The Morphemic Plane Hypothesis and Plane Internal Phonological Domains

Masahide Ishihara
University of Arizona

0. Introduction[1]

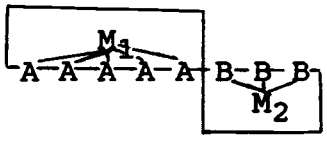
The Morphemic Plane Hypothesis[2] (hereafter MPH) of McCarthy (1979, 1981, 1986) claims that in languages with nonconcatenative morphology, such as Semitic languages, different morphemes are represented on different planes. Under this view, an Arabic word **kaatab** "correspond:perfect active" has a phonological representation as follows:

(1)

Notice that the string of consonants, the skeleton, and the vowel are each morphemes in Arabic.

In order to account for cyclic and noncyclic stress assignments in some languages such as Vedic and Lithuanian, Halle and Vergnaud (henceforth H&V) (1987a, b), following McCarthy, claim that different morphemes do have different planes. In this approach, a sequence of two morphemes is represented as in (2).

(2)



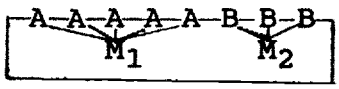
Furthermore, H&V assume that only a certain class of morphemes, namely cyclic ones, "give rise to independent planes" (H&V 1987a:79). Concatenation of cyclic morphemes is accompanied by Plane Conflation (PC). According to H&V, this process "copies the content of the stem onto the plane of the affix..." (H&V 1987a:80). In this paper, I will represent two morphemes (or words) after PC as follows:[3]

---

[1] This work has greatly improved through discussions with Diana Archangeli, Megan Crowhurst, Richard Demers, Michael Hammond, Richard Oehrle, Patricia Shaw, Kelly Sloan, and Cari Spring: I thank them for their generosity. All errors are of course my own.

[2] Following Halle and Vergnaud (1987a), I use the term "planes" instead of "tiers".

[3] According to H&V, two different morphemes, the second one being cyclic, have the following representation.

(3) 

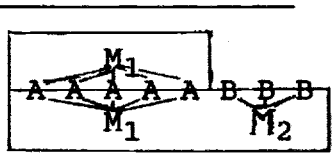
In contrast, noncyclic morphemes (or affixes) do not have their own planes. They are attached to a preceding or following plane. In this view, a sequence of two morphemes, the second one being noncyclic, is represented as shown in (4).

(4) 

It should be noticed that after PC cyclic and noncyclic morpheme concatenation have no representational differences. In both representations, two morphemes are in the same plane. What is important is that in cyclic morpheme concatenation, two morphemes are segregated on distinct planes before Plane Conflation.

With respect to the MPH two predictions are made. First, some phonological domains are intraplanar, and second, if a morpheme is cyclic, it has its own plane (or if a morpheme has its own plane, it is cyclic). In this paper, I will show that the data from Japanese compounding behaves exactly as the MPH predicts. Two different processes, namely Rendaku and syllabification in verb compounds, are to be investigated. The former shows that the domain of the Obligatory Contour Principle (to be discussed in Section 1 and 2) extends to the entire plane and that Plane Conflation applies after every cycle, while the latter reveals that syllabification in Japanese is plane-internal.

This paper is organized in the following way. In the first section, I provide a non-MPH account of Rendaku. In Section 2, I present a MPH account of Rendaku. The next section shows that Japanese syllabification is plane-internal and precedes Plane Conflation. Finally I conclude that the domains of the OCP and syllabification in Japanese are morphemic planes.



H&V state: "In the process of plane copying not all information available in the plane to be copied is transferred.... the information contained in the metrical grids is not copied...." (H&V 1987a:80). Since this paper does not deal with stress, I assume that all relevant information in the plane to be copied is transferred. In other words, the upper part of M_1 is irrelevant for this work. Thus, it is omitted in the representation of cyclic morpheme concatenation after PC as in (3).

1. Rendaku and its Non-MPH Account[4]

Rendaku is a phenomenon which has been widely studied by students of Japanese phonology (McCawley (1968), Otsu (1980), Itô and Mester (1986), Motohashi (1987), Vance (1987), Yamaguchi (1987), Murasugi (1988), Oyakawa (1988), among others). As demonstrated in (5), Rendaku is a process in which a word initial voiceless obstruent becomes voiced when it is contained in the second member of a compound.

(5)

a.	nise	+	kane	------> nisegane
	"fake"		"money"	"fake money"
b.	yo	+	kisa	------> yogisa
	"night"		"train"	"night train"
c.	kuro	+	satoo	------> kurozatoo
	"black"		"sugar"	"brown sugar"

In this section, I will first briefly discuss one property of Rendaku, a constraint called Lyman's Law. Next I will review Itô and Mester's (1986) (henceforth I&M) account of Rendaku and discuss one major problem of their analysis.

1.1. Lyman's Law

One property of Rendaku is that its application is conditioned by underlying representations of compound members. It is not the case that Rendaku applies unconditionally whenever a compound of the right morphological type is built. There are certain constraints on its application. One such condition is that the second compound member has no voiced obstruents. As demonstrated in (6), if there is at least one voiced obstruent in the second constituent of a compound, Rendaku does not apply.[5]

(6)

a.	kami	+	hubuki	----> kamihubuki / *kamibubuki
	"paper"		"snowstorm"	"confetti"
b.	naga	+	tabi	----> nagatabi / *nagadabi
	"long"		"trip"	"long trip"
c.	mawari	+	kudoi	----> mawarikudoi / *mawarigudoi
	"go round"		"tedious"	"circuitous"

(Examples are takes from Oyakawa (1988))

---

[4] I am not going to discuss the morphological conditions for Rendaku, except those which are relevant to this essay. For morphological conditions, see Otsu (1980), Itô and Mester (1986), and others.

[5] A few compounds do not observe this condition as demonstrated below.

nawa	+	hasigo	--->	nawabasigo / *nawahasigo
"rope"		"ladder"		"rope ladder"

This constraint on Rendaku is known as Lyman's Law, which Oyakawa (1988) states as follows:

(7) Lyman's Law:
If the domain [(the second compound member)MI] contains a voiced obstruent internally, the potential candidate is not subject to the [R]endaku phenomenon. (p.8)

When the first compound member contains a voiced obstruent, however, Rendaku applies as illustrated in (8).

(8)

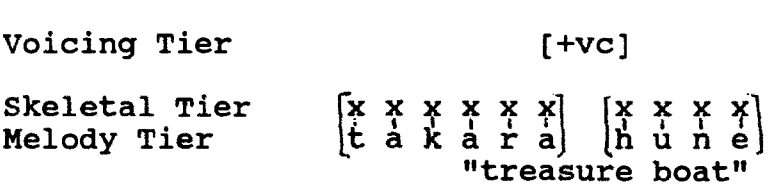
a.	naga	+ kutu	--->	nagagutu / *nagakutu
	"long"	"shoes"		"boots"
b.	muda	+ hanasi	--->	mudabanasi / *mudahanasi
	"waste"	"talk"		"wasteful talk"
c.	kotoba	+ tukai	--->	kotobadukai / *kotobatukai
	"language"	"use"		"language use"

Thus, it is clear that phonological conditions on Rendaku reside in the underlying form of the second compound member only. Notice that sonorants which are voiced in the surface representation do not hinder Rendaku application as shown in (8b).

1.2. Review of Itô and Mester (1986)

Itô and Mester (1986) (hereafter I&M) present an autosegmental analysis of Rendaku. They propose that Japanese has an independent voicing tier, which in underlying representation contains [+voice] autosegments. (I&M assume the theory of underspecification (eg. Kiparsky (1982) and Archangeli (1984)) where redundant features are not present in the underlying representation (UR).) I&M propose that only the voiced obstruents are marked with a [+voice] autosegment in UR. Rendaku seems to be a process, as demonstrated in (5) and (8) above, which involves only the voicing feature but not other features (such as [+continuant]). Thus I&M hypothesize that Rendaku is, as illustrated in (9), simply an insertion of a [+voice] autosegment onto the voicing tier.

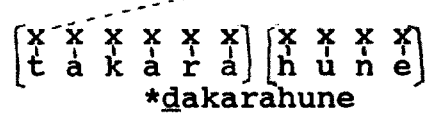
(9)



Note, however, that the Universal Association Convention (hereafter UAC), which says that the association of an autosegment to its anchor is one-to-one and from left-to-right (see Pulleyblank (1986), among others), would dock the autosegment [+voice] to the initial obstruent of the first

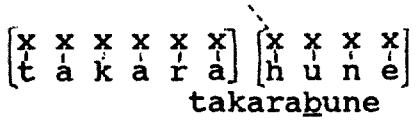
compound member, yielding *Dakarahune[6] instead of takaraBune "treasure boat." Two derivations -- one which is a problem and one which is a correct form -- are illustrated below.[7]

(10) a. *



*dakarahune

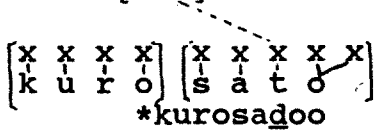
b.



takarabune

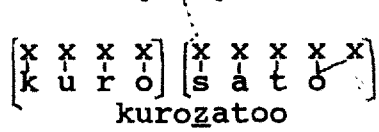
Notice also that if the association is right-to-left, instead of left-to-right, Rendaku fails to derive correct forms. This is demonstrated by the following example.

(11) a. *



*kurosadoo

b.



kurozatoo

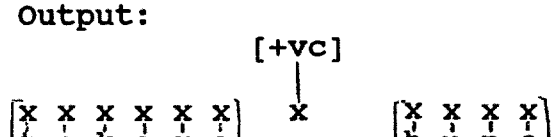
If the association is right-to-left, the autosegment would dock to the rightmost voiceless obstruent. As a result, the output would be an unacceptable *kurosaDoo instead of the correct form kuroZatoo "brown sugar".

In order to avoid a problematic association such as in (10a) and (11a), I&M formulate the Rendaku rule as in (12), in which the [+voice] autosegment is underlyingly docked to its skeletal anchor at the compound juncture.[8]

(12) Rendaku (I&M p.57)

Insert [+vc] /] ___ [

Output:



"treasure boat"

---

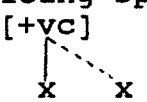
[6] In the text, but not in the figures, capitalization is used to draw attention both to segments voiced (correctly or incorrectly) by the docking of the Rendaku feature and to segments which do not become voiced in spite of being potential candidates for the voicing.

[7] I use [+vc] instead of [+voi] as used by I&M.

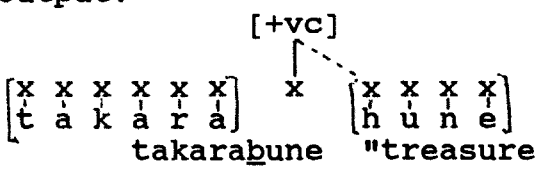
[8] Concerning the diacritic use of the skeleton, I&M assume: i) "[S]keletal elements intrinsically express only positionality, not timing. ii) Their status as timing units is entirely derivative, acquired through syllabification" (p.57).

However, this rule by itself does not ensure voicing of the word initial obstruent of the second compound member since the obstruent is not associated to the autosegment [+voice]. I&M, therefore, propose another rule of Voicing Spread, which has an independent motivation in verb conjugation (see I&M p.58).[9]

(13) Voicing Spread (I&M p.58)



Output:



takarabune "treasure boat"

In I&M's view of Rendaku, as demonstrated above, for the word initial voiceless obstruent of the second compound member to become voiced, two separate processes must apply to the compound: one is [+voice] insertion and the other is Voicing Spread. Notice, however, that their account of Rendaku crucially depends on diacritic use of skeleton. Usually the skeleton is used to represent timing slots; but, in I&M's view, the skeletal anchor for a [+voice] autosegment has nothing to do with timing and must ultimately delete since incorrect forms such as *takara[a]Bune could be derived.[10]

---

[9] The past tense marker ta surfaces as da following voiced obstruents or nasals as illustrated below, where derivations of surface forms are not of our interest in this paper.

a. kak + ta ---> kaita "write:pst"
b. kari + ta ---> karita "borrow:pst"
c. kas + ta ---> kasita "lend:pst"

but
d. yom + ta ---> yonda "read:pst"
e. tog + ta ---> toida "sharpen:pst"
f. tob + ta ---> tonda "fly:pst"

Notice that in (d) Voicing Spread applies after the nasal becomes voiced. This shows that Voicing Spread in verb conjugation might be different from that in Rendaku: the former applies after default voicing while the latter applies before default voicing.

[10] McCarthy and Prince (1986) argue that skeleta are not necessary in phonological representations. If they are correct, there is no skeleton to anchor the inserted [+voice] autosegment. This will pose a challenge to I&M's account of Rendaku.

1.3. Lyman's Law and Obligatory Contour Principle

As discussed in Section 1.1, one of the properties of Rendaku is that its application is constrained by Lyman's Law. This law describes the fact that if the second compound member has an underlying voiced obstruent, as demonstrated in (6), Rendaku does not apply. In the appendix, following McCarthy (1986), I&M (1986:p. 71-72) interpret Lyman's Law in terms of the Obligatory Contour Principle (henceforth OCP). They state:

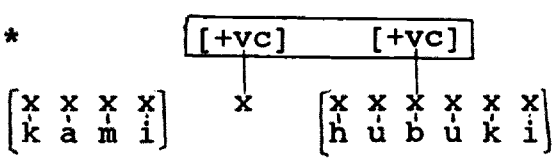
> If Rendaku voicing is understood as [+voi] entering the voicing tier of the second compound member, the process will be blocked by the OCP whenever a [+voi] is already present. (p.71)

The OCP, which was originally proposed in analyses of tonal phenomena (Leben (1973)), has been successfully extended to nonlinear segmental phonology (e.g. McCarthy (1979, 1986) and Yip (1988)). The OCP is stated formally in (14) (McCarthy 1986:208)

(14) The Obligatory Contour Principle (OCP)
At the melodic level, adjacent identical elements are prohibited.

In this view, the insertion of a [+voice] autosegment would create two adjacent identical units if the voicing tier of the second compound member has an underlying [+voice], as shown in (15), violating the OCP. Therefore, such an insertion will be prohibited.

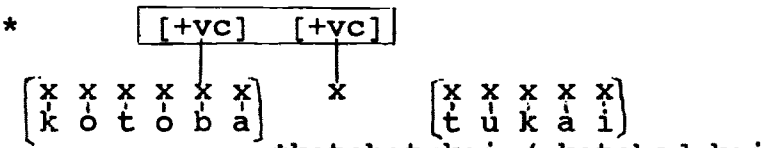
(15) *



To sum up, in I&M's view Rendaku is an insertion, at the morpheme juncture, of a [+voice] autosegment linked to a skeletal slot accompanied by a voicing spread from the autosegment to the following obstruent unspecified for voicing, which is the surface bearer of the [+voice]. However, an insertion of [+voice] will be blocked by the OCP if the second compound member has a voiced obstruent in the underlying representation.

1.3. A Problem of I&M's Account of Rendaku

Itô and Mester's (1986) account of Rendaku, as it stands, incorrectly blocks an insertion of [+voice] in certain cases. Since the autosegment is inserted at the morpheme juncture, the domain of the OCP would be presumably interpreted as to include the whole compound. If this interpretation of the OCP domain is correct, when the first compound member has a voiced obstruent, as illustrated in (16), a [+voice] insertion would be rejected by the OCP. (But see examples in (8).)

(16) * 

*kotobatukai / kotobadukai
"language use"

Since the insertion of the [+voice] is blocked by the OCP, there would be no Voicing Spread. Thus, the output would be an incorrect kotobaTukai instead of kotobaDukai "language use". Therefore, in order to account for the fact that Rendaku does apply even if the first member has an underlying [+voice], we must have an ad hoc stipulation which says, "the OCP will look only to the right". That is, the OCP, which should be symmetrical (i.e. look on both sides of the autosegment in question), applies asymmetrically looking on only one side of the autosegment.

To summarize, under I&M's account of Rendaku, the OCP would block the insertion of the autosegment [+voice] if another [+voice] is already present on either side of the insertion site of the autosegment in compounds. Therefore, some solution to this problem must be found in order to ensure the insertion of [+voice] even if the first compound constituent has an underlying autosegment to the left of the insertion site.

2. The MPH Account of Rendaku

As mentioned in the introduction, Halle and Vergnaud (henceforth H&V) (1987a,b), following McCarthy (1979, 1981, 1986), propose to extend the Morphemic Plane Hypothesis to concatenative morphology. They further propose that only cyclic morphemes be represented on separate planes. If H&V's proposal is correct, the MPH provides an explanation for the asymmetry in the OCP (i.e. Lyman's Law) as discussed in Section 1.3.: the OCP applies only when the second compound member contains a voiced obstruent.

In the discussion of I&M's account of Rendaku, we saw a problem of Rendaku with respect to the OCP if the two compound members are on the same plane. That is, the OCP is asymmetric but should be symmetric. Suppose then that two compounds members are segregated on two different planes. Then two predictions are made.

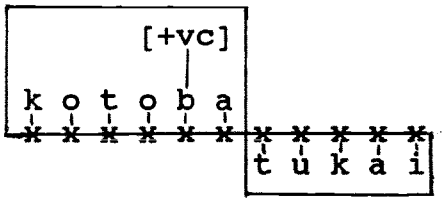
(17) i) OCP is sensitive to only one of the two members.
ii) Rendaku is cyclic.

In this section, I present the MPH account of Rendaku and show that the predictions in (17) are exactly what are needed.

2.1. The OCP and the MPH

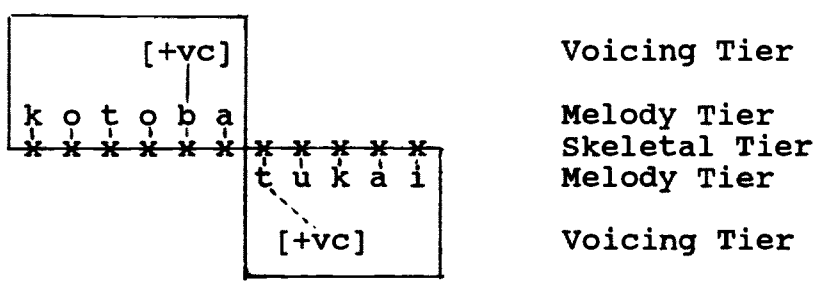
Under the MPH, in which two morphemes are segregated on distinct planes, a compounding of kotoba "language" and tukai "use", prior to [+voice] insertion, would be represented as follows.

(18)



Notice that in the representation in (18), each morpheme has its own voicing tier. Since Rendaku is a process in which the morpheme initial voiceless obstruent of the second compound member becomes voiced, it is interpreted as the insertion of the autosegment [+voice] into the voicing tier of the second constituent. Under this view, [+voice] insertion to the voicing tier of the second compound constituent will not violate the OCP. The two [+voice] autosegments are on different planes. In other words, they are not adjacent. Furthermore, the inserted autosegment would be automatically associated with the morpheme initial voiceless obstruent of the second constituent by the Universal Association Convention (UAC) -- one-to-one and left-to-right association (see (19)). Thus, there will be no Voicing Spread involved in Rendaku.

(19)



Notice that in our MPH account of Rendaku, the diacritic use of the skeleton as proposed in I&M is not necessary.

According to H&V, if two morphemes are on different planes, such a morpheme concatenation is cyclic. In the present MPH account, in order for Rendaku to apply without violating the OCP when the first compound member has a voiced obstruent, it is required that two members of a compound be segregated on distinct planes. What this requirement means is that Rendaku is cyclic. If it is not cyclic, it would apply to a compound represented on a single plane. However, as demonstrated in Section 1.3., this claim is false: Rendaku would not apply if the first compound member has a voiced obstruent since [+voice] insertion would violate the OCP.

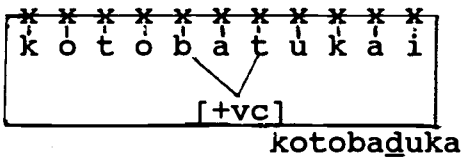
As claimed in H&V, cyclic morpheme concatenation accompanies Plane Conflation (hereafter PC). In the case of Japanese compounding which is cyclic as demonstrated above, PC copies the content of the first compound member onto the plane of the second compound member.[11] From the discussion thus far, it is clear that PC takes place after [+voice] insertion and association. As

---

[11] The question of which plane conflates onto which plane does not seem to be crucial for our argument.

a result, the compound will have the representation as in (20). Notice that the two [+voice] autosegments associated separately on each voicing tier will not violate the OCP when the two planes are conflated because they will merge into one autosegment, by the shared feature convention of Clements (1985),[12] which is associated to two melodic segments (see also McCarthy (1986) for "fusion" discussion).

(20)



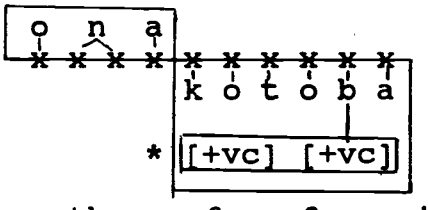
Skeletal Tier
Melody Tier

kotobadukai "language use"

Thus the outcome is the desired kotobaDukai "language use."

On the other hand, when the second compound member has an autosegment [+voice], the OCP will block insertion of the autosegment. As demonstrated in (21), such insertion would violate the OCP.

(21)



Melody Tier
Skeletal Tier
Melody Tier

Voicing Tier

Therefore, the surface form will be onnaKotoba "female wording" not *onnaGotoba. In other words, under the Morphemic Plane Hypothesis the OCP (or Lyman's Law) is sensitive only to the second compound member.

Given the discussion thus far, Rendaku seems to be simply an insertion of a [+voice] autosegment into the voicing tier of the second compound member. Thus, Rendaku is reformulated as follows.

(22) Rendaku (reformulated)
Insert [+voice]/ [_____]$_{2ND}$
where **2ND** means the second compound member.

Notice that in the Rendaku rule it is not necessary to specify the insertion site. The [+voice] autosegment is automatically linked to the leftmost segment by the Universal Association Convention (hereafter UAC) -- one-to-one and left to right association -- unless the insertion is blocked by the OCP.

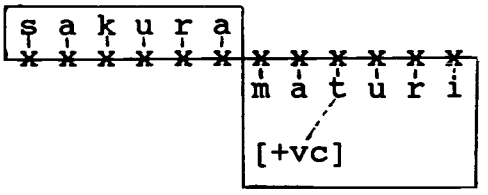
Moreover, the autosegment [+voice] seems to be associated to word initial sonorant consonants and vowels. That is, if sonorants and vowels are supposed to have [+voice] only by a fill-in rule, which seems to apply after [+voice] autosegment insertion by Rendaku, the autosegment would dock to a non-sonorant segment, yielding an unacceptable form *sakuramaDuri "cherry blossom festival" as illustrated in (23a).

---

[12] This was mentioned by Megan Crowhurst.

(23)

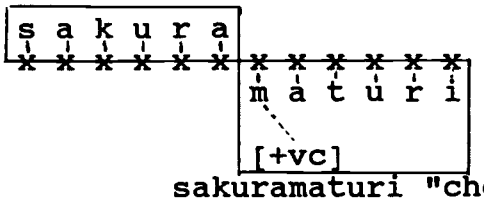
a.



*sakuramaduri "cherry blossom festival"

cf.

b.



sakuramaturi "cherry blossom festival"

Thus, the autosegment is linked to the leftmost segment of the second compound member, either an obstruent or a non-obstruent as illustrated in (23b). (Support for this point will be given in the following section.)

To sum up this section, Rendaku is a cyclic phenomenon because the two members of a compound must be on different planes. Under the MPH account, it is required for Rendaku to apply, without violating the OCP when the first compound member has a voiced obstruent, that the two members of a compound be segregated on distinct planes. In such cases, the OCP would not be violated upon the autosegment insertion into the voicing tier of the second compound member since the principle is sensitive only to the constituent. On the other hand, when the second compound constituent has a voiced obstruent, [+voice] insertion will be blocked by the OCP.

2.2. Multiple Application of Rendaku as a Cyclic Phenomenon

Rendaku application has an asymmetry depending on the structure of the compound when a compound member is itself a compound. As demonstrated in previous literature on Rendaku (Otsu (1980), Itô and Mester (1986), etc), Rendaku applies multiply when the <u>first</u> compound member is itself a compound as demonstrated in (24).

(24)

a. ori + kami ---> origami
"fold" "paper" "origami"

b. origami + tana ---> origami-dana
"origami" "shelf" "origami shelf"

c. origamidana + tukuri ---> origamidana-dukuri
"origami shelf" "making" "making of origami shelf"

d. origamidanadukuri + toki ---> origamidanadukuri-doki
"making of origami shelf" "time" "time for making origami shelf"

As illustrated in (25), however, Rendaku does not apply when the <u>second</u> compound member is itself a compound.

(25)
a. nise + sakuramaturi --> nise-sakuramaturi / *nise-zakuramaturi
"fake" "festival of cherry blossoms" "fake festival of cherry blossoms"

cf. nisezakura + maturi --> nisezakura-maturi
"fake cherry blossoms" "festival" "festival of fake cherry blossoms"

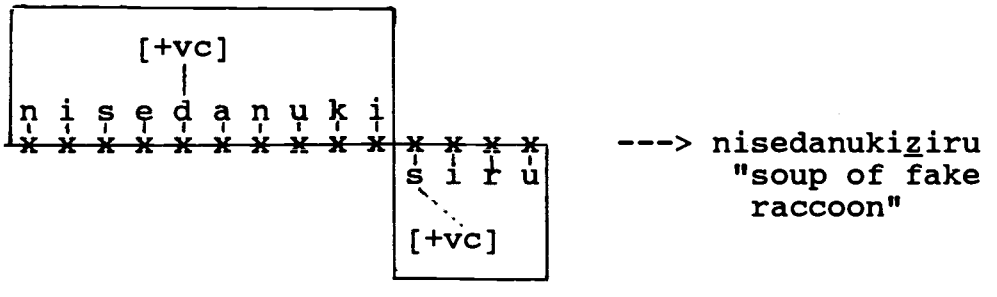
b. nise + tanukiziru --> nise-tanukiziru / *nise-danukiziru
"fake" "raccoon soup" "fake raccoon soup"

cf. nisedakuki + siru --> nisedanuki-ziru
"fake raccoon" "soup" "soup of a fake raccoon"

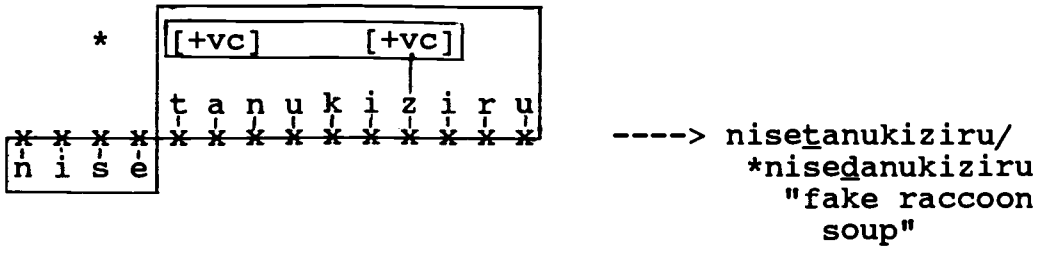
c. hatu + tanaorosi --> hatu-tanaorosi / *hatu-danaorosi
"first" "inventory checking" "first inventory checking"

Rendaku is cyclic as demonstrated in Section 2.1, since it requires each compound member to have its own plane. That is, Rendaku would potentially apply cyclically every time a bigger compound is made. Then, the asymmetry in application of the [+voice] insertion as shown in (24) and (25) resides in the structure of the compound built in the second or further cycle. That is, the nonapplication of Rendaku in the second cycle as shown in (25) is attributed to an OCP violation in that cycle. As demonstrated above, Rendaku applies when the first compound member is itself a compound in the second cycle as illustrated in (26a). On the contrary, when the second compound member is itself a compound, Rendaku does not apply as shown in (26b).

(26)
a.



b.

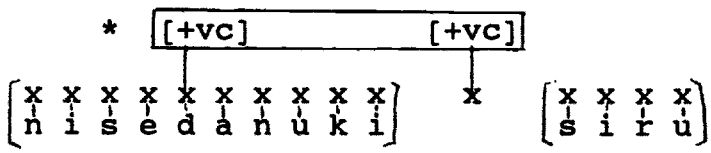


In (26b) an insertion of a [+voice] autosegment would violate the OCP since the second compound member, which is itself a compound, has a [+voice] inserted by Rendaku in the first cycle. Thus, such an insertion would be blocked; consequently, no

voicing of the word initial obstruent occurs in the second compound member. On the other hand, in (26a), there is no [+voice] present in the second compound constituent which is attached to a compound in the second cycle. The [+voice] autosegment in the plane of the first compound member inserted in the first cycle by Rendaku would not trigger an OCP violation upon insertion of the autosegment into the plane of the second compound member since the two planes are distinct. Thus, a [+voice] autosegment is allowed to be inserted into the voicing tier of the second constituent. Therefore, the word initial obstruent of the constituent becomes voiced.

Notice here that Rendaku would never apply in the second or further cycle if two members of a compound were on the same plane as in I&M's account of Rendaku. In other words, there would be no cyclic application of Rendaku. Under this non-MPH approach, a compounding such as in (26a) would have the following structure.

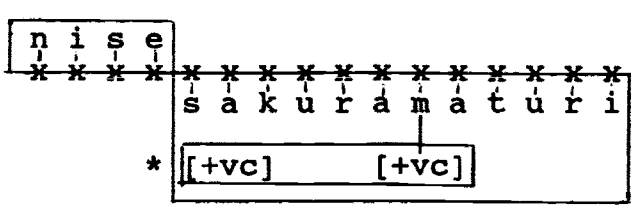
(27)



Since the the domain of the OCP is assumed to extend to the whole compound, the insertion of [+voice] at the compound juncture will be blocked by the principle. Thus Rendaku does not apply in the second cycle. However, in our MPH account, application of Rendaku in the second or further cycle in compounding is ensured as demonstrated in (26a).

Nonapplication of Rendaku in (25a) --i.e. nise-Sakuramaturi not *nise-Zakuramaturi "fake festival of cherry blossoms" -- supports our claim that the [+voice] autosegment can be associated with nonobstruents (see (23b)). The voicing tier of the second compound member (sakuramaturi "festival of cherry blossoms"), which is built in the first cycle, contains [+voice] as shown in (28).

(28)



Thus, an insertion of [+voice] will be blocked since it would violate the OCP. As a result, Rendaku does not apply in this compounding which is in the second cycle.

To sum up, with our present view of Rendaku, this phenomenon is accounted for as an insertion of a [+voice] autosegment into the voicing tier of the second compound member. Under the Morphemic Plane Hypothesis account of Rendaku, the OCP does not block [+voice] insertion into the plane of the second compound member when the first member has a [+voice] either underlying or inserted in the previous cycle because the domain of the OCP is the plane of the former. Moreover, without relying on a diacritic use of a skeleton and the Voicing Spread as I&M do, the inserted

autosegment automatically docks to the leftmost segment, if unspecified for voicing in the UR, by the Universal Association Convention.

2. Syllabification

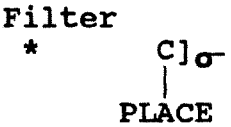
In the preceding section, it was argued that Rendaku supports the Morphemic Plane Hypothesis (MPH) and that the OCP domain is plane-internal. This section lends further support to the hypothesis that the MPH delineates domains of rule application. I will provide another argument for the MPH from a discussion of the properties of syllabification in verbal compounds. That is, syllabification in Japanese is intraplanar: two distinct planes are needed to account for syllabification in verbal compounding, which is thus assumed as cyclic.

Briefly, the Universal Core Syllable Condition (UCSC) (see Ito (1986:5)), which says that "[t]he sequence CV must belong to a single syllable," applies plane-internally in Japanese. Thus, Japanese syllabification also arguably takes place before Plane Conflation (PC) since it does not make a single core syllable from a consonant and a vowel which belong to different planes.

2.1. Syllabification in Japanese

Japanese has a CVVC syllabic template. As discussed in Itô (1986, to appear), this language has language specific conditions for syllabification. One of them is that a consonant which underlyingly has a Place Node is prohibited to appear in the coda position.[13] To account for the coda constraint, Ito (to appear) proposes the following Coda Filter:

(29) Coda Filter



(Itô (to appear:8))

which says a coda segment cannot have a Place Node. In other words, if a consonant has a Place Node it will not be syllabified as a coda. Thus, the following sequence of strings cannot be Japanese words since their syllabification violates the Coda Filter.

(30)

---

[13] If dorsal and labial consonants are specified in the UR, specification of coronal is redundant. Thus, coronal consonants universally may not have the place node underlyingly. Avery and Rice (1988) and Shaw (1988) discuss cases of coronal consonants which do not have the Place Node. If this claim is correct, we will incorrectly predict that a single coronal consonant can be syllabified as a coda of a syllable in Japanese. I will leave this problem open for further research.

Notice that every syllable in (30) is illicit for Japanese.[14]

2.2. Syllabification in Verbal Compounds

Japanese has a word formation of verb compounding, in which verb stems are combined to make verbs. The verb compounds show an interesting property with respect to syllabification: the domain of Japanese syllabification is plane-internal. That is, as presented in (31), when a stem final consonant is followed by a stem initial vowel (i.e., a -C-V- sequence), the two segments are not syllabified as a core syllable. Instead, there is [i]-epenthesis to make a core syllable with the stem final consonant. In other words, Ito's UCSC, which universally interprets a -C-V- sequence as tautosyllabic, does not apply in this case.[15]

(31) a. hik + age ----> hi-ki-a-ge / *hi-ka-ge
"pull" "raise" "withdraw"
b. tum + age ----> tu-mi-a-ge / *tu-ka-ge
"load" "raise" "accumulate"
c. but + atar ----> bu-ti-a-ta-r / *bu-ta-ta-r
"hit" "crash" "collide"
d. tuk + otos ----> tu-ki-o-to-s / *tu-ko-to-s
"thrush" "drop" "push off"

One possible claim is that the first verb stem is not consonant final but actually vowel final. However, this claim is easily refuted when we observe verb conjugation. That is, when a present tense marker **-ru** or a causative morpheme **-sase** are attached to a verb stem, the morpheme initial consonant of -ru and -sase ([r] and [s], respectively) surfaces after vowels but deletes if the verb stem is consonant final, as shown in (32) and (33), respectively.[16]

(32) Verb stem + -ru
a. mi + ru ---> miru "see"
b. tuki + ru ---> tukiru "exhaust"
however,
c. hik + ru ---> hiku / *hikiru "pull"
d. tuk + ru ---> tuku / *tukiru "thrust"

(33) Verb stem + -sase
a. mi + sase ---> misase "see:caus"
b. tuki + sase ---> tukisase "exhaust:caus"

---

[14] For further discussion of the Coda Filter, see Itô (to appear). In this paper it suffices to say that a consonant cannot be a syllable coda if it has a Place Node.

[15] The status of the compound final consonant as in (31c,d) will be discussed later.

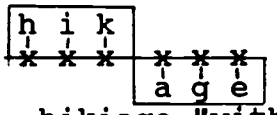
[16] I will discuss syllabification of forms containing these suffixes later in this section.

however,

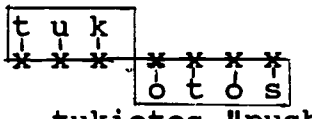
c. hik + sase ---> hikase / *hikisase "pull:caus"
d. tuk + sase ---> tukase / *tukisase "thrust:caus"

From these alternations, it is apparent that the first verb stems of the verb compounds in (31) are all consonant final. Thus, nonapplication of the Universal Core Syllable Condition must be explained.

The MPH provides us with an explanation for the phenomenon. Suppose that the two members of a compound are segregated on distinct planes, i.e. verbal compounding is cyclic. Then, the fact that a stem final consonant and a stem initial vowel in a (verb) compound are not syllabified as a core syllable is the result of this segregation: Syllabification cannot scan two distinct planes. However, if word formation is noncyclic, the two stems are presumed to be on the same plane as claimed by H&V. Then, the -C-V- sequence across stems is expected to be syllabified as a core syllable; but they are not. Therefore, a corollary is that they belong to different planes and the lack of syllabification is a result of this representation. Thus, verb compounding appears to be cyclic and two verb stems belong to different planes as shown in (34).

(34) a. 

hikiage "withdraw"

b. 

tukiotos "push off"

Given these representations, we might posit that the domain of syllabification is the morphemic plane. Thus, the stem final consonant and the stem initial vowel cannot be syllabified as a core syllable since they belong to separate planes. Moreover, in the plane internal syllabification, the stem final consonants cannot be a coda since those consonants have a Place Node[17]: the Coda Filter would block such an ill-formed syllable structure. I follow Ito (to appear:15) in assuming that the stem final consonant is assigned a syllable node since it does not fit into the preceding syllable. Thus the verb compounds have the following syllabification.

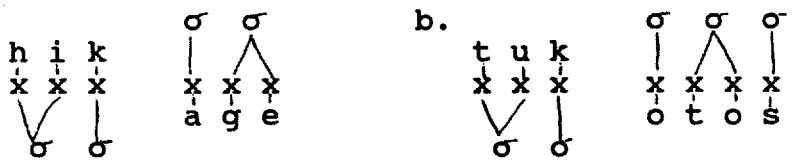
---

[17] If we assume that coronal consonants do not have a Place Nodes, /t/ as in but + atar , or /n/ as in sin + isog, is expected to be syllabified as a coda. Thus, there would be no epenthesis. However, this claim is not correct as shown below.

a. butiatar-u / *butatar-u "crash:prs"
b. siniisog-u / *sinisog-u "haste to die:prs"

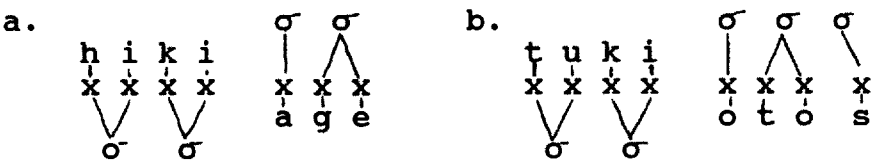
Thus, it appears that either these coronals have a Place Node or the Code Filter is not correctly stated.

(35)



Since the stem final consonant in each case cannot consist of a syllable by itself, a vowel is inserted so that the consonant and this epenthetic vowel are syllabified as a core syllable. In this case of verb compounding, a high front vowel [i] is inserted.[18] As a result, the epenthesis will result in the following.

(36)



Notice here that the compound final consonant is also unsyllabifiable. To the verb compounds, suffixes such as **-ru** "present tense" and **-sase** "causative" are concatenated. Although properties of these morphemes with respect to cyclicity are not clear yet, the leftmost vowel will be syllabified with the compound final consonant presumably after consonant deletion (see (32) and (33)). Thus, we will have the following outputs after the suffixation, where the hyphens indicate syllable boundaries.

(37)
a. hik + age + ru --> hi-ki-a-ge-ru "withdraw:prs"
b. tuk + otos + ru --> tu-ki-o-to-su "push off:prs"

However, when a zero suffix is attached in order for the compounds to be nominalized, the epenthetic vowel is inserted after the compound final consonant as illustrated in (38).

(38)
a. hik + age + ø ---> hi-ki-a-ge "withdraw:nom"
b. tuk + otos + ø ---> tu-ki-o-to-si "push off:nom"
c. tor + kum + ø ---> torikumi "match:nom"

Moreover, the nominative forms of verbal compounds support our claim that each verbal stem has its own plane. Some nominative forms of verbal compounds undergo Rendaku as demonstrated in (39). As discussed in Section 1.3., Rendaku, which applies before Plane Conflation, is a cyclic process which requires that the

---

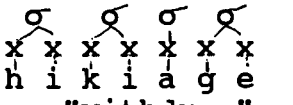
[18] An epenthetic vowel is usually the least specified one. (See Archangeli (1984) for discussion of this matter.) However, the status of [i], in this epenthesis, with respect to underspecification is beyond the scope of this paper.

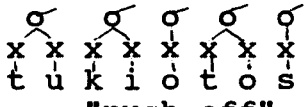
two compounds members be on distinct planes.[19]

(39)
a. kaw + tame + ø ---> kaidame
   "buy" "store" "hording"
b. tukaw + her + ø ---> tukaiberi
   "use" "decrease" "wear and tear"
c. mi + koros + ø ---> migorosi
   "see" "kill" "letting a person die before one's eye

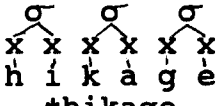
Therefore, the application of Rendaku to nominal forms of verbal compounds supports the hypothesis that the verbal stems are segregated on distinct planes.

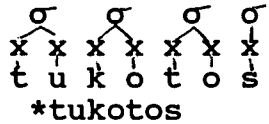
After the epenthesis, Plane Conflation takes place to result in the following.

(40) a. 
"withdraw"

b. 
"push off"

Notice that syllabification and epenthesis must precede plane conflation. If the order of the processes is reversed, the -C-V- sequence of the stem final consonant and the stem initial vowel would be interpreted as tautosyllabic, as shown in (41): since they now belong to the same plane, there would be no obstruction to the UCSC.

(41) a. 
*hikage


*tukotos

These forms, however, are unacceptable. Therefore, syllabification and vowel epenthesis must precede PC.

To summarize, nonapplication of the Universal Core Syllable Condition to verb compounds in Japanese is a result of intraplanar syllabification. In Japanese where Syllabification applies before PC, the Universal Core Syllable Condition cannot put together an interplanar -C-V- sequence, which are segregated on distinct planes according to the MPH, as a core syllable. Moreover, a stem final consonant cannot be syllabified as a coda because of the Coda Filter. As a result, [i]-epenthesis applies. Furthermore, segregation of verbal stems on distinct planes is supported by the fact that Rendaku applies to certain nominalized

---

[19] In (39a,b) [w] deletes before [i], an epenthetic vowel in this case. If fact [w] deletes before every non-low vowel.

a. waraw + ru ---> warau "laugh:prs"
b. waraw + e ---> warae "laugh:imp"
c. waraw + oo ---> waraoo "let's laugh"

forms of verb compounds.

4. Conclusion

The MPH predicts: 1) some phonological domains may be intraplanar, and 2) if a morpheme has its own plane, it is cyclic; thus phonological processes applied only within the plane before Plane Conflation are also cyclic. In this paper, it has been demonstrated that Japanese compounding supports these predictions. Rendaku has revealed that Japanese compounding is cyclic, thus two members of a compound must be segregated on distinct planes. It has been shown that Plane Conflation must take place after each cycle. Otherwise, we would expect Rendaku to apply in some compounds where it should be blocked by the OCP. Furthermore, nonapplication of Rendaku in compounds whose second constituents are themselves compounds reveals that the domain of the OCP extends to the whole plane. On the other hand, nonapplication of the Universal Core Syllable Condition to a interplanar -C-V- sequence in verbal compounds has shown that syllabification in Japanese is intraplanar.

REFERENCES

Archangeli, D. (1984) Underspecification in Yawelmani Phonology and Morphology, doctoral dissertation, MIT, Cambridge, MA.

Cole, J. (1987) Planar Phonology and Morphology, doctoral dissertation, MIT, Cambridge, MA.

Halle, M. and J.R. Vergnaud (1987a) An Essay on Stress, MIT Press, Cambridge, MA.

_____ (1987b) "Stress and the Cycle," Linguistic Inquiry 18, 45-84.

Itô, J. (1986) Syllable Theory in Prosodic Phonology, doctoral dissertation, University of Massachusetts, Amherst.

_____ (to appear) "A Prosodic Theory of Epenthesis," Natural Language and Linguistic Theory 19.

Itô, J. and R.A. Mester (1986) "The Phonology of Voicing in Japanese: Theoretical Consequences of Morphological Accessibility," Linguistic Inquiry 17, 49-73.

Kindaichi, K. (1976) "Rendaku no kai," Shophia Linguistica II, 1-22.

Kiparsky, P. (1982) "Lexical Phonology and Morphology," Linguistics in the Morning Calm, Hanshin Publishing Co., Seoul, Korea.

_____ (1985) "Some Consequences of Lexical Phonology," Phonology Yearbook 2, 82-138.

McCarthy, J.J. (1979) Formal Problems of Semitic Phonology and Morphology, doctoral dissertation, MIT, Cambridge, MA.

_____ (1981) "A Prosodic Theory of Nonconcatenative Phonology," Linguistic Inquiry 12, 373-418.

_____ (1986) "OCP Effects: Gemination and Antigemination," Linguistic Inquiry 17, 373-418.

McCawley, J.D. (1968) The Phonological Components of a Grammar in Japanese, Mouton, The Hague.

Motohashi, T. (1987) "Rendaku and Geminates in Japanese," ms., University of Arizona, Tucson.
Murasugi, K. (1988) "A Lexical Approach to Rendaku and Velar Nasalization," Cahiers Linguistiques D'Ottawa, University of Ottawa, Ottawa, Canada.
Leben, W. (1973) Suprasegmental Phonology, doctoral dissertation, MIT, Cambridge, MA.
Otsu, Y. (1980) "Some Aspects of Rendaku in Japanese and Related Problems," MIT Working Papers 2.
Oyakawa, T. (1988) "Some Remarks on Japanese rendaku (I)," ms., University of the Ryukyus, Okinawa, Japan.
Pulleyblank, D. (1986) Tone in Lexical Phonology, Reidel, Dordrecht.
Vance, T. (1987) An Introduction to Japanese Phonology, SUNY Press, Albany, N.Y.
Yamaguchi, Y. (1987) "Kodai-go no hukugoo-go ni kansuru iti-koosatsu -- rendaku-o megutte,"
Yip, M. (1988) "The Obligatory Contour Principle and Phonological Rules: A Loss of Identity," Linguistic Inquiry 19, 65-100.