Senior Thesis in Linguistics:

Issues in *Rendaku:*
Solving the Nasal Paradox and
Reevaluating Current Theories
of Sequential Voicing in Japanese

James Low
Pomona 2009

Section 1.1: Introduction*

Rendaku (連濁), or Sequential Voicing, is a process that occurs in Japanese compounds wherein the initial voiceless obstruent of the second element becomes voiced. This phenomenon has been the subject of much study because of its extreme irregularity, to the point that it led one researcher to remark, "I am unable to state the environment in which the 'voicing rule' applies. The relevant data are completely bewildering" (McCawley, 1968 qtd. in Vance, 1982, 333). Understanding *rendaku* is not entirely without hope, however, for recent studies have provided many interesting insights into the subject. In this paper I will first introduce the basic facts of *rendaku* and its history, and then will delve further into the details, looking at some of the many interesting approaches to the complexities of this confusing phenomenon. Finally, I will focus in on one specific set of problems and propose a solution that turns out to have important implications for the greater theory of *rendaku* mechanics in general.

1.2: The Basics of *Rendaku*

Japanese syllabic structure is CV or CVṆ, with Ṇ referring to the moraic nasal.[1] The phonemic voiceless obstruents of Japanese are /k/, /s/, /t/, and /h/. /s/ is realized as [ʃ] before /i/, /t/ is realized as [tʃ] before /i/ and [ts] before /u/, and /h/ is realized as [ç] before /i/ and [ɸ] before /u/. For typographical convenience, I will be using the common Hepburn Romanization as used

[1] The word-final moraic nasal was introduced into Japanese from Chinese around the 6th or 7th century, and only began appearing in native words later. Also, though word-internal moraic nasals are now common even in native words, it is near impossible to find a word-final Ṇ from the native lexicon (Vance, 1982).

by Masuda (1972), wherein IPA [ʃ] is written as "sh," [tʃ] - "ch," [ç] - "h," [ɸ] - "f," [ʤ] - "j,"

and [j] - "y."

All word-initial voiceless obstruents are susceptible to *rendaku*, no matter what the

following vowel may be. Consider the following examples from Ito and Mester (1986):

(1) /k/ - [g] Alternation

a.	iro	+	kami	→	irogami	
	'color'		'paper'		'colored paper'	
b.	asa	+	kiri	→	asagiri	
	'morning'		'mist'		'morning mist'	
c.	de	+	kuchi	→	deguchi	
	'leave'		'mouth'		'exit'	
d.	eda	+	ke	→	edage	
	'branch'		'hair'		'split hair'	
e.	unari	+	koe	→	unarigoe	
	'moan'		'voice'		'groan'	

(2) /s/ - [z]/[j] Alternation

a.	yo	+	sakura	→	yozakura
	'night'		'cherry'[2]		'blossoms at night'
b.	inu	+	shini	→	inujini
	'dog'		'death'		'useless death'
c.	maki	+	sushi	→	makizushi
	'rolled'		'sushi'		'rolled sushi'
d.	mizu	+	seme	→	mizuzeme
	'water'		'torture'		'water torture'
e.	hoshi	+	sora	→	hoshizora
	'star'		'sky'		'starry sky'

(3) /t/ - [d]/[j]/[dz][3] Alternation

a.	e	+	tako	→	edako
	'picture'		'kite'		'picture kite'
b.	hana	+	chi	→	hanaji
	'nose'		'blood'		'nosebleed'

---

[2] Though Ito and Mester (1986) here translate *sakura* as 'cherry,' a more accurate translation would be 'cherry blossom,' the fruit instead being *sakurambo*.
[3] For many speakers, [z] and [dz] are in free variation (Vance, 1987), so henceforth any "z" or "dz" should be read with that in mind.

c.	kokoro +	tsukai	→	kokorodzukai	
	'heart'	'usage'		'consideration'	
d.	yama +	tera	→	yamadera	
	'mountain'	'temple'		'mountain temple'	
e.	yu +	toofu	→	yudoofu	
	'hot water'	'tofu'		'boiled tofu'	

(4) /h/ - [b] Alternation[4]

a.	ike +	hana	→	ikebana	
	'arrange'	'flower'		'ikebana' (The art of flower arrangement)	
b.	tabi +	hito	→	tabibito	
	'journey'	'person'		'traveler'	
c.	kake +	futon	→	kakebuton	
	'cover'	'futon'		'top futon'	
d.	hanashi +	heta	→	hanashibeta	
	'talk'	'bad'		'poor talker'	
e.	suna +	hokori	→	sunabokori	
	'sand'	'dust'		'storm dust'	

The above data can be summarized by the following generalization:

(5)

k	→	g
s/sh	→	z/j
t/ch/ts	→	d/j/dz
h/f	→	b

Though the relations may seem a little haphazard in IPA or Romanization, they are actually very easily represented in the Japanese writing system by the simple addition of *dakuten* (濁点) voicing marks.[5]

Rendaku is not confined to two-word compounds, but can appear multiple times in complex compounds such as in (6) (Ito & Mester, 1986):

---

[4] This alternation results from a historical change /p/ > /∅/ > /h/, so where historically word-initial /p/ would voice to [b], modern /h/ maintains the same voicing relationship and voices to [b] (Vance, 1982).
[5] For example, the set {sa, shi, su, se, so – za, ji, zu, ze, zo} is written as {さ,し,す,せ,そ – ざ,じ,ず,ぜ,ぞ}

(6) a. ori + gami b. ori + gami + dana c. ori + gami + dana + dzukuri
    'paper folding'   'origami shelf'   'origami shelf making'

ori	kami		ori	kami	tana		ori	kami	tana	tsukuri
	↓			↓	↓			↓	↓	↓
	g			g	d			g	d	dz

[[fold] paper] [[[fold] paper] shelf] [[[[fold] paper] shelf] making]
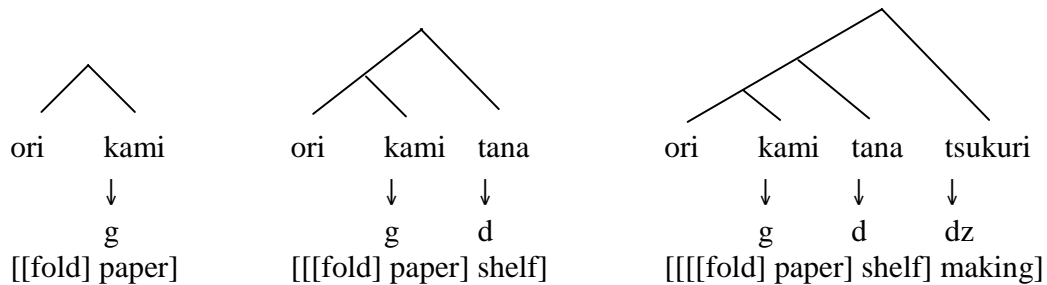
1.3: Lyman's Law

    Though the examples above show the fairly simple mechanics behind *rendaku* at work, there are an incredible amount of complicating factors once we look at more data. First, let us consider the examples in (7):

(7) a. oo + kata → oogata
       'big'   'size'   'big size'

    b oo + kaze → ookaze
       'big'   'wind'   'big wind'

    c. juzu + tama → juzudama
       'rosary'   'beads'   '(prayer) beads'

    d. juzu + tsunagi → juzutsunagi
       'rosary'   'sequence'   'roping together'   (Tsujimura, 2007)

    e. oo + sakuraN̩bo → oosakuraN̩bo
       'big'   'cherry'   'big cherry'   (Otsu, 1980)

These data reflect an effect often called Lyman's Law, named after the first non-Japanese to write about it.[6] According to Lyman's Law, if the second element of a compound already contains a voiced obstruent, then the voicing effect of *rendaku* will be blocked. As we can see with (7d) and (7e), it does not matter how deep into the word the voiced obstruent is; its presence will always block *rendaku*. (7a) shows that unvoiced obstruents do not trigger Lyman's Law.

---

[6] Lyman was not the first to notice this effect, however. Namely, Japanese scholar Norinaga Motoori (1730-1801) explicitly stated the same rule as Lyman. (Vance, 1982)

Furthermore, as can be seen in (7c-e), vowels, nasals and other sonorants also do not trigger Lyman's Law.

1.4: Otsu's Right Branch Condition

Let us now consider some more complex compounds similar to the ones in (6) above. In compounds like (8), (9) (Otsu, 1980), and (10) (Tsujimura, 2007) below, we can see that the activation of *rendaku* seems to rely partly upon the morphological structure of the compound.

(8)   nise +   tanuki +   shiru
       'pseudo'   (raccoon dog) 'soup'

a.   b.

nise   tanuki shiru   nise   tanuki shiru
     ↓   ↓   ↓
     d   j   j
[[pseudo tanuki] soup]   [pseudo [tanuki soup]]
'soup made from a fake tanuki'   'a tanuki soup that is fake'
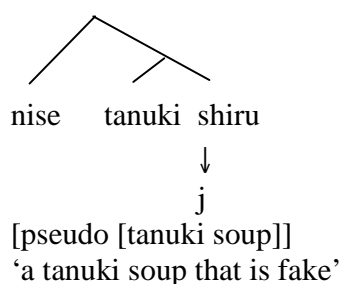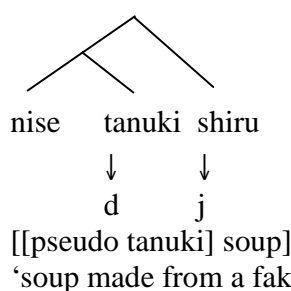
(9)   nuri +   hashi +   hako
       'lacquered'   'chopsticks'   'box'

a.   b.

nuri   hashi hako   nuri   hashi hako
     ↓   ↓   ↓
     b   b   b
[[lacquered chopsticks] box]   [lacquered [chopsticks box]]
'a box for lacquered chopsticks' 'a lacquered box for chopsticks'
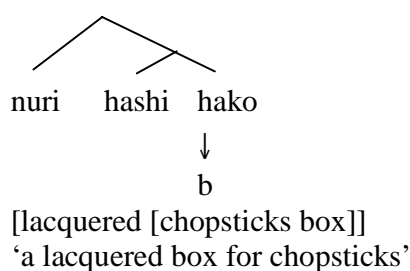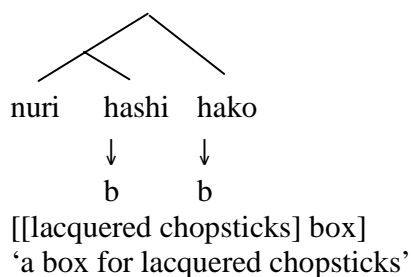
(10) nuri + kasa + ire
      'lacquered' 'umbrella' 'case'
a.   b.

[[lacquered umbrella] case]   [lacquered [umbrella case]]
'a case for lacquered umbrellas' 'a lacquered case for umbrellas'
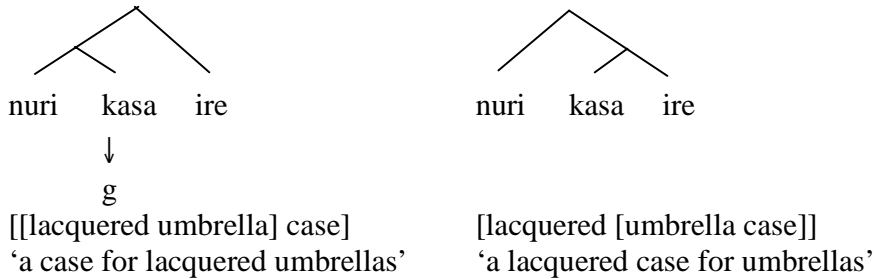
In (8) and (9), we can clearly see how the morphological structure of the compound either blocks or activates *rendaku*. We could posit that in the (b) compounds, the first compounding results in a voiced obstruent, so naturally in the higher compounding stage its presence should activate Lyman's Law and block voicing. This intuitively makes sense, but when we look at (10), that explanation does not hold up. If the compounding of /kasa/ and /ire/ does not result in a voiced obstruent, why should it block *rendaku* in the higher compound?[7] What is special about these compounds with vowel-initial elements? Our results can be summarized as follows:

(11) a.   b.
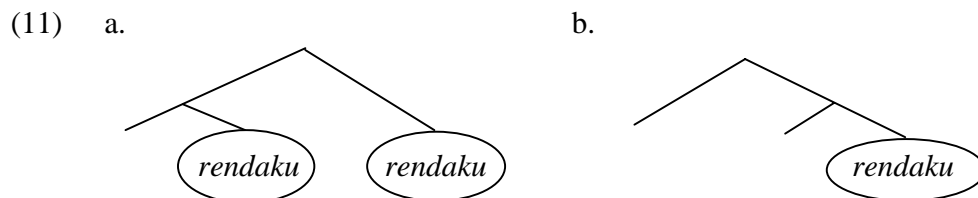
This inconsistency led Otsu to propose the Right Branch Condition, stating that "*Rendaku* applies only when a potential *rendaku* segment is in a right branch constituent" (1980, 219). We shall revisit this analysis later, as many eventually came to criticize it.

---

[7] Though Otsu does not use this example, the hypothetical compound *nuri+kasa+hako* would behave in exactly the same way as *nuri+hashi+hako* in (9), so the data in (10) are not the result of some unique property of *kasa* (Kurita, personal communication).

Section 2: More Exceptions to *Rendaku*

2.1: Lexical Stratification

      There are many other kinds of exceptions to *rendaku*. The most commonly noted one is

that *rendaku* applies most heavily in the native Yamato lexicon.[8] Some scholars go so far as to

say that "*Rendaku* is restricted to [+Yamato] morphemes" (Ito & Mester, 1986, 54), while others

make the slightly weaker claim that "The second element should be *wago* (…as opposed to

kango…and *gairaigo*)" (Otsu, 1980, 208).[9] Looking at the data in (12) along with those in (13),

it should be clear that the issue is not as simple as [±Yamato]:

(12) [-Yamato] Blocks *Rendaku*

a.	nise +	kane	$\rightarrow$	nisegane	
	'fake'	'money'		'counterfit money'	
		[+Yamato]			
b.	nise +	kiN̩	$\rightarrow$	nisekiN̩[10]	
	'fake'	'money'		'counterfit money'	
		[+Sino-Japanese]			(Ito & Mester, 1986)
c.	biN̩boo +	kami	$\rightarrow$	biN̩boogami	
	'poverty'	'god'		'god of poverty'	
		[+Yamato]			
d.	biN̩boo +	shoo	$\rightarrow$	biN̩booshoo	
	'poverty'	'disposition'		'disposition to living stingily'	
		[+Sino-Japanese]			
e.	yasu +	heya	$\rightarrow$	yasubeya	
	'cheap'	'room'		'cheap room'	
		[+Yamato]			
	yasu +	hoteru	$\rightarrow$	yasuhoteru	
	'cheap'	'hotel'		'cheap hotel'	
		[+Gairaigo]			

---

[8] The Japanese lexicon can be broken up into four sub-groups: native Yamato (和語, *wago*); Sino-Japanese (漢語,
kango); other foreign loan words (外来語, *gairaigo*); and ideophonic/onomatopoeic (Ito & Mester, 1986).
[9] The lexical sub-group of the first word (the trigger) does not matter, as will be explained further in (16).
[10] Kurita (personal communication) challenges the validity of this word, saying she has never heard it.

(13) [-Yamato] Exhibits *Rendaku*

a.	booeki +	kaisha	→	booekigaisha
	'trade'	'company'		'trading company'
		[+Sino-Japanese]		
b.	iṆdo +	karee	→	iṆdogaree[11]
	'India'	'curry'		'Indian curry'
		[+Gairaigo]		(Otsu, 1980)
c.	hana +	karuta	→	hanagaruta
	'flower'	'cards'		'flower cards' (a card game)
		[+Gairaigo] (from Portuguese *carta*)		
d.	mizu +	kiseru	→	mizugiseru
	'water'	'pipe'		'hookah'
		[+Gairaigo] (from Cambodian *khsier)*		
e.	yama +	kyaṆpu	→	yamagyaṆpu[11]
	'mountain'	'camp'		'mountain camp'
		[+Gairaigo]		(Vance, 1987)

Vance (1987), citing Okumura (1952, 1955) says that in the past, many two-morpheme

Sino-Japanese compounds used to exhibit *rendaku* but have since lost that trait. Fukuzawa and

Kitahara (2001) point out that voicing in Sino-Japanese compounds can be semantically

contrastive, as in (14):

(14) a. kaṆ   +   too   →   kaṆtoo
         'pass' (関)   'East' (東)   'Kanto' (An Eastern area of Japan)
      b. kaṆ   +   doo   →   kaṆdoo
         'feeling' (感)   'movement' (動) 'to be moved emotionally'

While it might be argued that *rendaku* is less common in Sino-Japanese words in order to avoid

possible semantic ambiguity, there are numerous examples of homophonic Sino-Japanese

morphemes (such as *kan* and *kan* in (14) above), so that argument is invalid.

---

[11] Apparently the acceptability of (b) and (e) is not entirely agreed upon by all scholars (Otsu, 1980), so some see these as evidence of a gradual change taking place with foreign words becoming more accepted into the native lexicon with the passage of time. In contrast, Kurita (personal communication), argues instead that modern speakers are probably more aware of divisions between foreign and native words because of recent standardizations in the spelling system. In modern times, the *katakana* script is generally used for non-native words and sounds, while *hiragana* is reserved for words that are considered more native. In the past these roles were not as clear. There still exist many *gairaigo* words that are written in *hiragana*, and some that can even be written in Chinese characters, and many young Japanese may be unaware of these words' foreign roots. Kurita proposes that with the clearer distinction between foreign and native in the modern Japanese writing system, speakers may be less likely to apply native grammar rules to foreign words.

Vance (1987) also notes that Sino-Japanese compounds will still commonly exhibit

rendaku when the second element is a *Kango* binom (consists of two Chinese characters):

(15) a. uṆdoo +   fusoku (不足) →   uṆdoobusoku
          'exercise'   'insufficiency'   'lack of exercise'
      b. ko   +   kaisha (会社) →   kogaisha
          'child'   'company'   'subsidiary company'   c.f. (13a)

It should also be noted that though there is certainly much restriction against *rendaku*

occurring in [-Yamato] words, words from any sub-group of the lexicon can be *rendaku* triggers:

(16) a. eiga   +   suki   →   eigazuki
          'movies'   'fans'   'movie fans'
          [+Sino-Japanese]
      b. garasu   +   to   →   garasudo
          'glass'   'door'   'glass door'
          [+Gairaigo]
      c. arabia   +   kami   →   arabiagami
          'Arabia'   'paper'   'paper made in Arabia'
          [+Gairaigo]
      d. chaaruzu   +   kawa   →   chaaruzugawa
          'Charles'   'river'   'The Charles River'
          [+Gairaigo]   (Otsu, 1980)
      e. booru   +   hako   →   boorubako
          'ball'   'box'   'ball bin'
          [+Gairaigo]

2.2: Differences between Types of Compounds

Various scholars have noted that there are a few distinct types of compounds in Japanese,

and their *rendaku* patterns vary. Otsu (1980) identifies three types of compounds:

(17) Strict Compound   ex. [$_N$#kara(+)kami#]   'a paper sliding door'
                               'China' 'paper'
      Loose Compound   ex. [$_N$#[$_N$#kara#][$_N$#gami#]#]   'Chinese paper'
                                                                  or 'Arabic,' 'American,' etc.
      Dvanvda Compound   ex. [$_{N'}$#[$_{N'}$#yama#][$_{N'}$#kawa#]#]   'mountains and rivers'
                               'mountain'   'river'

Strict compounds never exhibit *rendaku*, are unproductive, and their meanings are unpredictable from their component parts. Otsu argues that strict compounds must be learned by children as single lexical entries, and notes that when they appear in larger compounds, they pattern according to his Right Branch Condition, as in (18):

(18) oo + karakami → oogarakami
      'large'   'a large paper sliding door'   (Otsu, 1980)
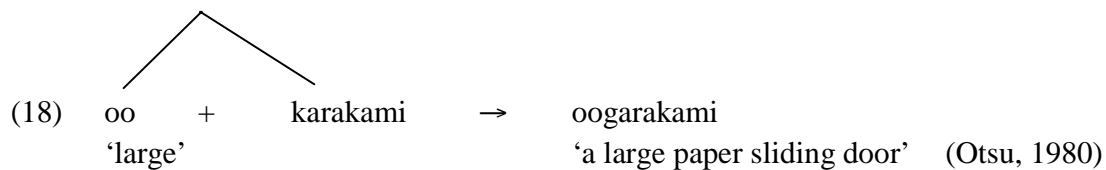
Accordingly, Vance (1987) argues that Otsu would analyze the Sino-Japanese binom compounds in (15) like (18) above.

Loose compounds, where the first element modifies the second, are the most common and most productive type. *Rendaku* tends to apply most regularly in this situation.

Dvanda compounds are compounds that have an "X and Y" meaning. Since dvanda compounds never show *rendaku*, there can be interesting semantic contrasts between compounds that share the same elements but not the same voicing patterns. For example, the dvanda compound in (17) [yamakawa] 'mountains and rivers' contrasts with the loose compound [yamagawa] 'mountain river,' which shows *rendaku*.[12]

Vance (1987) notes a few additional kinds of compounds. The first are reduplicated words, and there are inconsistencies here as well. Consider (19) below:

(19) a. hito x2   →   hitobito
          'person'   'people' n.
      b. shimi x2   →   shimijimi
                          'keenly,' 'heartily' adv.
      c. haki x2   →   hakihaki
                          'briskly' adv.

---

[12] Kurita (personal communication) challenges the validity of these words, but agrees that the basic theory is sound.

The ideophonic/onomatopoeic class contains many adverbial reduplicated words which in general do not exhibit *rendaku*, and we will return these for a possible explanation after we have discussed the history of *rendaku*.

Vance also discusses compounds of what are referred to as "inflected words" (用言, *yoogen*) in Japanese: verbs and adjectives. When these words combine, the first element must be in its uninflected stem form, which is also interpretable as a noun form. Adj.+Adj. and V+Adj. compounds that show *rendaku* are common,[13] but V+V are apparently very rare. Here are some examples in (20):

(20) a.   usu +   kurai   →   usugurai
           'pale'   'dark'   'dim'
           Adj. stem   Adj.   Adj.

    b.   mi +   kurushii   →   migurushii
           'look'   'painful'   'unsightly'
           V stem   Adj.   Adj.

    c.   ura +   kiru   →   uragiru
           'back'   'cut'   'betray'
           N   V   V

    d.   nori +   kaeru   →   norikaeru
           'board'   'change'   'change (trains, etc.)'
           V stem   V   V

    e.   nori +   kae   →   norikae
           'board'   'change'   'transfer'
           V stem   V stem   N

    f.   iki +   tomaru   →   ikidomaru
           'go'   'stop'   'reach an impasse'
           V stem   V   V

    g.   wakachi +   kaku   →   wakachikaku[14]
           'divide'   'write'   'write with spaces between the words'
           V stem   V   V

---

[13] Vance actually just says that this is his "intuition" and has "no real evidence to offer," but in comparison to the very real lack of V+V *rendaku* compounds, it does not seem like the most radical claim to make.

[14] According to Kurita (personal communication), this verb form is almost never heard. Apparently, the influence of the more commonly used set noun phrase *wakachigaki* in (20h) is so strong that speakers tend to instead opt to use a combination of *wakachigaki* and the verb *suru* 'to do.'

h.	wakachi +	kaki	→	wakachigaki
	'divide'	'write'		'writing with spaces between the words'
	V stem	V stem		N

(20a-c) are typical examples of the kinds of *yogen* compounds that will exhibit *rendaku*, whereas (20d-h) show how inconsistent V+V compounds can be. Apparently those of type (20d,e) with both verb and noun form showing no *rendaku* are most common, while those of type (20g,h) that do not show *rendaku* in the verb form but do in the noun form are very rare. As summarized by Vance, Sakurai (1966) would analyze those of type (20f) not as V+V, but as N+V, the understanding being something like "going stops." This almost makes sense; however, Vance points out that it then becomes very difficult to judge when an initial V stem is being treated as a noun, and there is a danger of judging based solely upon whether or not the word shows *rendaku*, which cannot really be the right solution because it is dangerously circular.

True N+V compounds require a little more discussion, however. Vance notes a contrast in voicing that might depend on whether or not the first noun is being used as a direct object or as an "adverbial modifier." Consider the data in (21) below:

(21) a. yane   +   fuki →   yanefuki
          'roof'   'covering'   'covering a roof'
          N   V stem   N
                    cf. /yane o fuki/ 'cover a roof,' /o/ direct object
      b. kawara   +   fuki →   kawarabuki
          'tile'   'covering'   'tiling a roof'
                    cf. /kawara de (yane o) fuki/ 'cover (a roof) with tile,' /de/ instrumental
      c. mijiṆ   +   kiri →   mijiṆgiri
          'bit'   'cut'   'mincing'
      d. garasu   +   kiri →   garasukiri
          'glass'   'cut'   'glass cutter'

In (21a,d), the first element is the direct object of the verb and does not show *rendaku*, but in (21b,c) the first element is more of a modifier; we could define these compounds as 'covering

with tiles' and 'cutting in bits.' The form in (22), though, is a counterexample to the

generalization above, with a direct object first element that still triggers *rendaku*:

(22)   zooge   +   hori   →   zoogebori
         'ivory'   'carving'   'ivory carving'

Summarized in Vance, Nakagawa (1966) notes a voicing difference between DO+V compounds

that seems to vary between abstract noun and occupational meanings:

(23)   a.   hito   +   koroshi → hitogoroshi
              'person'   'killing'   'murder'
      b.   inu   +   koroshi → inukoroshi
              'dog'   'killing'   'dog catcher'
      c.   fude   +   tsukai → fudezukai
              'writing brush'   'usage'   'handling a writing brush'
      d.   niṆgyoo   +   tsukai → niṆgyootsukai
              'puppet'   'usage'   'puppeteer'

Kurita (personal contact) argues that it is not "occupational," but "human" meanings that

might allow *rendaku*, bringing up the example *oni+koroshi→onikoroshi* 'demon killer,' which is

not a human demon hunter but actually a rather strong type of sake.[15] However, there are other

compounds with "human" meanings that do not show *rendaku*, such as *zou+tsukai→zoutsukai*

'elephant trainer' and *e+kaki→ekaki* 'painter,' so the issue is not very clear.

Before we go on to address other issues with *rendaku*, now is a convenient time to

address its possible diachronic motivations.

---

[15] On a recent restaurant trip, I actually saw this sake listed as "onigoroshi," so it seems that there are multiple attested readings.

Section 3: Japanese Post-Nasal Voicing and the History of *Rendaku*

Many scholars agree that the native Yamato lexicon has an automatic post-nasal voicing

rule that Rice (1996) presents as the constraint ***NT**, or ***[+nasal][-voi, -son]**. Ito and Mester

(1986) posit a slightly more general voicing spread rule which looks like:

      [+voice]
        ⌈- - - - -⌉
       X   X
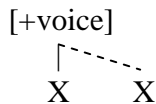
Rice and Ito and Mester argue that this rule/constraint can be seen at work in within single

morphemes as well as in inflected words:

(24)   a.   shindoi   'tired'   cf. *shintoi
         b.   tombo   'dragonfly'   cf. *tompo
         c.   unzari   'disgruntled'   cf. *unsari   (Rice, 1996)

(25)   a.   tog   +   te   /   ta   →   toide/toida
              'sharpen'   (gerund)   (past)
         b.   tok   +   te   /   ta   →   toite/toita[16]
              'solve'   (Ito & Mester, 1986)
         c.   shin +   te   /   ta   →   shinde/shinda
               'die'
         d.   kam +   te   /   ta   →   kande/kanda
               'chew'

Remember that ***NT** only applies to [+yamato] morphemes, as the examples in (14) showed

some Sino-Japanese exceptions to ***NT**.[17]

*NT plays into the discussion because it is possible that modern *rendaku* is the

descendant of a conjunction form something like /X+NV+C/, /NV/ being either the genitive *no*

or the locative/dative *ni*. For example, the modern word *kido* 'wooden gate' (from /ki/ 'wood'

and /to/ 'door) probably comes from the older phrase /ki+no+to/, and though the middle /no/ has

---

[16] The [i] results from a process of velar vocalization, according to Ito and Mester.
[17] For a [+Gairaigo] example, consider /santa kuroozu/ 'Santa Claus' (Rice, 1996).

since been lost, its effect remains (Vance, 1987).[18] Vance (1987) argues that it is possible that

rendaku's irregularity may stem from the fact that not all compounds were formed in this manner,

so there would have been no voicing trigger at all in many cases:

(26)   a.   fune   +   no   +   ki   →   funagi
             'boat'   gen.   'wood'   'wood for boat building'
       b.   fune   +   hashi   →   funahashi
             'boat'   'bridge'   'pontoon bridge'

However, ancient [funahashi] is now modern [funabashi] (Vance, 1982), so it seems plausible

that modern speakers have extended the power of *rendaku* by analogy to be greater than a simple

no/ni lineage would imply.[19]

Section 4: Revisiting the Environment of *Rendaku* and Lyman's Law

        Considering our historical discussion, the following analysis of the mechanics behind

rendaku from Ito and Mester (1986) seems quite plausible. They propose that *rendaku* inserts a

floating [+voi] at the skeletal level whose voicing then spreads to the second element via the

voicing spread rule they previously argued for. See (27):

(27)   *Rendaku*: Insert [+voi] /]__[
                                    |
                                    x

       hana + tayori:

               [+voi]
                 ⌐`⸜
       [x x x x] x [x x x x x x]
         | | | | | | | | | | →   hanadayori
         h a n a   t a y o r i   'flower tidings'

_____
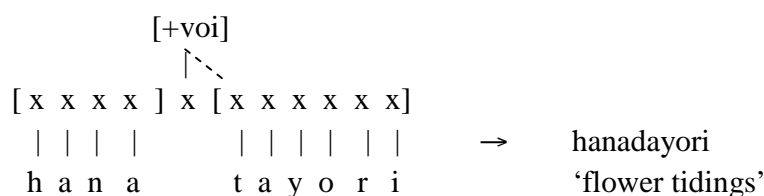
[18] A full history might look like: /X-NV-C/→/X-N-C/→/X-^{N}C/→/X-C$_{[+voi]}$/ (Vance, 1982; Ito & Mester, 1986)
[19] Because most adverbial ideophonic "compounds" probably do not result from this ancient *no/ni* construction, that could be an explanation as to why so many of them do not show *rendaku*.

Ito and Mester restate Lyman's Law in terms of the deletion of this floating [+voi] segment,

presented in (28) where x' represents the floating [+voi] segment's position in the skeleton.

(28) An Updated Lyman's Law: [+voi]→∅ / ___ [+voi]
$$|$$
x'

In other words, the floating [+voi] segment is removed from the skeleton if the second element

already contains a [+voi] segment. Note that this relies upon the underspecification for voicing

of sonorants, including nasals, as is exemplified by the /y/ and /r/ of /tayori/ above in (27). Let

us compare in (29) the different processes in the *rendaku* compound *hanadayori* and the

rendaku-blocked compound *hanakazari* 'flower decorations' (Ito & Mester, 1986):

(29)

Compounding:

```
                              [+voi]
                                 |
      [ x x x x]   [ x x x x x x ]      [ x x x x ]   [ x x x x x x]
       | | | |      | | | | | |          | | | |       | | | | | |
       h a n a      k a s a r i          h a n a       t a y o r i
```

Rendaku:

```
                [+voi]  [+voi]                    [+voi]
                   |       |                        |
      [ x x x x]  x [ x x x x x x ]      [ x x x x ] x [ x x x x x x]
       | | | |        | | | | | |          | | | |       | | | | | |
       h a n a        k a s a r i          h a n a       t a y o r i
```

Lyman's Law:

```
                    [+voi]
                       |
      [ x x x x]  ∅ [ x x x x x ]
       | | | |        | | | | | |              N/A
       h a n a        k a s a r i
```

Voicing Spread:

```
                                                   [+voi]
                                                     ⌐‑‑‑‑‑
                                        [ x x x x ] x [ x x x x x x ]
                  N/A                     | | | |       | | | | | |
                                          h a n a       t a y o r i
```

Output: hanakazari   hanadayori

More recently, many have come to see Lyman's Law as a manifestation of the Obligatory Contour Principle, which states that "At the melodic level, adjacent identical elements are prohibited" (McCarthy, 1986 qtd. in Fukuzawa & Kitahara, 2001, 85).[20] It seems that in Japanese, the OCP's domain is the single morpheme, for otherwise compounds like /tabi/ 'journey' + /hito/ 'person' → [tabibito] 'traveler' would be unacceptable. (30) shows how the OCP/Lyman's Law holds within single morpheme words:

(30) a.   C   V   C   V   ex. futa 'lid'
      b.   C   V $C_{[+voi]}$ V   ex. fuda 'sign'
      c. $C_{[+voi]}$ V   C   V   ex. buta 'pig'
      d.   *$C_{[+voi]}$ V $C_{[+voi]}$ V   ex. *buda   (Ito & Mester, 1986)

In modern terms, Lyman's Law comes into effect in *rendaku* compounds in order to avoid violating the OCP by creating two [+voi] elements in the same morpheme. Again, we rely upon the underspecification of voicing for all other segments, because first, if all elements including sonorants were specified as [+voi], then we would already have an OCP violation, and second, if unvoiced obstruents were marked for [-voi], then certain compounds which should block *rendaku* would no longer have a need to, as in (31):

(31)   [-voi] [-voi] [+voi]
                      | | |
        onna   +   k o t o b a   →   *onnagotoba
        'female'   'word'   'feminine speech'   (Clements, 2001)

The correct form in (31) is *onnakotoba*, but as depicted, specifying voiceless obstruents as [-voi] would not only allow *rendaku* voicing to work without problem, but the resulting form actually looks like the best candidate because it eliminates a [-voi][-voi] OCP violation already present in the underlying form. Obviously, then, if we are to hold to an OCP interpretation, we must stick

---

[20] Among those who have adopted this view are Fukuda and Fukuda (1994), Clements (2001), and Ito and Mester themselves (Fukuzawa & Kitahara, 2001).

to the claim that the only voicing specification present in the voicing tier is the [+voi] of voiced

obstruents.

Section 5: Nasals and the Voicing Paradox

Unfortunately, though we must rely upon the underspecification of [+voice] in nasals for

our analysis of *rendaku* to stand, this presents us with a paradox when we think about ***NT** again.

Both underspecification and ***NT** are argued to be existent phenomena, but ***NT** relies upon the

explicit specification of [+voice] on nasals in order to have any voicing to spread to the obstruent.

Furthermore, those voiced obstruents which seem to result from ***NT** activate Lyman's Law and

block *rendaku*:

(32)   a. haya   +   kane   →   hayagane 'fire bell'
                                                    *hayakane
       b. shirooto   +   kaNgae   →   shirootokangae 'layman's idea'
                                                    *shirootogangae   (Suzuki, 1997)

Suzuki (1997) studies this paradox in detail, discussing the issue mostly in terms of licensing,

working from Ito, Mester and Padgett (1995). Suzuki presents a few constraints with regards to

the problem:

(33)   a.   **LICENSING CANCELLATION**: If F ⊃ G, then ¬(F λ G)
            "If the specification F implies the specification G, then it is not the case that F
            licenses G"

       b.   **NASVOI**:   [nasal] ⊃ [voice]
            "If the segment is specified for [nasal], then the segment is also specified for
            [voice]"   (Ito, Mester & Padgett 1995 qtd. in Suzuki, 1997).

       c.   **LICENSE[VOICE]** (**LICENSE)**
            The feature [voice] must be licensed.

Accordingly, though a nasal cannot license [voice] because of (33a), since the voicing of an

obstruent is not automatic, obstruents can license [voice]. The ranking

LICENSE>>NASVOI>>FAITH, where **FAITH** is a constraint against creating or deleting

features or association lines, results in the correct selection of winning candidates, as in (34):

(34)

Input 1=/kami/; Input 2=/tompo/

	Candidates	LICENSE	NASVOI	FAITH
a. ☞	k a m i		*	

b.	k a m i
	     |
	     V
		*!		*

c. ☞	t o m b o
	     \ /
	     V
				**

d.	t o m p o
	     |
	     V
		*!		*

e.	t o m p o		*!	

f.	t o m b o
	     |
	     V
			*!	*

(Suzuki, 1997)

Personally, I feel that Suzuki's interpretation does not fit in very well with the theory of

the historical development of *rendaku* as from the combination of the disintegration of the

particles *no* or *ni* and the gradual replacement by ***NT** / Voicing Spread. Either way, continuing

with Suzuki's proposed account, he goes on to explain that we run into another problem in the

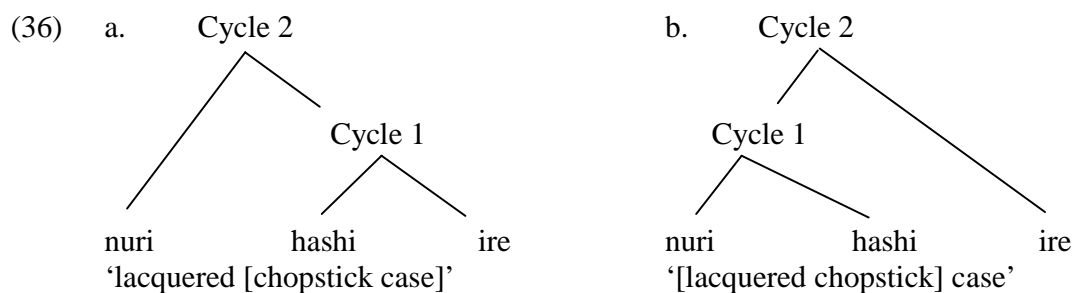case of nasal geminates, which do block *rendaku* as in (35)[21]:

(35)   a.   hana   +   kammuri   →   hanakammuri 'flower crown'
                                                                         *hanagammuri

       b.   ito   +   koɲɲaku   →   itokoɲɲaku   'thin konyaku'
                                                                            *itogoɲɲaku

       c.   yaki   +   samma   →   yakisamma   'fried saury'
                                                                           *yakizamma

---

[21] Apparently there might be some dialectical variation in the voicing behavior of these nasal-geminate containing words. Takahashi (personal communication) posits that speakers from the Kyoto area might be more likely to voice these compounds than standard Tokyo speakers.

The problem is that if a singleton nasal does not block *rendaku* and cannot license any [voice] capable of doing so, then how could an NN cluster suddenly possess a [voice] capable of activating Lyman's Law in the same way as a voiced obstruent? Unfortunately, Suzuki's ensuing solution to the problem relies upon Local Conjunction, which is very unsatisfying. We will return to this Nasal Paradox later, and I will propose a solution that not only defeats it, but also simplifies our general model of *rendaku* mechanics.

Section 6: Otsu's Right Branch Condition Revisited

Ito and Mester (1986) were unsatisfied with Otsu's RBC, feeling that it conflicted with the Atom Condition, summarized as "In lexical derivations from X, only features realized on X are accessible" (49). Feeling that his interpretation wrongly gave *rendaku* access to the morphological structure of its input, Ito and Mester pointed out that under their interpretation, the RBC is completely unnecessary. All rules apply cyclically, and (36) shows the full process involved in the compound /nuri + hashi + ire/:

(36)   a.   Cycle 2   b.   Cycle 2

                        Cycle 1   Cycle 1

       nuri   hashi   ire   nuri   hashi   ire
       'lacquered [chopstick case]'   '[lacquered chopstick] case'

Cycle 1 a.   b.

Compounding [x x x x]   [x x x]   [x x x x]   [x x x x]
             | | | | | | | | | | | | | | |
             h a sh i   i r e   n u r i   h a sh i

                    [+voi]   [+voi]
                      | |
Rendaku   [x x x x]   x   [x x x]   [x x x x]   x   [x x x x]
             | | | | | | | | | | | | | | |
             h a sh i   i r e   n u r i   h a sh i

Lyman's Law   N/A   N/A

                                      [+voi]
                                    ⌐ - - - - ˎ
Voicing Spread   N/A   [x x x x]   x   [x x x x]
                              | | | | | | | |
                            n u r i   h a sh i

Cycle 2   a.   b.

                           [+voi]   [+voi]
                              | ∖
Compounding [x x x x]   [x x x x x x x]   [x x x x x x x x]   [x x x]
             | | | | | | | | | | | | | | | | | | | | | |
             n u r i   h a sh i i r e   n u r i h a sh i   i r e

                  [+voi]   [+voi]   [+voi]   [+voi]
                  | | ∖ |
Rendaku   [x x x x] x [x x x x x x x]   [x x x x x x x x] x [x x x]
             | | | | | | | | | | | | | | | | | | | | | |
             n u r i   h a sh i i r e   n u r i h a sh i   i r e

                         [+voi]
                          |
Lyman's Law [x x x x] ∅ [x x x x x x x]   N/A
             | | | | | | | | | | |
             n u r i   h a sh i i r e

Voicing Spread   N/A   N/A

Output   nuri hashi ire   nuri bashi ire
                  'lacqured [chopstick case]'   '[lacquered chopstick] case'
                              cf. (10) /nuri + kasa + ire/

As can be seen in (36a), though in the initial compound /hashi+ire/ the floating [+voi] does not spread onto the /i/, it still remains present in the structure and activates Lyman's Law in the later compounding. Since this paper came out, most authors no longer mention the Right Branch Condition. Even in modern Optimality Theory-based analyses of *rendaku*, many scholars include Ito and Mester's floating [+voi] as a kind of **INSERT([+VOI])** (Clements, 2001) or **REALIZE-MORPHEME** (Fukuzawa & Kitahara, 2001) constraint that then acts in just the same way as before with regards to the OCP. Later I will return to this analysis and show how it actually has residual problems related to the nasal paradox. Consequently, I will propose an alternative model that streamlines our overall approach to *rendaku*.

Section 7: Murasugi's Lexical Phonology Approach

Murasugi (1988) praised Ito and Mester (1987) for eliminating the need for the RBC, but said "As an explanation or description of the processes involved in *rendaku* it is original and well-founded, but it lacks depth as a theory in its failure to predict the occurrence of *rendaku*" (61). This criticism is warranted, for nowhere in their paper did they address the many inconsistencies in *rendaku* such as those discussed here in Section 2.

Murasugi (1988) goes on to apply a Lexical Phonology-based analysis to *rendaku* and ends up with a fairly satisfying explanation. Working from Kiparsky (1982) and Mohanan (1982), she states the basic theory behind Lexical Phonology as being "At each level of morphological derivation there is a set of phonological rules associated with the morphological processes at that level. The phonological rules are ordered with respect to each other, but the morphological ones are not" (65). Furthermore, each successive level has no access to the

internal morphological structure of its input. Murasugi (1988) provides her map of Japanese's

levels as in (37):

(37)   Level 1 (Derivation)
          Morphological Rules:
               Affixing (prefixing and suffixing)
          Phonological Rules:
               None relevant
     Level 2 (Co-compounding/Dvanda)
          Morphological Rules:
               Honorification (prefixing)
               Dvanda
               Onomatopoeic Reduplication
          Phonological Rules:
               None relevant
     Level 3 (Subcompounding/Loose Compounding)
          Morphological Rules:
               Compounding
               Reduplication (non-onomatopoeic)
          Phonological Rules:
               Rendaku
     Level 4 (Inflection)
          Morphological Rules:
               Inflection
          Phonological Rules:
               None   (67)

Murasugi's analysis is satisfying in that it manages to deal with many of the previously

discussed inconsistencies of *rendaku*, such as voicing differences between compound types. One

of the issues not previously discussed much is that of affixing. Taken as one large group, the

results can be very confusing:

(38)   a.   hito   +   koe   →   hitokoe
          'one-'$_{prefix}$ 'voice'   'one voice'
                                                cf. hito+goe 'human voice'
      b.   futa   +   koto   →   futakoto
          'two-'$_{prefix}$ 'word'   'two words'
      c.   o   +   hanashi   →   ohanashi
          hon.$_{prefix}$ 'talk'   'talk (honorific)'
                                                cf. mukashi+banashi 'fairy tale'

d.	go	+	kuroo	→	gokuroo
	hon.$_{prefix}$		'hardship'		'hardship (honorific)'
					cf. ki+guroo 'anxiety' (Vance, 1987)
e.	shizuke	+	sa	→	shizukesa
	'quiet'$_{adj.}$		'-ness'$_{suffix}$		'quietness' (Murasugi, 1988)

----

f.	o	+	kawa	→	ogawa
	'small-'		'river'		'brook'
g.	ko	+	fune	→	kobune
	'small-'		'boat'		'small boat'
h.	oo	+	koe	→	oogoe
	'big-'		'voice'		'big voice' (Vance, 1987)

(38c) and (38f) have what looks to be the same phonetic element as a prefix, yet with two different voicing results. Murasugi's analysis requires that we consider those of type (38a-e) as affixes and those of type (38f-h) as simple morpheme elements of compounds. She says that there is some justification to the claim, as /oo/ 'big' can be transformed into other semantic types like /ookii/ (adj.) and /ookisa/ 'size' (71); however, the same does not hold true for /o/ or /ko/ 'small.'[22] While there is a definite divide between the two above groups of affixes, I think more work needs to be done to determine what exactly divides them.

Overall, Murasugi's Lexical Phonology-based analysis is quite satisfying in its handling of many of the issues of *rendaku*, but it unfortunately does not do much to address the irregularity of voicing in [-Yamato] elements of the lexicon.

Section 8: A Brief Example of Modern OT Analysis of *Rendaku*

Modern Optimality Theory-based discussions of *rendaku* so far have not added too much to the discussion. Mostly it seems that scholars have just updated the old data and theories by

---

[22] The adjective for 'small' would be /chiisai/.

plotting them into the tableaus of OT, but for the sake of thoroughness, I will include some

example tableaus below, taken from Fukuzawa and Kitahara (2001):

(39)

/kita + ϭ + kaze/ | | [voi] [voi]	OCP[voice]	UNIFORMITY [voice]-M	REALIZE-MORPHEME	UNIFORMITY [voice]-G
☞ a. [kita + kaze] | [voi]			*	
b. [kita + gaze] ╱ | [voi]ϭ [voi]	*!			
c. [kita + gaze] \\\|/ [voi]ϭ		*!		*

(40)

/tabi + ϭ + hito/ | | [voi] [voi]	OCP[voice]	UNIFORMITY [voice]-M	REALIZE-MORPHEME	UNIFORMITY [voice]-G
a. [tabi + hito] | [voi]			*!	
b. [tabi + bito] | | [voi] [voi]ϭ	*!			
☞ c. [tabi + bito] \\/ [voi]ϭ				*

UNIFORMITY is a set of constraints which prohibit the fusion of two [voice] features, with

uniformity in a single morpheme outranking more general uniformity in an output. What

Fukuzawa and Kitahara's analysis does accomplish is that it generalizes the OCP, and under

their analysis it seems that it is not necessary to restrict its domain to the morpheme.[23]

Section 9: A Compelling Explanation of Yet Another Set of *Rendaku* Anomalies

      Rosen (2003) addresses a lingering problem that none of the above articles had yet

discussed. There are certain [+Yamato] elements that never exhibit *rendaku* even though they

should, and there are others that do not show *rendaku* in certain environments but then show it in

others. Rosen labels those that always block *rendaku* as "immune," and those that sometimes

block as "resisters":

(41)   Some *Rendaku* Immune Elements

kita 'north'	kasu 'dregs'	tsuchi 'earth'	katachi 'shape'
hashi 'edge'	hima 'leisure'	himo 'string'	kamachi 'framework'
hime 'princess'	tsuya 'gloss'	shita 'below'	kemuri 'smoke'

            cf. uta hime 'songstress,' oto hime 'Princess Oto,' shira-yuki hime 'Snow White'

(42)   Some *Rendaku* Resisters

    a.   shino   +   hara   →   shinohara
          'bamboo'   'field'   'bamboo field'

    b.   tono   +   hara   →   tonobara
          'nobility'   'field'   'the nobility'

    c.   matsu   +   hara   →   matsubara
          'pine'   'field'   'pine grove'

    d.   no   +   hara   →   nohara
          'field'   'field'   'field'

    e.   no   +   kusa   →   nogusa
          'field'   'grass'   'field grasses'

    f.   ashi   +   kuse   →   ashikuse
          'foot, leg'   'habit'   'way of walking'

    g.   kuchi   +   kuse   →   kuchiguse
          'mouth'   'habit'   'way of speaking'

---

[23] Although Fukuzawa and Kitahara do not look at compounds of three or more words (cf. (6) *ori+gami+dana+dzukuri*), it can be assumed that they would fall in line with the above model and have all of their inserted [+voi] specifications merged into one.

(42d-e) illustrate that it is not some quality of the trigger that inhibits *rendaku*, but rather some quality within the second element itself. (42f-g) illustrate that it is not a semantic difference at the root of the inconsistency, because their meanings are derived in the same way. Rosen proposes a three-way specification divide between these elements, as in (43):

(43)   a. Immune: Kita 'north'   b. Resister: Kusa 'grass'   c. Normal: Kuchi 'mouth'

                         |

                 [-voi]   [-voi]

The Immune group comes with [-voi] attached and always blocks *rendaku*, the resister group comes with a floating [-voi] that presumably gets associated in certain circumstances and blocked in others,[24] and the normal group has nothing to block *rendaku* and presumably gets its [-voi] specification in its singular form from another rule like **IF [**-son**] THEN [**-voi**]** (Rosen, 2003).

It is a very interesting paper, and certainly contributes a valuable theory of the issues at hand, but there is still much work to be done concerning other exceptions to *rendaku*.

Section 10: Further Examining the Nasal Paradox and Reanalyzing *Rendaku* Theory

10.1: Introduction to NT Clusters in Sino Japanese Words

Discussing NT clusters in Yamato words and how they activate Lyman's Law and block *rendaku*, Rice (1996) comments that she "must leave open the question of what happens when a Sino-Japanese word with a nasal-voiceless obstruent clusters [sic] enters into Rendaku; this would clearly be interesting data" (129). Unlike the Yamato lexicon, Sino-Japanese permits NT clusters, so recalling words like (32b) *shirooto+kaŊgae* and how in those cases ***NT** resulted in a voiced obstruent with the power to block *rendaku*, Rice is wondering how Sino-Japanese

---

[24] For example, triggers with more than three moras will always result in a display of *rendaku* in resisters.

words like /saṆpo/ 'walk,' /haṆtai/ 'opposite,' and /kaṆkei/ 'relation' would act when put into compounds. Since there are no voiced obstruents to activate Lyman's Law and block *rendaku*, would /yama/ 'mountain' + /saṆpo/ act like some other Sino-Japanese binom compounds and result in the voiced [yamazampo]? Or could *rendaku* somehow be blocked, leaving the compound to surface as [yamasampo]?

Feeling that not enough work had been done with the Sino-Japanese side of the lexicon and still feeling troubled by the nasal paradox raised by Rice (1996) and Suzuki (1997), I decided that I would follow up on Rice's suggestion above and find data on the *rendaku* behavior of Sino-Japanese words with NT clusters. Because no work had been done to examine the interaction between Lyman's Law and segments that are predicted to show voicing but do not, I thought this work could shed more light onto the mechanics of *rendaku* in general, and at the very least give us more data on the Sino-Japanese lexicon.

Vance (1996) previously did a study entitled "Sequential Voicing in Sino-Japanese," wherein he compared the behavior of a randomly selected group of 100 Yamato words and 100 Sino-Japanese words.[25] Of those, 87 Yamato words and only 10 Sino-Japanese words showed *rendaku* voicing. Of the 10 voiced *kango* words, none contained an NT cluster. In fact, though 11 of the 100 *kango* words contained NT clusters, none of them showed any voicing. Since the overall percentage of *kango rendaku* voicing was 10%, it should follow that at least one of the NT words would have shown voicing, but this is not the case. It appears that there might be something else going on to actively block rendaku in these NT examples.

---

[25] His study was a dictionary search only. All examples were pulled from dictionary entries.

10.2: Testing the Activity of *Kango* NT Words in New Compounds

10.2.1: Test Process

For my study I decided that I wanted to actively test the *rendaku* behavior of native speakers. I created a list of 75 *kango* words with NT clusters, the first syllables representing all possible onsets and nuclei that can appear before the moraic nasal, and in the second syllable, all unvoiced obstruent segments that could possibly follow the nasal. In addition, a few other following segments were included, such as sonorants and vowels.[26] Each *kango* NT word was matched with a cohesive trigger to create a new compound word.[27] For example, the word 関係, *kankei* 'relationship,' was matched with the trigger 親子, *oyako* 'parent and child,' to create a new compound 親子関係 with the intended meaning 'parent-child relationship.'

In addition to the 75 *kango* test words, 25 control words were included. Some of these words were copies of examples from the literature, while others were new compounds whose voicing properties were expected to fall in line with the normal rules of *rendaku*. The new control compounds were included to make sure that speakers were actively applying the *rendaku* rule, and not just repeating lexical items they had already heard. For example, the Yamato word *kawa* 'river' was paired with *sukuukiru* 'Schuylkill,' the name of a river in the Philadelphia area. The speakers had never heard of this river, yet still voiced the compound as the rule would normally dictate, producing *sukuukirugawa*.

---

[26] Following a moraic nasal, sonorants and vowels never syllabify with it. Though there is an existing *ny-* onset and *n* can be an onset for all possible vowels (*na, ni, nu, ne, no*), in these test words, the sonorants and vowels maintain their status as distinct onsets for the second syllable.

[27] Triggers included Yamato, Sino-Japanese, and foreign loan-word elements, as there is no restriction on possible *rendaku* triggers.

The experimental and control groups were randomized and compiled into a list of 3 introductory words (all control) and 97 test body words. Wherever possible, words were written with *kanji* characters so as not to dictate pronunciation.[28] All test elements were written in *kanji*.

The test procedure went as follows: participants were shown a computer screen with the three introductory words displayed and broken down into their elements. Participants were told they were helping in a study of compound words, and quickly shown through the mechanics of compounding.[29] Participants were then told that they were going to be taken through a list of 97 new compounds and asked to read them out loud according to their gut instinct. The remaining 97 words were then presented one after the other, with the speaker pronouncing each compound in succession.[30]

The test was performed with four speakers,[31] combining for a total of 300 utterances of test words and 100 utterances of controls.

10.2.2: Test Results

Because of the inherent ambiguity in *kanji* readings, speakers did not always agree on their pronunciations, even for the control words. However, within the control group, despite varying readings, all four of the speakers were 100% consistent with their voicing production. In other words, all four were normal, *rendaku* producing native speakers.

---

[28] Japanese has three writing systems that are used in tandem. Two are syllabaries which explicitly dictate pronunciation (including voicing), and the third is *kanji*, Chinese characters. Chinese characters stand for semantic ideas and have multiple readings, so presenting entries in *kanji* allows consultants to determine pronunciation on their own.

[29] For example, given the introductory word *kyoukotoba*, participants were shown that it was comprised of the elements *kyou* 'Kyoto' and *kotoba* 'word,' and how they mix to create a new word meaning 'words from Kyoto' or 'Kyoto dialect.'

[30] See appendix B for sample screenshots of the test.

[31] The speakers were all college age females. Two were natives of Tokyo, and the others had also spent years living there.

Of the 75 test words, only 3 ever showed voicing. Out of 300 total utterances, those three words accounted for only 4 cases of voicing. The three compounds were *yama+sampo* 'a mountain stroll,' pronounced as *yamazampo* by one speaker, *wa+sensu* 'Japanese-style folding fan,' pronounced as *wazensu*[32] by one speaker, and *kyoudai+kenka* 'a fight between siblings,' pronounced as *kyoudaigenka* by two speakers. The first two speakers noted that *kyoudaigenka* is an already existing word and that they knew a few others like it, such as *oyakogenka* 'a fight between parent and child' and *koibitogenka* 'a fight between lovers.' Because of this, I changed the trigger for *kenka* to *gojira* 'Godzilla.' The following two speakers did not voice *kenka* in this new compound.

Including *kenka*, this means that 4% of test words showed voicing at least once, but in total, only 1.3% of all test utterances showed any voicing. Compared to Vance's (1996) survey, which showed Sino-Japanese words voicing around 10% of the time, this is a significant finding. Because the rate of *rendaku* voicing in these NT cluster words is so significantly lower than the expected rate for *kango* words, it seems like there must be something going on that actively blocks *rendaku* from operating. I take this assumption for my analysis.

10.2.3: Questions for Analysis

If something is blocking *rendaku* in these *kango* NT words, what could it be? The only process we know of that consistently blocks *rendaku* is Lyman's Law, and yet there is no voiced segment in these words that should trigger it. Had voicing spread from the nasal onto the following consonant, we could simply say that that is what triggers Lyman's Law, but these

---

[32] Apparently this is already an existing word, and its official reading is *wazensu*, which displays *rendaku*. Interestingly, three of the four speakers seemed unaware of this and pronounced the word without *rendaku*.

consonants remain unvoiced.[33] Furthermore, these *kango* binoms are not the result of a previous compounding, so no voicing could have been inserted into the word to trigger Lyman's Law in an RBC-like hypothesis. Even if that voicing had been inserted, why would it not have already spread, producing an NC$_{[+voi]}$ cluster instead of an NC$_{[-voi]}$ one? What is it about the Sino-Japanese lexicon that allows for NC$_{[-voi]}$ in the first place if ***NT** is supposed to be active in Japanese? Lastly, why do these NC$_{[-voi]}$ clusters act just like NC$_{[+voi]}$ in compounds and consistently block *rendaku*?

10.3: Solving the Sino-Japanese NT Cluster Problem and the Nasal Paradox at the Same Time

Recalling Rosen's (2003) compelling analysis of another blocking problem wherein he utilized unattached, floating [-voi] specifications, and Rice's (1996) discussion of applying Inkelas-style co-phonologies to *rendaku*, I propose a similar solution that not only makes sense of the current problem, but also solves the nasal paradox and turns out to have major implications for the entire theory of *rendaku* mechanics as it currently stands. My proposal has 3 main points:

(44)　　1) ***NT** is active in all grammars of Japanese.
　　　　2) An NT cluster is fixed by the insertion of a floating [+voi] specification
　　　　　　onto the unvoiced consonant: C　　　C
　　　　　　　　　　　　　　　　　　　　　　　　|
　　　　　　　　　　　　　　　　　　　　[+nas]　[+voi]
　　　　　　　　　　　　　　　　　　　　　　　　↑
　　　　　　　　　　　　　　　　　　　　　　　　∅
　　　　3) In the Yamato co-phonology, there is a rule that then attaches the floating [+voi]
　　　　　　specification, resulting in a voiced consonant. There is no such rule in other
　　　　　　Japanese co-phonologies. (***Y-FLOAT**$_{[voi]}$):　　　C　　　C
　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　|　　　|
　　　　　　　　　　　　　　　　　　　　　　　　　　　[+nas]　[+voi]

---

[33] That would only be taking us further into the nasal voicing paradox, anyway.

In (44), NT includes any combination of a nasal followed by a consonant not specified for voice. This includes sonorants, as NC[son] clusters ended up blocking *rendaku* in the test, just as NC[obs] clusters did.

Let us look at an example of this process at work in (45) below, using the words *kinshi*[-Yamato] 'ban' and *kangae*[+Yamato] 'idea,' still using Ito and Mester's model of the *rendaku* process:

(45) *kinshi*[-Yamato] vs. *kangae*[+Yamato]

Cycle 1

	a.	b.

Word Formation:	k i n sh i
	     |
	   [+nas]
		k a n k a e
		      |
		    [+nas]

*NT:
(insert[+voi])
	k i n sh i
	     |
	  [+nas][+voi]
		k a n k a e
		      |
		   [+nas][+voi]

OCP[voi**]:**	NA	NA

*Y-FLOAT[voi]**:**
(attach float)
	NA	k a n k a e
		     | |
		   [+nas][+voi]

Output:	kinshi	kangae

Cycle 2

Compounding:	neko + k i n sh i
	         |
	     [+nas][+voi]
		shirooto + k a n g a e
		         / \\
		     [+nas][+voi]

Rendaku:	neko + k i n sh i
	         |
	   [+voi] [+nas][+voi]
		shirooto + k a n g a e
		         / \\
		   [+voi] [+nas][+voi]

OCP[voi**]:**
(Lyman's Law)
	neko + k i n sh i
	         |
	   ∅ [+nas][+voi]
		shirooto + k a n g a e
		         / \\
		   ∅ [+nas][+voi]

Voicing Spread:	NA	NA
Output:	nekokinshi 'cats prohibited'	shirootokangae 'layman's idea'

Through the above model, we get exactly the results we expected. As you can see, there is no need for a voicing spread rule in NT clusters, because the insertion of the [+voi] feature is in itself a sufficient repair for a ***NT** violation regardless of whether or not it associates to the post-nasal consonant. Because we no longer need to rely upon explicit voicing specification in nasals for a spread rule at the same time as relying upon underspecification for voicing for Lyman's Law, we have defeated the nasal paradox. Under my proposal, nasals can consistently remain unspecified for [voice], and we still predict the same results as shown by the data. Recalling (32) and (35), let us look at two more examples below, using the word *kane*[+Yamato] 'bell' and *samma* 'saury,'[34] again still using Ito and Mester's model:

(46) *Cycle 1*
Word Formation:

a.
k a n e
        |
    [+nas]

b.
s a m m a[35]
          |
      [+nas]

*NT:
(insert[+voi])

k a n e
    |
  [+nas]

s a m m a
        |
    [+nas][+voi]

OCP[voi]:

NA

NA

*Y-FLOAT[voi]:
(attach float)

NA

NA(?)

Output:

kane

samma

---

[34] I am unsure as to whether this word is Yamato or Sino-Japanese in origin, but its etymology is actually irrelevant to the analysis.

[35] Technically, the second /m/ should also be [+nas], but it is unnecessary to notate that here.

Cycle 2

Compounding: haya + k a n e   yaki + s a m m a
                            | |
                          [+nas]   [+nas][voi]

Rendaku: haya + k a n e   yaki + s a m m a
                          | | | |
                        [+voi] [+nas]   [+voi] [+nas][+voi]

OCP[voi]:   NA   yaki + s a m m a
(Lyman's Law) |
                                              ∅   [+nas][+voi]

Voicing Spread: haya + k a n e   NA
                        / |
                    [+voi]   [+nas]

Output: hayagane   yakisamma
                  'firebell'   'fried saury'

As we can see from the examples in (45) and (46), under my proposal nasals act consistently and predictably in all contexts, completely defeating the nasal paradox. However, that brings our attention to an even more interesting nasal paradox that surprisingly had never been pointed out: In their analysis, Ito and Mester posited that the floating [+voi] inserted by *rendaku* was the remnants of an ancient *no/ni* particle that would have come between the two words. How could this nasal, with no underlying [+voi] specification, have disintegrated away, leaving a floating [+voi] capable of spreading?

10.4: Leaving Voicing Spread Behind and Reanalyzing Rendaku

As it turns out, there is actually no need at all for a voice spread rule in Japanese, and getting rid of it greatly improves our overall analysis of *rendaku*. If we have determined that all non-obstruents are unspecified for [voice], and the only possible consonant cluster in Japanese is NC, then there is no possible environment for a voicing rule to apply in, anyway. Ito and Mester (1986) originally argued for a voicing spread rule on two basic data points, 1) that voicing

spreads from nasals (which is untrue for *kango* words and an incorrect analysis for Yamato words), and 2) that it spreads from voiced obstruents in verb conjugations. Presented once again below is the key data for their latter point:

(25) a. tog + te / ta → toide/toida
          'sharpen' (gerund) (past)
      b. tok + te / ta → toite/toita[36]

/g/ is one of two possible root-final voiced obstruents, the other being /b/. See *asobu* below:

(47)   asob + te / ta → asonde/asonda
          'play'

As we can see in (47), /b/ nasalizes to become [n], so it would not be going too far to posit that a similar nasalization process occurs with /g/. As it turns out, /g/ frequently alternates with [ŋ] in a variety of environments (Vance 1987),[37] so we could posit an intermediate form for (25a) that works as in (48):

(48)   t o g + t e

Nasalization: t o ŋ + t e
                              |
                            [+nas]

*NT: t o ŋ + t e
(insert[+voi]) |
                            [+nas] [+voi]

*Y-FLOAT[voi]:   t o ŋ + t e
(attach float) | |
                            [+nas] [+voi]

Velar Vocalization: t o i + t e
                                    |
                                  [+voi]

Output: toide

With the above points, we can see that a voicing spread rule is misleading and completely unnecessary, so why should we rely on it for our analysis of *rendaku*? If we still assume that *rendaku* holds the remains of an ancient *no/ni* particle, what if we look at *rendaku* not as the insertion of a floating [+voi], but rather as the insertion a floating [+nas]? As we will see, this is the better option for many reasons. But first, let us go through a few test examples to see how it might work in normal processes:

(49) New Proposed Model of *Rendaku*:

        Rendaku: Insert [+nas] /]__[

(50) Normal Yamato Words, (29) Revisited

Compounding: a.   hana + t a y o r i b.   hana + k a z a r i
                                               |
                                           [+voi]

Rendaku: hana + t a y o r i   hana + k a z a r i
(insert [+nas])
                                            |
               [+nas]   [+nas]   [+voi]

*NT: hana + t a y o r i   hana + k a z a r i
(insert [+voi])
                                            |
              [+nas][+voi]   [+nas][+voi] [+voi]

OCP[voi]:   hana + k a z a r i
(Lyman's Law)   NA
                                          |
                              [+nas] ∅ [+voi]

*Y-FLOAT[voi]: hana + t a y o r i
(attach float) | NA
              [+nas][+voi]

Output: hanadayori   hanakazari

40

(51) Words with Nasals, (46) Revisited

Compounding: a. haya + k a n e   b. yaki + s a m m a
                                         |
                    [+nas]   [+nas][+voi]

Rendaku: haya + k a n e   yaki + s a m m a
(insert [+nas]) |
              [+nas]   [+nas]   [+nas]   [+nas][+voi]

*NT: haya + k a n e   yaki + s a m m a
(insert [+voi]) |
        [+nas][+voi] [+nas]   [+nas][+voi] [+nas][+voi]

OCP[voi]**:**   NA   yaki + s a m m a
Lyman's Law |
                                  [+nas] ∅ [+nas][+voi]

*Y-FLOAT_[voi]**:**   haya + k a n e   NA
(attach float) | |
              [+nas][+voi] [+nas]

Output: hayagane   yakisamma
              'firebell'   'fried saury'

(52) NC Words in Compounds, (45) Revisited

Compounding: a. neko + k i n sh i   b. shirooto + k a n g a e
                           | / \
                    [+nas][+voi]   [+nas][+voi]

Rendaku: neko + k i n sh i   shirooto + k a n g a e
(insert [+nas]) | / \
             [+nas]   [+nas][+voi]   [+nas]   [+nas][+voi]

*NT   neko + k i n sh i   shirooto + k a n g a e
(insert [+voi]) | / \
           [+nas] [+voi] [+nas][+voi]   [+nas] [+voi] [+nas][+voi]

OCP[voi]**:**   neko + k i n sh i   shirooto + k a n g a e
(Lyman's Law) | / \
           [+nas] ∅ [+nas][+voi]   [+nas] ∅ [+nas][+voi]

*Y-FLOAT_[voi]**:**   NA   NA
(attach float)

Output: nekokinshi   shirootokangae
              'cats prohibited'   'layman's idea'

As shown by the charts above, the new model predicts the correct output in each case. By changing Ito and Mester's floating [+voi] to a floating [+nas], I have not only eliminated an unnecessary rule, but have also created a unified model of word formation where we can apply the same processes to both single lexical items and compounds. Furthermore, my new model fits in better with the historical motivation than the previous one. The fact that it can account for Sino-Japanese words like *kinshi* is also a great advantage, and the model extends to make an even greater prediction in regards to [-Yamato] words: If *rendaku* inserts a floating [+nas] which in turn inserts a floating [+voi] onto the following consonant, unless the word is [+Yamato], that [+voi] will never get attached. See (53) below for an example that clarifies this prediction:

(53) [-Yamato] Compounds (cf. (12))

Compounding:	bimboo + sh o o	yasu + h o t e r u
Rendaku: (insert (+nas))	bimboo + sh o o [+nas]	yasu + h o t e r u [+nas]
*NT: (insert (+voi))	bimboo + sh o o [+nas] [+voi]	yasu + h o t e r u [+nas] [+voi]
OCP[voi]: (Lyman's Law)	NA	NA
*Y-FLOAT[voi]: (attach float)	NA	NA ←**Key step**
Output:	bimbooshoo	yasuhoteru

Because of ***Y-FLOAT**[voi]'s restriction to the Yamato lexicon, the model correctly predicts that [-Yamato] words will not undergo *rendaku* voicing.[38] Although my proposed

---

[38] At least, for the majority of cases. If we go by Vance's (1996) study, then this rule should fail about 10% of the time. Furthermore, this model also predicts that the lexical grouping of compounds is determined by their right-branched heads, so for example, *bimboushou* is determined to be [-Yamato] because its head is the Sino-Japanese element *shou*. With this established, ***Y-FLOAT**[voi] does not apply and the voicing remains unattached.

model is unfortunately more abstract than Ito and Mester's, its numerous advantages more than make up for it.

10.5: Residual Issues with the New Model

While I have shown that my new model is clearly superior in many ways to previous theories, there are still a few issues that remain to be worked out. First, in order to get rid of the need for a voicing spread rule, we must hold to the assumption that /g/ nasalizes to [ŋ] in verb conjugations, as proposed in (48) above. Future research should be done to check whether this is the right analysis.

Second, my model predicts that all [-Yamato] words will fail to undergo voicing, but as discussed earlier, there are numerous examples of [-Yamato] words that show *rendaku* voicing, both from the Sino-Japanese and foreign loan-word lexicons. We could propose that ***Y-FLOAT**[voi] occasionally overgeneralizes and draws association lines on words that usually would not receive them. This is understandable, as most speakers are probably unaware of the phono-morphological distinctions within their own grammars. Maybe over time, originally random instances of *rendaku* become normalized as special lexical exceptions for certain words, such as *kaisha*[Sino-Japanese] or *karuta*[foreign] (cf. (13)). Another possibility is that certain originally [-Yamato] words have been accepted into the Yamato lexicon and now operate by its rules. In order to test that claim, we would need to find other evidence besides *rendaku* voicing. Unfortunately, this issue will probably remain beyond us for some time.

Lastly, my proposed model in its current form has trouble dealing with cases of the moraic nasal followed by a vowel. These vowels never syllabify with the nasal, a $\_N_\mu.V$ sequence instead resulting in a nasal followed by a nasalized glide-like segment into the vowel,

and words containing this sequence were found to block *rendaku* in my study. Let us look at one

example with the Sino-Japanese word *kun$_\mu$iku* 'discipline' below:

(54) *Cycle 1*
Word Formation: k u n$_\mu$ i k u
                                        |
                                     [+nas]

*NT: NA
(insert [+voi])

OCP[voi**]**:   NA
(Lyman's Law)

*Y-FLOAT$_{[voi]}$:   NA
(attach float)

Output: kun'iku

Cycle 2
Compounding: bukkyoo   +   k u n' i k u
                                                            |
                                                         [+nas]

Rendaku: bukkyoo   +   k u n' i k u
(insert [+nas]) |
                                          [+nas]   [+nas]

*NT: bukkyoo   +   k u n' i k u
(insert [+voi]) |
                                          [+nas] [+voi] [+nas]

OCP[voi**]**:   NA
(Lyman's Law)

*Y-FLOAT$_{[voi]}$:   NA   ←**Key step**
(attach float)

Output: bukkyookun'iku
                             'Buddhist discipline'

10.6: Potential Solutions

10.6.1: Option 1: ***N$_\mu$X** and a New *Rendaku*

As (54) shows, under the current model, again we rely upon the lexical stratification approach of ***Y-FLOAT**$_{[voi]}$. Because it seems that this rule has a 10% failure rate, the current model predicts that around 10% of these words would show voicing, even though none did in my study.[39] Because of this, I would prefer a more categorical defeat of *rendaku* voicing in words with a medial moraic singleton nasal, so I will propose a slightly different version of ***NT**. Because consonant clusters are only possible with the moraic nasal, and because it seems that the moraic nasal followed by any segment has the power to block *rendaku*, I propose that if the moraic nasal is followed by any segment it will insert a floating [+voi]. It is crucial that this rule does not apply if the moraic nasal is not followed by anything, i.e. is at the end of a word.

(55)   ***N$_\mu$X**: insert [+voi] / N$_\mu$ ___ … #

The other crucial change we must make if we adopt ***N$_\mu$X** and still want to maintain direct correlation between word-internal nasal cluster voicing and *rendaku* in compounds is that we have to then posit that *rendaku* does not just insert a floating [+nas], but actually inserts a floating moraic [+nas]$_\mu$:

(56)   *Rendaku*: insert [+nas]$_\mu$ /]__[

Let us see how these new rules apply in two different situations, one that shows *rendaku*, and one that does not. In (57) below, we compare *kun$_\mu$iku* and *futon$_\mu$* and see that ***N$_\mu$X** and the new *rendaku* rule must come in tandem in order for our model to work:

---

[39] The sample size for these kinds of words was quite small however. More work could be done with a survey including a greater number of these words to test whether they really do categorically block *rendaku*.

(57) *Cycle 1*
Word Formation:

a.

k u n$_\mu$ i k u
          |
       [+nas]

b.

f u t o n$_\mu$
              |
           [+nas]

*N$_\mu$X:
(insert [+voi])

k u n$_\mu$ i k u
        |
   [+nas][+voi]

NA

OCP[voi**]**:
(Lyman's Law)

NA

NA

*Y-FLOAT$_{[voi]}$:
(attach float)

NA

NA

Output:

kun'iku

futon

Cycle 2
Compounding:

bukkyoo + k u n' i k u
                  |
             [+nas][+voi]

kake + f u t o n
                |
             [+nas]

Rendaku:
(insert [+nas]$_\mu$)

bukkyoo + k u n' i k u
         | |
   [+nas]$_\mu$ [+nas][+voi]

kake + f u t o n
       | |
  [+nas]$_\mu$ [+nas]

*N$_\mu$X:
(insert [+voi])

bukkyoo + k u n' i k u
         | |
 [+nas]$_\mu$[+voi] [+nas][+voi]

kake + f u t o n
       | |
 [+nas]$_\mu$[+voi] [+nas]

OCP[voi**]**:
(Lyman's Law)

bukkyoo + k u n' i k u
                      |
 [+nas]$_\mu$ ∅ [+nas][+voi]

NA

*Y-FLOAT$_{[voi]}$:
(attach float)

NA

kake + f u t o n
          \ |
  [+nas]$_\mu$[+voi] [+nas]

Output:

bukkyookun'iku
'Buddhist discipline'

kakebuton
'top cover,' 'over-futon'

Though more abstract than ***NT** and the old *rendaku*,[40] this model correctly predicts that *rendaku* is blocked with *kun'iku* and allowed for *futon*. Furthermore, the fact that *futon* is actually a Sino-Japanese word that exceptionally shows voicing proves the importance of categorically preventing *rendaku* from operating when a word-medial moraic nasal is present, as leaving it up to chance predicts that 10% of the time we would get words like *bukkyoogun'iku* which are so far unattested in the data. In all other cases, the new model acts exactly like the old ***NT** model and predicts the correct outcomes for compounds.

Furthermore, the combination of ***N$_\mu$X** and the new *rendaku* is able to account for three-branch compounds. Let us look at what this model predicts for the compound [*nuri*+[*hashi*+*ire*] 'a lacquered case for chopsticks' from (36):

(58)

	Cycle 1	*Cycle 2*
Compounding:	hashi + i r e	nuri + h a sh i i r e ＼ [+nas]$_\mu$[+voi]
Rendaku: (insert [+nas]$_\mu$)	hashi + i r e [+nas]$_\mu$	nuri + h a sh i i r e ＼ [+nas]$_\mu$ [+nas]$_\mu$[+voi]
*N$_\mu$X: (insert [+voi])	hashi + i r e [+nas]$_\mu$[+voi]	nuri + h a sh i i r e ＼ [+nas]$_\mu$[+voi] [+nas]$_\mu$[+voi]
OCP[voi]: (Lyman's Law)	NA	nuri + h a sh i i r e ＼ [+nas]$_\mu$ ∅ [+nas]$_\mu$[+voi]
*Y-FLOAT$_{[voi]}$: (attach float)	hashi + i r e ＼ [+nas]$_\mu$[+voi]	NA
Output:	hashiire	nurihashiire

---

[40] It is possible that a rule like ***N$_\mu$X** could have derived by analogy over time. For example, one generation of speakers could have broadened ***NT**, subconsciously thinking "Well, we add a floating [+nas] to the segment after the moraic N in this environment, so why not add it to all segments following the moraic N?" As for the new *rendaku*, if the floating [+nas] descended from the full syllable *no/ni*, it is possible for it to have retained its mora along with its [+nas] specification.

The downside of a ***N$_μ$X,** new *rendaku* model is that it is somewhat more abstract than previous models. Furthermore, positing *rendaku* as the insertion of a floating moraic segment predicts that some influence of the mora could be evident on the surrounding segments, possibly leading to a lengthened vowel, for example.[41, 42] It might be possible to posit that *rendaku* voicing is exactly that evidence of moraic influence, however further research should be done to figure out if there are any other processes with floating moras in Japanese and what happens in those situations if they exist.

10.6.2: Option 2: ***NT** and **OCP[+nas]**

A second option is that instead of changing our interpretations of ***NT** and the mechanics of *rendaku*, we could propose a sister rule to Lyman's Law, a kind of OCP constraint against floating [+nas] segments. It is crucial that it be against floating segments only, otherwise in words like (57b), the *rendaku* nasal would get deleted and voicing would fail to appear. Let us go through the processes for (57) and (58) again to see how this model would handle them:

---

[41] For example, *nuri+μ+hashiire* could theoretically lead to *nuriihashiire*, with a lengthened [i].

[42] Marlo and Mwita (2009) propose an analysis of Kuria tone patterns that relies upon floating moras which do not seem to have any effect on the preceding vowels, so explicit immediate effect may not always be necessary.

(59) *Cycle 1*   a.   b.

Word Formation:

```
a.  k  u  nμ  i  k  u          b.  f  u  t  o  nμ
              |                                |
           [+nas]                           [+nas]
```

OCP[+nas, +float]:   NA   NA
(delete float)

*NT: NA   NA
(insert [+voi])

OCP[voi]:   NA   NA
(Lyman's Law)

*Y-FLOAT[voi]:   NA   NA
(attach float)

Output: kun'iku   futon

Cycle 2

Compounding:

```
bukkyoo  +   k  u  n'  i  k  u          kake  +   f  u  t  o  n
                        |                                      |
                     [+nas]                                 [+nas]
```

Rendaku:
(insert [+nas])

```
bukkyoo  +   k  u  n'  i  k  u          kake  +   f  u  t  o  n
                  |     |                          |           |
               [+nas] [+nas]                    [+nas]      [+nas]
```

OCP[+nas, +float]:   NA   NA
(delete float)

*NT:
(insert [+voi])

```
bukkyoo  +   k  u  n'  i  k  u          kake  +   f  u  t  o  n
                   |  |    |                       |        |
            [+nas][+voi] [+nas]              [+nas] [+voi]  [+nas]
```

OCP[voi]:   NA   NA
(Lyman's Law)

*Y-FLOAT[voi]:
(attach float)   NA

```
                                        kake  +   f  u  t  o  n
                                                  |        |
                                           [+nas][+voi]  [+nas]
```

Output: bukkyookun'iku   kakebuton
             'Buddhist discipline'   'top cover,' 'over-futon'

Here it is important to point out that this model more heavily relies upon ***Y-FLOAT**[voi] than the ***N$_\mu$X** model does, as it is the crucial step that results in *bukkyookun'iku* instead of *bukkyoogun'iku*. It also makes the difference between *kun'iku* and *futon* less clear, as their chances for voicing should be equal as both are Sino-Japanese words, yet only *futon* shows voicing. Let us move on to reexamining *nurihashiire*:

(60)	*Cycle 1*	*Cycle 2*
Compounding:	hashi + i r e	nuri + h a sh i i r e
		[+nas]
Rendaku: (insert [+nas])	hashi + i r e	nuri + h a sh i i r e
	[+nas]	[+nas] [+nas]
OCP[+nas, +float**]**: (delete float)	NA	nuri + h a sh i i r e
		∅ [+nas]
*NT: (insert [+voi])	NA	NA
OCP[voi**]**: (Lyman's Law)	NA	NA
*Y-FLOAT[voi]: (attach float)	NA	NA
Output:	hashiire	nurihashiire

Like the ***N$_\mu$X** model, this model also predicts the correct outcomes for the above examples. While advantageous in that ***NT** and normal *rendaku* are less abstract than the ***N$_\mu$X** model, the downside is that it complicates the analysis by making it necessary to add the **OCP[**+nas, +float**]** rule. Furthermore, an OCP specific to floating features is fairly abstract in its own right and somewhat stipulative, although apparently not entirely without precedent.[43]

---

[43] According to Paster (personal communication), such a rule/constraint may exist in Twi and related languages.

10.6.3: Choosing a Model

It is clear that both versions of the floating nasal analysis being proposed here are superior to earlier analyses of *rendaku* based on Ito and Mester's original work. The new models eliminate the unnecessary and confusing voicing spread rule, they do away with the nasal paradox, make more sense historically, and correctly predict *rendaku*'s lexical stratification. However, each model comes with its own theoretical problems. While the ***NT** model retains a certain naturalness, I am drawn more towards the ***N$_\mu$X** model for its economy and categorical blocking of *rendaku* in N$_\mu$V words like *kun'iku*. As suggested above, more work could be done to determine which model is truly better.

Section 11: Conclusion

In this paper I have laid out many of the basic problems of *rendaku*, highlighting Ito and Mester's (1986) analysis of the mechanics behind this confusing voicing rule. Although their model answered many questions and provided great insight into the issue, it relied on a voicing spread rule that resulted in an unfortunate paradox related to the voicing specification of nasals. Based on the results of a study I conducted with native speakers, I proposed the new model of ***NT** and ***Y-FLOAT**$_{[voi]}$ to replace voicing spread. This new model not only solved the nasal paradox, but also turned out to be applicable to the more general theory of *rendaku* mechanics. Based on these new rules, I proposed a new model of *rendaku* that inserts a floating [+nas] between words in a compound. This new model proved to be not only much more economical, but also made more historical and lexical sense. Lastly, I discussed the possible complications of different versions of the newly proposed model, and left it up to further research to ultimately determine which is best.

My new model is strong at explaining many issues of *rendaku*. However, there are still many issues that it cannot account for. It cannot fully account for the fact that 10% of [-Yamato] words still show *rendaku* voicing even though they should not. It cannot account for many of the lexical category problems pointed out by Vance (1987). Lastly, as a rule-based model, it is uncertain how it would fit into an Optimality Theory-based account. There is still a lot to learn about *rendaku*, but my new model has made the problem somewhat easier to understand.

Appendix A
List of Words Used in the Study

The following is the complete list of all the words I used in my study. Test words were gathered from personal communication and dictionary searches. The 75 test words represent all possible onsets and nuclei for syllables with the N$_\mu$ coda, as well as all possible following segments. Qualifiers (the first elements of each compound) were chosen by me for their semantic compatibility with the test words. Though I intended to create entirely novel compounds, some of the resulting combinations apparently already exist (Kurita, personal communication). The 25 control words were pulled from the literature. The list here is arranged in Japanese alphabetical order based on the second (the test) word. The readings in *italics* are only some of many possible readings for the characters, not meant to convey any intended or suggested reading on my part.

Key
#	(trigger)test word	intended compound meaning
in	possible readings	
test	individual glosses	

Test Group
Ka row

73. (親子)関係   'parent-child relationship'
     oyako + kankei
     'parent and child' + 'relationship'

53. (和)感性   'Japanese sensibility'
     wa + kansei
     'Japanese' + sensibility'

81. (新)観念   'new ideas,' 'new concepts'
     shin + kannen
     'new' + 'concept'

4.   (秋)寒波   'an Autumn cold wave'
     aki + kampa
     'Autumn' + 'cold wave

96. (和)慣例   'Japanese custom, precedent'
wa + kanrei
'Japanese' + 'custom'

10. (授業)関与   'class participation'
jugyou + kan'yo
'class' + 'participation'

80. (急)緩和   'quick relaxation, thaw'
kyuu + kanwa
'sudden' + 'thaw'

12. (青)近海   'blue waters'
ao + kinkai
'blue' + 'waters'

88. (真)均衡   'true balance, equilibrium'
shin + kinkou
'true' + 'balance'

44. (猫)禁止   'a ban on cats,' 'cats prohibited'
neko + kinshi
'cat' + 'prohibition'

28. (学校)緊張   'school-related stress, nervousness'
gakkou + kinchou
'school' + 'stress'

99. (仏教)訓育   'Buddhist discipline, education'
bukkyou + kun'iku
'Buddhism' + 'discipline'

36. (軍隊)勲功   'military distinction, merit'
guntai + kunkou
'military' + 'merit'

43. (軍隊)勲章   'military decoration,' 'insignia'
guntai + kunshou
'military' + 'insignia'

60. (ゴジラ)喧嘩   'a Godzilla fight,' 'a fight with Godzilla in it'
gojira + kenka
'Godzilla' + 'fight'

66. (新)見解   'new opinion, view'
shin + kenkai
'new' + 'view'

14. (昇段)剣客   'a swordsman of 1st dan-level rank'
shoudan + kenkyaku
'1st level rank' + swordsman'

37. (言語)研究   'linguistic research'
gengo + kenkyuu
'language' + 'research'

90. (新)検索   'a new search'
shin + kensaku
'new' + 'search, retrieval'

67. (大)根気   'great patience, perseverance'
dai + konki
'large' + 'patience'

16. (子)困苦   'a small, petty hardship'
ko + konku
'small' + 'hardship'

78. (長)昏睡   'a long coma'
naga + konsui
'long' + 'coma'

94. (大)混沌   'great chaos'
dai + konton
'large' + 'chaos'

Sa row

38. (大)賛嘆   'great, whole-hearted praise'
dai + santan
'large' + 'whole-hearted praise'

61. (授業料)算定   'calculation of one's tuition'
jugyouryou + santei
'tuition' + 'computation'

15. (山)散歩   'a stroll through the mountains'
yama + sampo
'mountain' + 'stroll'

45. (人間)進化   'the evolution of mankind'
ningen + shinka
'human' + 'evolution'

97. (アポロ)神官   'The Oracle of Apollo'
aporo + shinkan
'Apollo' + 'oracle'

8. (新)震災   'new earthquake, disaster'
shin + shinsai
'new' + 'earthquake'

62. (子)寸評   'a small mention'
ko + sumpyou
'small' + 'mention'

46. (新)選挙   'a new election'
shin + senkyo
'new' + 'election'

92. (大学)専攻   '(one's) major in college'
     daigaku + senkou
     'college' + 'major (of study)'
91. (和)扇子   'a Japanese-style folding fan'
     wa + sensu
     'Japanese' + 'folding fan'
54. (新)戦争   'a new war'
     shin + sensou
     'new' + 'war'
26. (東京)銭湯   'a public bathhouse in Tokyo'
     toukyou + sentou
     'Tokyo' + 'public bathhouse'
11. (古老)村会   'a village council of elders'
     korou + sonkai
     'elder' + 'village council'
39. (子)損失   'a small loss'
     ko + sonshitsu
     'small' + 'loss'
75. (新)損傷   'new damage, injury'
     shin + sonshou
     'new' + 'damage'
42. (大)尊重、 sonchou   'great respect'
     dai + sonchou
     'large' + 'respect,' 'regard'

Ta row

57. (山)探検   'a mountain expedition'
     yama + tanken
     'mountain' + 'exploration'
87. (山)炭鉱   'a coal mine in a mountain'
     yama + tankou
     'mountain' + 'coal mine'
68. (家庭)担当   'household duties'
     katei + tantou
     'household' + 'duties'
82. (コンピューター)端末   'a computer terminal'
     compyuutaa + tammatsu
     'computer' + 'terminal'
76. (大)賃上げ   'a large pay-raise'
     dai + chin'age
     'large' + 'pay raise'

56

83. (偽)鎮静   'pseudo-remission'
nise + chinsei
'false' + 'remission, subsidence'

25. (車)賃貸   'car renting,' 'car rental'
kuruma + chintai
'car' + 'rental'

85. (海)天気   'ocean-like weather,' 'weather at
umi + tenki   the sea'
'sea' + 'weather'

40. (新)典拠   'the new authority, reference'
shin + tenkyo
'new' + 'authority'

63. (赤ちゃん)天才   'a baby genius'
akachan + tensai
'baby' + 'genius'

47. (赤)点灯   'red lighting'
aka + tentou
'red' + 'lighting'

84. (花)頓死   'the sudden death of a flower'
ka + tonshi   'a flower-like sudden death'
'flower' + 'sudden death'

24. (和)頓知   'Japanese wit'
wa + tonchi
'Japanese' + 'wit'

Ha row
86. (中)半径   'radius from the center'
chuu + hankei
'middle' + 'radius'

22. (象)繁殖   'the breeding/propagation of
zou + hanshoku   elephants'
'elephant' + 'breeding'

41. (和)帆船   'a Japanese-style sailboat'
wa + hansen
'Japanese' + 'sailboat'

35. (新)判定   'a new verdict'
shin + hantei
'new' + 'decision, verdict'

48. (新聞)頒布   'newspaper distribution'
shimbun + hampu
'newspaper' + 'distribution'

30. (夕食)賓客   'an honored guest at dinner'
    yuushoku + hinkyaku
    'dinner' + 'honored guest'

69. (大)貧困   'great poverty'
    dai + hinkon
    'large' + 'poverty, want'

64. (入院)頻発   '(one's) frequency of entering into
    nyuuuin + himpatsu   hospital care'
    'enter into hospital care' + 'frequency'

19. (朝)噴火   'an eruption in the morning'
    asa + funka
    'morning' + 'eruption'

77. (若者)奮起   'a rallying of the youth'
    wakamono + funki
    'youth' + 'rousing,' 'rallying,' 'stirring'

98. (金)紛失   'money loss'
    kin + funshitsu
    'money,' 'gold' + 'loss'

58. (若)奮闘   'a young struggle,' 'a youth effort'
    waka + funtou
    'young' + 'struggle,' 'effort'

71. (急)変化   'a sudden change'
    kyuu + henka
    'sudden' + 'change'

93. (遅)返金   'late repayment'
    oso + henkin
    'late' + 'repayment'

52. (早)返球   'an early throw-in'
    chou + henkyuu
    'early' + 'throw-in (sports)'

29. (白人)偏見   'prejudice against Caucasians'
    hakujin + henken   'Caucasian-held prejudice' (both?)
    'Caucasian person' + 'prejudice'

65. (大学)本科   'a regular college course'
    daigaku + honka
    'college' + 'regular course'

9. (大)本船   'a huge mother ship'
    dai + honsen
    'large' + 'mother ship'

59. (新)本邦   'a new Japan'
    shin + hompou
    'new' + 'Japan,' 'this country'

Shu row

17. (昼)瞬間   'an afternoon moment'
    hiru + shunkan
    'noon' + moment'
72. (青)春季   'green Spring'
    ao + shunki
    'green' + 'Spring'
32. (作文)竣工   'the completion of a piece of writing'
    sakubun + shunkou
    'piece of writing' + 'completion'
34. (山)春風   'a mountain Spring breeze'
    yama + shumpuu
    'mountain' + 'Spring breeze'

Control Group

1. 大雨   'strong rain'
   oo-ame
2. 旅人   'traveler'
   tabi-bito
3. 京言葉   'Kyoto dialect'
   kyou-kotoba
5. 子会社   'branch company'
   ko-gaisha
6. ニューヨーク桜   'New York cherry blossoms'
   nyuuyooku-zakura
7. 折り紙棚   'origami shelf'
   ori-gami-dana
13. 大風   'strong wind'
    oo-kaze
18. 数珠繋ぎ   'roping together'
    juzu-tsunagi
20. 貧乏性   'disposition to living stingily'
    bimbou-shou
21. 英会話不足   'lack of English conversation'
    eikaiwa-busoku
23. アラビア紙   'Arabian paper'
    arabia-gami
27. ガラス戸   'glass door'
    garasu-do

31.	大唐紙 *oo-garakami*	'a large paper sliding door'
33.	見苦しい *mi-gurushii*	'unsightly'
49.	花便り *hana-dayori*	'flower tidings'
50.	素人考え *shirouto-kangae*	'layman's idea'
51.	飛行機寿司 *hikouki-zushi*	'airplane sushi'
55.	二言 *futa-koto*	'two words'
56.	小舟 *ko-bune*	'small boat'
70.	小川 *o-gawa*	'small river'
74.	和太鼓 *wa-daiko*	'Japanese drumming'
79.	中太鼓 *chuu-daiko*	'mid-size taiko drum'
89.	女言葉 *onna-kotoba*	'feminine speech'
95.	沖縄口 *uchinaa-guchi*	'Okinawan language'
100.	白雪姫 *shira-yuki-hime*	'Snow White'

Appendix B
Example Test Slides

The following are two examples of the slides that participants were presented with during the study. The first is the introductory slide, and the second is from the main body of the test and is representative of all other screens from the test proper. The first slide in (1) outlines the process of compounding using example words with their meanings in parentheses, but without calling attention to their pronunciations. As shown in (2), during the test itself participants were only shown Chinese characters without any indication of intended pronunciation or meaning.

(1) Introductory Slide (*ooame*, *tabibito*, *kyoukotoba*)

(2) Test Proper Slide (*aki+kampa*)

Appendix C
Test Results

The following are the complete results of the test I performed with native speakers. Words in *italics* represent control words. In the column marked "Voi?" each "x" represents an instance of *rendaku* voicing. The "Notes" column contains some notes on the different pronunciations produced by speakers based on varying readings for the *kanji*. Misreadings that resulted in an underlyingly voiced onset were not counted as examples of *rendaku*. However, though they are invisible in the final data, misreadings that resulted in unvoiced onsets that still did not show *rendaku* are significant, as they show that even when speakers did not have the right *kanji* readings, they still applied *rendaku* in a consistent manner.

After the end of the test, I told speakers what I was studying and asked their opinions on a few words. In the "Notes" column, phrases in quotes and words with an asterisk are statements and judgments by the speakers themselves.

Word	Voi?	Notes
1. 大雨、ooame		
2. 旅人、tabibito	xxxx	
3. 京言葉、kyookotoba		
4. (秋)寒波、kampa		'shun-'
5. 子会社、kogaisha	xxxx	
6. ニューヨーク桜、nyuuyookuzakura	xxxx	
7. 折り紙棚、origamidana	xxxx	
8. (新)震災、shinsai		
9. （大）本船、honsen		'oomotobune'x2
10. （授業）関与、kanyo		
11. (古老)村会、sonkai		
12. (青)近海、kinkai		'ao-'
13. 大風、ookaze		'taifuu'
14. (昇段)剣客、kenkyaku		

15.（山）散歩、sampo	---x	both 'yama-' and 'san-' with no z (1 person)
16. (子)困苦、konku		
17.（昼）瞬間、shunkan		'hiru-,' 'chuu-'
18. 数珠繋ぎ、*juzutsunagi*		
19. (朝)噴火、funka		'chou-'
20. 貧乏性、*bimboushou*		'-sei'
21. 英会話不足、*eikaiwabusoku*	xxxx	
22.（像）繁殖、hanshoku		
23. アラビア紙、*arabiagami*	x	'-shi'x3
24. (和)頓知、tonchi		
25.（車）賃貸、chintai		pause between
26.（東京）銭湯、sentou		pause between
27. ガラス戸、*garasudo*	xxxx	
28.（学校）緊張、kinchou		
29.（白人）偏見、henken		'-biken'?
30.（夕食）賓客、hinkyaku		
31. 大唐紙、*ookarakami*	--x-	'daitoushi,'x3 'oogarakami'
32.（作文）竣工、shunkou		'-senkou,' 'houkou'
33. 見苦しい、*migurushii*	xxxx	
34.（山）春風、shunpuu		'yamaharukaze,'x2 'sanshunpuu'
35.（新）判定、hantei		
36.（軍隊）勲功、kunkou		'-kunshou,' 'donkou'
37.（言語）研究、kenkyuu		*genkyuu (definitely bad)
38.（大）賛嘆、santan		
39.（子）損失、sonshitsu		'ko-'
40.（新）典拠、tenkyo		'-kyokko'
41.（和）帆船、hansen		'-honsen,' '-kousen'x2
42.（大）尊重、sonchou		
43.（軍隊）勲章、kunshou		'-kunchou'
44.（猫）禁止、kinshi		
45.（人間）進化、shinka		
46.（新）選挙、senkyo		
47.（赤）点灯、tentou		'seki-'
48.（新聞）頒布、hampu		'-himpu,' 'bumpu'
49. 花便り、*hanadayori*	xxxx	
50. 素人考え、*shirootokangae*		
51. 飛行機寿司、*hikoukizushi*	xxxx	
52.（早）返球、henkyuu		'sou-'
53.（和）感性、kansei		
54.（新）戦争、sensou		

55. 二言、futakoto		'nigen,' 'nigo'
56. 小舟、kobune	xxxx	
57. （山）探検、tanken		'-sakken'
58. （若）奮闘、funtou		
59. （新）本邦、hompou		'-pompou'
60. （ゴジラ）喧嘩、kenka	xx--	"genka might be better-sounding," analogy case
61. （授業料）算定、santei		
62. （子）寸評、sumpyou		
63. （赤ちゃん）天才、tensai		*densai
64. (入院)頻発、himpatsu		
65. （大学）本科、honka		
66. （新）見解、kenkai		
67. （大）根気、konki		
68. （家庭）担当、tantou		
69. （大）貧困、hinkon		
70. スクーキル川、sukuukirugawa	xxxx	
71. （急）変化、henka		
72. （青）春季, shunki		'sei-'
73. （親子）関係、kankei		
74. 和太鼓、wadaiko	xxxx	
75. （新）損傷、sonshou		'-hokken'
76. （大）賃上げ、chin'age		
77. （若者）奮起、funki		
78. （長）昏睡、konsui		'chooshisui'
79. 中太鼓、chuudaiko	xxxx	
80. (急)緩和、kanwa		'-danwa'
81. （新）観念、kannen		
82. (コンピューター)端末、tammatsu		
83. （偽）鎮静、chinsei		'gi-,' 'karishinshi,' 'nise'
84. （花）頓死、tonshi		'ka-'
85. (海)天気、tenki		'kai-'x2, 'umi-'
86. （中）半径、hankei		
87. （山）炭鉱、tankou		'-sumi,' 'san-'
88. (真)均衡、kinkou		
89. 女言葉、onnakotoba		
90. （新）検索、kensaku		
91. （和）扇子、sensu	-x--	
92. （大学）専攻、senkou		

93. （遅）返金、henkin		'chi-'
94. （大）混沌、konton		
95. 沖縄口、uchinaaguchi	xxxx	'okinawa-'x4
96. （和）慣例、kanrei		
97. (アポロ)神官、shinkan		
98. （金）紛失、funshitsu		'-pun,' 'kane-'
99. （仏教）訓育、kun'iku		
100. 白雪姫、shirayukihime		

Summary
4 speakers x 100 words = 400 words
4 x 75 = 300 test words
4 x 25 = 100 control words

Though readings vary, all voicing in agreement on control words

1 speaker (d) voiced on (15) – *yama + sampo → yamazampo*
2 speakers (a, b) voiced on (60) when it was still *kyoudai + kenka* (→ *kyoudaigenka*)
1 speaker (b) voiced on (91) – *wa + sensu → wazensu*

3 of 75 words showed voicing at least once – 4%
4 total voicing displays out of 300 opportunities – 1.3%

References

Clements, G. N. (2001). Representational Economy in Constraint-Based Phonology. In Hall, T. A. (Ed.), *Distinctive Feature Theory* (pp. 71-146). Berlin: Mouton de Gruyter.

Fukuda, S., & S. Fukuda. (1994). To Voice or Not to Voice: The Operation of Rendaku in the Japanese Developmentally Language-Impaired. *McGill Working Papers in Linguistics = Cahiers linguistiques de McGill, 10*(1-2), 178-193.

Fukuzawa, H., & M. Kitahara. (2001). Domain-Relative Faithfulness and the OCP: Rendaku Revisited. In van de Weijer, J., & Nishihara, T. (Eds.), *Issues in Japanese Phonology and Morphology* (pp. 85-110). Berlin: Mouton de Gruyter.

Inkelas, S. (1997.) The theoretical status of morphologically conditioned phonology: a case study of dominance effects. In Booij, G., & van Marle, J (Eds.), *Yearbook of Morphology 1997* (pp. 121-155).

Ito, J., & R. Mester. (1986). The Phonology of Voicing in Japanese: Theoretical Consequences for Morphological Accessibility. *Linguistic Inquiry, 17*(1), 49-73.

ジーニアス：英和辞典・和英辞典 and 明鏡：国語辞典. (2006). Contained in 漢字そのまま：ＤＳ：楽引辞典. [Nintendo DS software]. Kyoto: Nintendo.

Marlo, M., & C. Mwita. (2009). Problems in Kuria H Tone Assignment. Ms., Indiana University and Kenyatta University.

Murasugi, K. (1988). A Lexical Phonology Approach to Rendaku and Velar Nasalization in Japanese. *Cahiers linguistiques d'Ottawa, 15,* 53-80.

Otsu, Y. (1980). Some Aspects of Rendaku in Japanese and Related Problems. *MIT Working Papers in Linguistics, 2,* 207-227.

Rice, K. (1996). Japanese NC Clusters Revisited: Is Postnasal Voicing Redundant? *Toronto Working Papers in Linguistics, 15*(2), 125-132.

Rosen, E. (2003). Systematic Irregularity in Japanese Rendaku: How the Grammar Mediates Patterned Lexical Exceptions. *Canadian Journal of Linguistics = Revue canadienne de linguistique, 48*(1-2), 1-37.

Suzuki, K. (1997). NN: Rendaku and Licensing Paradox. *Japanese/Korean Linguistics, 6*(6), 215-228.

Tsujimura, N. (2007). *An Introduction to Japanese Linguistics*. Oxford: Blackwell.

Vance, T. J. (1982). On the Origin of Voicing Alternation in Japanese Consonants. *Journal of the American Oriental Society, 102*(2), 333-341.

Vance, T. J. (1987). *An Introduction to Japanese Phonology*. Albany: SUNY.

Vance, T.J. (1996). Sequential Voicing in Sino-Japanese. *The Journal of the Association of Teachers of Japanese, 30*(1), 22-43.

Williams, D. (1994). An OT Analysis of Tone Rendaku in Yamato. *University of Alberta Papers in Experimental and Theoretical Linguistics, 2,* 61-75.