>David</td>
<td>deebiddo</td>
<td>20%</td>
<td>1178</td>
</tr>
</tbody>
</table>

(43) OCP not violated (data from Nishimura 2004, p.c.)

<table>
<thead>
<tr>
<th>Source word</th>
<th>Japanese with voiced geminate</th>
<th>% of devoicing</th>
<th>Total N</th>
</tr>
</thead>
<tbody>
<tr>
<td>leg</td>
<td>reggu</td>
<td>7%</td>
<td>9114</td>
</tr>
<tr>
<td>tag</td>
<td>taggu</td>
<td>0%</td>
<td>9788</td>
</tr>
<tr>
<td>egg</td>
<td>egggu</td>
<td>0%</td>
<td>26671</td>
</tr>
<tr>
<td>mad</td>
<td>maddo</td>
<td>1%</td>
<td>353</td>
</tr>
<tr>
<td>kid</td>
<td>kiddo</td>
<td>1%</td>
<td>792</td>
</tr>
<tr>
<td>head</td>
<td>heddo</td>
<td>0%</td>
<td>283516</td>
</tr>
</tbody>
</table>

Nishimura 2002 notices that this is the same kind of co-occurrence restriction as Lyman’s Law in the Yamato vocabulary (22). He takes up this fact to consider how the loanword stratum should be dealt with in the Japanese lexicon. His analysis is in an Optimality Theoretic framework, which I do not go into in this paper.

Now, I, and Nishimura also (personal communication 2004), observe that there is another segment which triggers devoicing beside the voiced obstruents b, d, g and z, and that is the singleton [p]. This is shown in (44), a partial extraction of the data from Appendix II. These words show a relatively high frequency of devoicing and all words have [p] with the exception of two words, faraddo < ‘farad’ (unit for capacitance) and huddo < ‘Hood’. In fact, from the devoicing rates, we can see that P triggers devoicing as much as voiced obstruents do (42), unlike the other voiceless obstruents (43).

(44) Singleton p participates in devoicing in loanwords (data from Nishimura p.c., 2004)

<table>
<thead>
<tr>
<th>Source word</th>
<th>Japanese with voiced geminate</th>
<th>% of devoicing</th>
<th>Total N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cupid</td>
<td>kjuupiddo</td>
<td>78%</td>
<td>44400</td>
</tr>
<tr>
<td>pad</td>
<td>paddo</td>
<td>31%</td>
<td>1613</td>
</tr>
<tr>
<td>rapid</td>
<td>rapiddo</td>
<td>26%</td>
<td>385</td>
</tr>
<tr>
<td>farad</td>
<td>faraddo</td>
<td>25%</td>
<td>484</td>
</tr>
<tr>
<td>lily pad</td>
<td>riripaddo</td>
<td>24%</td>
<td>738</td>
</tr>
<tr>
<td>Hood</td>
<td>huddo</td>
<td>24%</td>
<td>4500</td>
</tr>
<tr>
<td>spread</td>
<td>supureddo</td>
<td>23%</td>
<td>433</td>
</tr>
</tbody>
</table>

In sum, singleton [p] patterns with voiced obstruents in that it can trigger devoicing of voiced geminates in loanwords. Thus, [p] is more marked in this sense than the other voiceless obstruents. This suggests that [p] is more complex representationally than the other voiceless obstruents by having a feature that they do not have. Furthermore, the additional
feature on \( p \) would be also on voiced obstruents, because they all trigger devoicing at similar rates. Moreover, this feature would be for the Laryngeal node because Lyman’s Law involves this node. Notice that we observed \([p]\) pattern with voiced obstruents in native grammar (§2.2), if singleton \( p \) blocks Rendaku. There, I proposed to ascribe this pattern to the avoidance of OCP violation on Glottal (24). Now, we can ascribe the devoicing effect to the same feature. Devoicing of voiced geminates occurs to avoid OCP at the node Glottal.

Before I give the representations, we need to recognize the inventory of loanwords. To recall, in the Yamato and Sino-Japanese vocabularies, the alternations suggest that the voiceless labial stop \([p]\) and fricative \( h \) \([\zeta, \phi, h]\) are positional allophones, with \( p \) in a doubly-linked position and \( h \) in a singly-linked position, repeated here in (45).

(45) \([p]\) and \( h \) as positional allophones in alternations

a. \( h \) in a singly-linked position          b. \( [p]\) in a doubly-linked position

\[
\begin{array}{c}
X \\
[\zeta, \phi, h] \\
\end{array}
\quad \begin{array}{c}
X \\
\begin{array}{c}
[p] \\
\end{array}
\end{array}
\]

In loanwords, the linking condition is not active, and the consequence is that both singletons \( p \) and \( h \) are lexicalized.\(^{31}\) We have the labial segment \( p \), and peripheral segment \( h \) contrastively. They can occur both in singly-linked position, like in onset as in (46a), and doubly-linked position, like in geminates, as in (46b).

(46) \( p \) and \( h \) in loanwords (All words except Bach, Sachertorte, Gogh and Koch can be found in Ishiwata 1990. These four words can be found in a dictionary called Daijirin.)

a. Singleton        b. Geminate
\[
\begin{array}{lcccc}
\text{pack} & > & [pakku] & \text{cup} & > & [kappu] \\
\text{pink} & > & [pinku] & \text{hip} & > & [hippu] \\
\text{pool} & > & [puuru] & \text{Mach} & > & [maaha] \\
\text{pedal} & > & [pedaru] & (Johann Sebastian) Bach & > & [bahha] \\
\text{pot} & > & [potto] & Sachertorte & > & [zahhatorute] \\
\text{hat} & > & [hatto] & \text{sachlich} & > & [zahhariçiçi] \\
\text{hint} & > & [çiinto] & \text{Kocher} & > & [kohheru] \\
\text{helicopter} & > & [herikoputaa] & (Vincent van) Gogh & > & [gohho] \\
\text{hall} & > & [hooru] & (Robert) Koch\(^{32}\) & > & [kohho]
\end{array}
\]

The difference between the native inventory and loanword inventory is, then, the number of the members: one more in loanwords than in the native inventory because of the split of the segment \( P \) into \( p \) and \( h \). The representations I propose for loanwords are shown in (47). \( p \) has all features as those in \( P \), and \( h \) has the structure of \( P \), but without the Labial feature for place.\(^{33}\)

\(^{31}\) The condition is not respected in mimetic vocabulary also, where a singleton \([p]\) can occur.
\(^{32}\) German bacteriologist (1843-1910)
\(^{33}\) I mentioned in f.n. 13 the possibility of positing both \(/p/\) and \(/h/\) for the native inventory as well.
(47) Representations for $p$ and $h$ in loanwords (instead of $P$) (Cf. (25) for the native inventory)

These correctly explain the fact that devoicing of voiced geminates, $p$, $b$, $d$, $g$ and $z$ all have the feature Glottal and this triggers devoicing. Specifically, the marked pattern of $p$ in this process compared to the other voiceless obstruents, $t$, $k$ and $s$, is ascribed to the additional complexity on $p$ in the Laryngeal dimension: $p$ is more complex than $t$, $k$ and $s$ by having Glottal.

4. Some issues related to the feature Glottal and the Laryngeal structure of Japanese

In this section, I discuss some issues raised by proposing the feature Glottal on $p$ and $h$. Specifically, I will look at the questions for $h$, since I have not given independent evidence that suggests $h$ has Glottal. Most of the answers are rather inconclusive at the moment and more thought and data is needed to complete the discussion, even though the facts do not give us counterevidence. I will leave the solutions for future study.

4.1. Predictions of Glottal feature on $p$, $h$

There are some predictions that can be made by positing the feature Glottal on $p$ and $h$. Both are expected to show the quasi-Lyman’s Law effect. I say ‘quasi’ since the domain is Glottal and not Voice. Lyman’s Law refers to the feature Voice. The relevant processes I take up here are Rendaku and devoicing of geminates in loanwords. First, I look at Rendaku.
We saw that $p$ might indeed show the effect, as Lyman (1894) originally includes $p$ in the list of segments that block Rendaku. Here, the words are not known, since he does not give examples in the article. If the words are meant to be Yamato ones, then those $p$s must be from geminated $P$, [pp]. Whether Rendaku is blocked in these words or not should be investigated in the future.

What about $h$? Does singleton $h$ block Rendaku? There are not so many words in Yamato vocabulary that have a word-medial $h$ because, diachronically, most of them merged with $w$ and/or were lost (Koizumi 1978:226-231, Ono 1977). There are some words that became /w/ (and subsequently lost) but retrieved $h$, as in [haha] ‘mother’ (Ono 1977, Ohtomo 1962:137). To see if those words undergo Rendaku would be worth doing in the future, too.

Another prediction concerns devoicing of voiced geminates in loanwords. We saw that $p$ might show the quasi-Lyman’s Law effect in triggering devoicing. What about $h$? There, the prediction is: the segment $h$ would not block devoicing, just as $p$ might not. It looks like, in the data from Nishimura 2004, p.c., with $bb$, this may be the case, but overall, it is not very clear, because there are not enough words to test the predictions, and we need more words to study.

4.2. Post-lexical rules and the feature Glottal on $h$

There are processes in the post-lexical domain that support the analysis of an additional feature Glottal on $h$, and the absence of this feature for the other voiceless obstruents. There are two such processes. One is the allophonics of singleton $P$, that is, $h$ [h, ç, ß]. It can be voiced phonetically in intervocalic position (Kawakami 1977:49, Tsuchida 1997: 220-226; Vance 1987:21). To my knowledge, there is no acoustic or articulatory description of allophonic intervocalic voicing for the other voiceless obstruents $t, k$ and $s$. This suggests that $h$ has the feature Glottal that has something to do with voicing in phonetic implementation.

The other post-lexical rule that may support the feature Glottal on $h$ is High Vowel Devoicing, by which the high vowels $i$ and $u$ are devoiced when they are surrounded by two voiceless obstruents or preceded by a voiceless obstruent and followed by a pause (Tsuchida 1997, Vance 1987). In the literature, example words for High Vowel Devoicing include [p] as one of the surrounding voiceless obstruents. However, how consistently [p] triggers devoicing, relative to other voiceless obstruents, is not very clear. For example, Tsuchida

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34 Ohtomo (1962:137) gives more words that regained the fricative in this way. They are from a lecture given by Sato in 1957 at Tohoku University. I give here the exact forms that Ohtomo gives. /kawa/ > /kawa/, /kewai/ > /kehai/, /hanawada/ > /hanada/, /sibahu/ > /sibahu/, /owo/ > /wo/. He does not give the meaning for these words. Their forms in Modern Japanese whose history that I could check with a dictionary called Nihon Kokugo Daijiten (2nd ed., 2000) are haha ‘mother’, kehai–kewai ‘a sign, an indication’, sibahu–sibau ‘lawn’ and hoho–hoo ‘cheek’. ‘~’ indicates that the two forms are doublets. I did not find the form /hanawada/ under modern hanahada ‘extremely, greatly’ in the same dictionary nor in two dictionaries of classical Japanese (kogo jiten). Ohtomo (1962:145, f.n.7), citing Sato, suggests the reason for this restriction: it would be a revival from their written forms. Among the words given above, the influence of orthography in the course of change is explicitly suggested for the form kehai in dictionaries of Modern Japanese such as Nihon Kokugo Dai Jiten (2000) and Shin Metkai Kokugo Jiten (5th ed., 1997, 2000). They both give doublets kewai and kehai, stating that the latter form (kehai) comes from the pronunciation of the characters that are assigned to this word.

35 There are also other factors that may influence High Vowel Devoicing such as accentuation, consecutive environments and an environment between two voiceless fricatives. The probability of devoicing decreases in these environments.
(1997), in her experiments, does not use words with [p] for stimuli because “the labial stops often have an unusual status in the native lexicon of Japanese (e.g. single [p] occurs only in non-Yamato vocabulary)” (page 144). It would be interesting to see if the rates of devoicing change in words with [p], compared to words with other voiceless obstruents.

Although the behaviour of [p] with regard to vowel devoicing is not very clear, [h] exhibits interesting behaviour in this process. Tsuchida (1997:207ff) reviews literature and says that devoicing is inhibited when the vowel is at a word boundary and followed by h. She conducts an acoustic experiment using both real words and non-sense words to see if a following h blocks High Vowel Devoicing. Among the environments in the experiment, the one with a high vowel i preceded by a velar stop k and followed by h, i.e., kihV is relevant here.36 Devoicing occurred at the rate of zero percent (page 219), showing that a following h indeed blocks vowel devoicing at least in the environment of the experiment, \( ki__V \).37 Recall that High Vowel Devoicing occurs when the vowel is surrounded by two voiceless obstruents. (I am putting aside the environment of between two fricatives, where devoicing is less likely to occur.)38 To put it another way, when either of the neighbouring segments is a voiced one, High Vowel Devoicing is not likely to occur. Thus, the results of Tsuchida’s experiment show that the segment h patterns with voiced segments in that it can block vowel devoicing in the environment of \( k i__V \).

What does this tell us about the laryngeal specification of \( P \)? High Vowel Devoicing is a post-lexical rule, since the derived segments, voiceless vowels, are not members of the Japanese vowel inventory and thus the rule is not structure-preserving. And, certain feature values absent from underlying representation are only filled in post-lexically (Kiparsky 1985). Therefore, the feature(s) that are referred to in this rule may not be specified underlyingly as distinctive feature(s) in the relevant segments. All we can say from the blocking effect of h and voiced obstruents on High Vowel Devoicing is that they all have the same feature, here possibly Glottal, post-lexically. And, this is not contradictory to what I proposed; if they have Glottal underlyingly, they may very likely have it post-lexically as well. My tentative analysis of the derivation of High Vowel Devoicing is as follows. By the time High Vowel Devoicing applies, the default feature for the Laryngeal node, which I call Spread, fills in on the unmarked voiceless segments t, k and s (48a, b). This feature can trigger vowel devoicing (49). However, \( P \) and voiced obstruents have the feature Glottal underlyingly (48a), which is still there when High Vowel Devoicing applies as well (48b), and can block vowel devoicing, because having Spread and Glottal simultaneously is not allowed (49c). Specifically with h, this is so at least in certain environment like \( ki__V \).

---

36 She also has tokens with the first consonant being g and the first vowel being o. The other high vowel that possibly participates in Devoicing, u, was not studied in the experiment.

37 In the experiment, she also shows that this blocking effect is found regardless of whether the vowel is accented or unaccented, a factor that previous literature had claimed to affect High Vowel Devoicing.

38 In Tsuchida’s analysis, the inhibition of vowel devoicing between two voiceless fricatives is because this environment meets an OCP violation with regard to the feature [spread, glottis] (pages 64-66), a feature that the voiceless fricative, including /h/, and devoiced vowels have (page 53ff). In her proposal, voiceless stops do not have this feature.
(48) Laryngeal features for obstruents

a. Underlying

\[
\begin{array}{cccccc}
 & t & k & s & b & d & g & z \\
Lar & Lar & Lar & Lar & Lar & Lar & Lar & Lar \\
Gl & Gl & Gl & Gl & Gl & Gl & Gl & Gl \\
\end{array}
\]

b. Post-lexical when High Vowel Devoicing applies

\[
\begin{array}{cccccc}
 & t & k & s & b & d & g & z \\
Lar & Lar & Lar & Lar & Lar & Lar & Lar & Lar \\
Gl & Spread & Spread & Spread & Gl & Gl & Gl & Gl \\
[x] & Voice & Voice & Voice & Voice & \\
\end{array}
\]

(49) High Vowel Devoicing (Irrelevant nodes are omitted. I am not making any claim about the laryngeal specification for vowels, but this would not evoke a serious problem here.)

a. Underlying

\[
\begin{array}{cccc}
C & V & C \\
Lar & Lar & Lar \\
\end{array}
\]

b. Post-lexical: vowel devoicing

\[
\begin{array}{cccc}
C & V & C \\
Lar & Lar & Lar \\
\end{array}
\]

c. Devoicing blocked

\[
\begin{array}{cccc}
*C & V & C \\
Lar & Lar & Lar \\
\end{array}
\]


Now, although both \( h \) and voiced obstruents block vowel devoicing, there is a difference between them. Tsuchida 1997, in her literature review, does not mention a special condition of voiced obstruents on vowel devoicing. If this means that they normally do not devoice a vowel whether they occur before or after the vowel, this is not exactly the same condition under which \( h \) blocks devoicing. \( h \) blocks devoicing when it follows the vowel, at least in the environment of \( ki\ V \), but it might trigger devoicing otherwise. If so, this suggests that the position, specifically whether the segment is in word-initial or word-medial position, may influence how \( h \) participates in devoicing. Moreover, if this is true, the default feature for the Glottal node, tentatively called \([x]\) in (48b), is the feature that can trigger High Vowel Devoicing in word-initial environments.

4.3 Some phonetic properties of stops

What also needs to be worked out is the phonetic enhancement of the proposed features for the laryngeal system of Japanese, including the feature \([x]\) that was mentioned in the previous section. For this, in turn, detailed phonetics is needed. I introduce a very small, and general, phonetic property for stops from the literature. VOT measurements (Homma 1981) and impressionistic observations do not show much aspiration for Japanese voiceless stops.

---

39 One may wonder if the whole reason for \( h \)'s blocking devoicing in \( ki\ V \) may be ascribed to the fact that \( h \) in the intervocalic position can be voiced (§4.2); voiced obstruents do not trigger vowel devoicing. However, Tsuchida (1997:226) says that intervocalic voicing of \( h \) is not relevant to the inhibition of devoicing, because even when \( h \) is voiceless, the high vowel was still voiced in her data (voicing rates in her experiment are 97% for [h], 59% for [ϕ] and 31% for [ɛ] (page 226, Table 5.4)).
(see Vance 1987 for summary), although dorsal shows a little bit of positive VOT (Homma 1981). This matches the observation about the width of glottal opening, which is wider for the production of [k] than for [p, t] (summarized in Tsuchida 1997:98). But, again, positional differences seem to exist. Word medially, stops are produced with a narrower glottal opening than they are word finally (from Tsuchida 1997:98). Sugito (1996) found in a perception experiment that the voice/voiceless distinction can even be made in terms of length word-medially; even without voicing, if they are long enough relative to the preceding vowel, stops can be perceived as voiced. It would deserve a further study to look at this temporal effect for the word-medial stops in the absence of voicing cues and how it relates to the representation.

5. Conclusion

In this paper, I looked at the marked pattern that labials have compared to the other places of articulation. I specifically showed that the special nature of labials, which was said to occur outside the loanword vocabulary, is found in loanwords, too. Despite their seemingly free occurrence in lexical forms, phonological processes suggest that labials are marked there. Formally, the markedness patterns are tied to the relative complexity of the representation of segments. Labials are representationally more complex than other places. Further, the voiceless labial is more complex than other voiceless segments in the Laryngeal dimension. This additional structural complexity creates an environment for the marked patterning of labials.

Lastly, relating to the issues to be investigated in the future, discussed particularly in section 4, I would like to mention the kind of database needed. Particularly, I would like to express the need for large-scale studies. In the arguments presented in this paper, the evidence comes in large part from the percentages with which processes occur (e.g., data for non-gemination and devoicing of voiced geminates in loanwords, and High Vowel Devoicing that I cite from the results of Tsuchida’s 1997 experiments); while, looked at in a small database with a small number of words, segments may seem to behave one way and the other as well, in a larger database, they may appear to belong to one category rather than another. An in-depth study in this sense is yet required to be done.

Appendix I—Gemination and non-gemination in loanwords

Here I give the results of my dictionary search for gemination. The dictionary is called Daijirin (Sanseido 2003). I used the online version at http://www.sanseido.net/sup/ash/AsahiFind.asp, to search for words that meet the structural descriptions for gemination. Since I am interested in gemination in word-final position, I used the reverse dictionary tool. I did not include proper names. I also did not include technical terms from chemistry, because they might follow some regulations that are unique to them. I only searched words with epenthetic vowel \( u \) for labial \( b \) and dorsal \( g \) and \( o \) for coronal \( d \), which are the normal epenthetic vowels (e.g., Koizumi 1979, Kubozono, Sawada 1985). In section A, I give all words that end in a singleton \( [b, d, g] \) in English. In section B, I extract a part of it, only showing CVC words in English (\( \rightarrow \) CVC.CV in Japanese (a dot designates a syllable boundary, and the italic \( V \) the epenthetic vowel)). We find that, in both, with or without the exclusion of longer words, the place asymmetry is very clear: \( b \) hardly geminates, \( d \) geminates at a high frequency,\(^{40}\) and \( g \) geminates almost half of the time, although it inclines slightly towards non-gemination.

\(^{40}\) When we look at the words only from English CVC, all \( d \)'s geminate if we do not take into consideration the truncated words \( (ad \) and \( rad) \), because they might have been derived from the full forms, in which case the environments do not meet the condition for the gemination rule any more.
A: All words (percentages are rounded)

<table>
<thead>
<tr>
<th></th>
<th>b (Total N: 27)</th>
<th>d (Total N: 41)</th>
<th>g (Total N: 36)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gemination:</td>
<td>15 percent</td>
<td>83 percent</td>
<td>42 percent</td>
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B: CVCV forms only ($V$ is the epenthetic vowel)

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English

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Appendix II—Devoicing of voiced geminates in loanwords

The data are from Nishimura p.c. 2004. The methodology that he used is as follows. The words are from compounds that appear in the entries in *Konsaisu Gairaigo Jiten* (Concise Loanwords Dictionary). He used compounds to avoid homophones. Then he used the internet engine Google to look at the frequency of devoicing. The source words in tables below are from my search. In the database that he gave me, the words were given in Katakana. I consulted Nishimura (2002) and/or a loanword dictionary called *Kihon Gairaigo Jiten* (Ishiwata 1990) and/or Google for them. I averaged the percentages over the compounds to obtain the devoicing frequency for each item that appears in the tables.

a. OCP violation

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### Labials in Japanese

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a Thanks to Vanessa Shokeir for the spelling.

b. OCP not violated
MANAMI HIRAYAMA

| Oersted | erusuteddo | 1% | 1166 |
| Alfred  | aruhureddo | 1% | 28769 |
| mad     | maddo     | 1% | 353  |
| kid     | kiddo     | 1% | 792  |
| red     | reddo     | 1% | 32427 |
| solid   | soriddo   | 1% | 5549 |
| mid     | middo     | 1% | 45251 |
| worsted | usuteddo  | 1% | 137  |
| liquid  | rikiddo   | 1% | 480  |
| trad(itional) | torado | 1% | 1590 |
| pointed | poinNeddo | 1% | 1568 |
| united  | junaiteddo| 1% | 48045 |
| limited | rimiteddto| 0% | 61285 |
| head    | heddo     | 0% | 283516 |
| method  | mesoddo   | 0% | 1479 |
| tread   | toreddo   | 0% | 1293 |
| wood    | addo      | 0% | 26747 |

a ‘phyton-cide, fitontsid’ from Russian [fitontsidi]41

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41 Thanks to Marina Cherkina for the transcription.

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