

# *Synchronically Unified Ranking and Distribution of Voice in Japanese\**

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## **1. Introduction**

It is well known that there are four classes of Japanese vocabulary with respect to its origin; Yamato vocabulary consists of native morphemes, Sino-Japanese consists of borrowed morphemes from Chinese, Foreign is a loanword from a language other than Chinese, and Mimetic describes sounds or manners. Each of these classes has different phonological properties.<sup>1</sup>

There are three phenomena with respect to the distribution of voice in Japanese. One of them is that post-nasal obstruents in Yamato vocabulary and Mimetic are mostly voiced while those in Sino-Japanese and Foreign are not. I will mainly focus on this property in this paper. However, I will also discuss the other phenomena, namely the compound voicing alternation (Rendaku) and the restriction of voiced sounds in a morpheme (Lyman's Law). These phenomena typically occur with Yamato vocabulary only.

Although the domain of each phenomenon largely overlaps with a certain class of lexical origin, they do not match completely with each other. The purpose of this paper is to account for the distribution of voice in Japanese by establishing a constraint ranking that covers Japanese vocabulary of any origin.

The organization of the paper is as follows. In section 2, I will present data and four problems to be solved. General tendency of Yamato vocabulary are summarized in 2.1, and many exceptions to the generalization are presented in 2.2. In section 3, I will give an analysis using a unified ranking rather than different rankings depending on origins of the vocabulary. In section 4, I will present two pieces of evidence ---historical and acquisitional---to support my claim that Japanese has only one ranking.

## **2. Distribution of Voice and Four Problems**

In this section, I will present data on the distribution of voicing and raise four problems to be solved. First, I will summarize general tendency of Yamato vocabulary and a problem discussed in Ito et al.'s sequential works (Ito & Mester 1993, Ito, Mester, & Padgett (henceforth IMP) (1993, to appear) in 2.1. In 2.2, I will present various data which do not follow the generalization.

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\* I would like to thank Diana Archangeli, Mike Hammond, Paul Smolensky, Douglas Pulleyblank, Keiichiro Suzuki, Tom Craig, Chip Gerfin, Hisako Ikawa, Tamotsu Ohno, and Noriko Ohno for their helpful comments.

<sup>1</sup> See Ito & Mester 1993:19 for the constraint map of the phonological lexicon of Japanese.

## 2.1. Distribution of Voice in Yamato and a Mystery of Nasal

In this subsection, I will summarize general tendency of Yamato vocabulary referring to each of the three phenomena and a problem raised in Ito, Mester, and Padgett (to appear).

The first phenomenon is known as Lyman's Law, which is defined as follows:

- (1) Lyman's Law: Morphemes contain at most one voiced obstruent. (Ito & Mester 1993:3)

Examples in (2) show that either the first or the second obstruents (or neither) may be voiced, but not both of them:

- |     |        |       |        |       |                 |
|-----|--------|-------|--------|-------|-----------------|
| (2) | a. --  | futa  | 'lid'  | kaki  | 'persimmon'     |
|     | b. - + | fuda  | 'sign' | kagi  | 'key'           |
|     | c. + - | buta  | 'pig'  | gaki  | 'kid (colloq.)' |
|     | d. ++  | *buda |        | *gagi |                 |

The second phenomenon is the compound voicing alternation, which is called Rendaku. Its definition is given in (3):

- (3) Rendaku: Voicing on second compound member. (Ito & Mester 1993:3)

Examples in (4) show that the initial obstruent of the second member alternate to voiced counterpart in compound:

- |     |                            |                   |
|-----|----------------------------|-------------------|
| (4) | a. hoši + kaki => hošigaki | 'dry persimmon'   |
|     | b. yama + tera => yamadera | 'mountain temple' |

When the second member of compound already has voiced obstruent, Rendaku is prevented due to Lyman's Law, as shown in (5):

- |     |                                |                   |               |
|-----|--------------------------------|-------------------|---------------|
| (5) | a. širo + tabi => širotabi     | 'white tabi'      | (*širodabi)   |
|     | b. mono + šizuka => monošizuka | 'tranquil'        | (*monozizuka) |
|     | c. onna + kotoba => onnakotoba | 'feminine speech' | (*onnagotoba) |

Rendaku occurs even if the second member contains a nasal as in (6):

- |     |                            |                 |
|-----|----------------------------|-----------------|
| (6) | a. ori + kami => origami   | 'paper folding' |
|     | b. mizu + hana => mizubana | 'running nose'  |

The data in (6) indicate that nasals do not prevent Rendaku. Looking at the data in (4)-(6) more carefully, we can generally say that Rendaku is prevented only by voiced obstruents.

The third phenomenon is voicing of post-nasal obstruents. Following Ito & Mester (1993), I will refer to this phenomena as \*NT.

- (7) \*NT: Post-nasal obstruents must be voiced in Yamato and Mimetic. This constraint does not hold in Sino-Japanese and Foreign. (Ito & Mester 1993:3)

Examples below show that monomorphemic Yamato vocabulary (8) and Mimetic (9) may have voiced obstruents but not voiceless ones after nasals:

- (8) a. tombo 'dragonfly' cf. \*tompo  
 b. kan̄gae 'thought' \*kan̄kae
- (9) a. šombori 'lonely' \*šompori  
 b. unzari 'disgusted' \*unsari

Data in (10)-(11) indicate that this phenomena is also seen in polymorphemic words:

- (10) a. yom + ta => yonda (\*yonta) 'read (past)'  
 b. šin + ta => šinda (\*šinta) 'died'
- (11) a. mi + ta => mita 'saw'  
 b. tor + ta => totta 'took'  
 c. kaw + ta => katta 'bought'

These data show that the suffix of past tense is /ta/ and it realizes as [da] by voicing alternation only after nasals.

From these phenomena, the following puzzle is raised (Ito, Mester, and Padgett (to appear)):

- (12) **Problem 1:** It seems (from Rendaku) that nasal lacks [voice], which prevents (parse of) another [voice]. What makes post-nasal consonant voiced?

In this subsection, I have summarized the phenomena and a puzzle discussed in IMP (to appear). In the next subsection, I will show various data on NC clusters of different origins and raise three more problems.

## 2.2. More Data on NC Clusters

In this subsection, I will present three kinds of data on NC clusters: exceptions to origin-based classification, words which are hard to classify, and non-alternating suffixes.

### 2.2.1. Exceptions to Origin-based Classification

In this subsection, I will present data from each origin-based class and show to what extent the origin-based generalization works.

Post-nasal voiceless obstruents are rare in Yamato vocabulary, but the following examples are found as exceptions:

- (13) a. *anta* 'you' (< *anata*)  
 b. *nante* 'how' (< *nani* + *te* ?) \**nanite*  
     *nantoka* 'somehow' (< *nani* + *to* + *ka* ?) \**nanitoka*  
 c. *nanjka* 'such thing as (postpositional particle)'  
     *nante* 'such thing as (postpositional particle)'

Although *anta* in (13a) is derived from *anata* (historically) by dropping a vowel, they are used independently in different situations or by different people. Vowels between nasals and voiceless obstruents are dropped in (13b) as well. Although words in (13b) seem to contain a morpheme *nani* and some suffix(es), vowels between nasals and voiceless obstruents in those words never appear at the output and the original meaning of each morpheme is not clearly maintained in the derived word (13b). Data in (13c) are postpositional particles which have post-nasal voiceless obstruents.

According to the origin-based generalization, neither Rendaku nor \*NT applies to Sino-Japanese. Thus Sino-Japanese vocabulary should not have voicing alternations. However, this is not true in many cases; there are many Sino-Japanese morphemes which has voicing alternation. For example, there are twenty-eight homophones *sin* and nine homophones *jin*. Among the homophones *sin*, at least five of them alternate to *jin* in some words.<sup>2</sup> The environment of this alternation, however, is not systematic phonologically, as shown in (14) and (15):

- (14) a. *an* ('implicit') + *san* ('calculation') => *anzan* 'mental arithmetic'  
 b. *kan* ('changing') + *san* ('calculation') => *kansan* 'conversion'
- (15) a. *kan* ('liver') + *šin* ('heart') => *kanjin* 'crucial'  
 b. *kan* ('relate') + *šin* ('heart') => *kanšin* 'interest'  
 c. *kan* ('feeling') + *šin* ('heart') => *kanšin* 'admiration'

A morpheme *san* become voiced in one environment (14a) but not in the other (14b), even though they are quite similar phonologically. A morpheme *šin* alternates to *jin* after a morpheme *kan* (15a) but it does not after its monophones (15b,c).

Sino-Japanese morpheme is monosyllabic and it is difficult to determine whether each alternation is due to Rendaku or \*NT. Compare (16) to (15):

- (16) *yoo* ('use') + *šin* ('heart') => *yoojin* 'care'

In this example, voicing alternation occurs after non-nasal environment.

However, alternation in (17) below is a clear example of post-nasal voicing:

- (17) a. *san* + *soku* => *sanzoku* '3 (pairs of things to wear on feet)'  
 b. *ni* + *soku* => *nisoku* '2 (pairs of things to wear on feet)'

*Soku* in (17) is a classifier that attaches to numerals to count pairs of things to wear on

<sup>2</sup> It is quite difficult to prove that a morpheme never held voicing alternation, since the alternation cannot be determined by phonological environment and thus may appear only in words that are not frequently used.

feet, such as shoes, socks, etc. It alternates to *zoku* only when it attaches to nasal-final numeral.<sup>3</sup>

Another classifier *satsu*, which is used to count books, does not alternate:

- (18) a. *san + satsu => sansatsu* '3 (books)'  
 b. *ni + satsu => nisatsu* '2 (books)'

Although the number of classifiers are not very small and it is difficult to make a complete list of them, (19) should cover most of classifiers (at least those which are frequently used).

- (19) The ratio of alternating classifiers<sup>4</sup>

	old units	others
voiceless	3 ( <i>sen, tsoo, se</i> )	23 ( <i>satsu, ko, too, tsui, kai, soo, seki, ki, po, pin, čaku, k<sup>y</sup>aku, puku, pitsu, kaku, ko, too, tai, sai, šuu, šoku, šoku</i> )
alternating	7 ( <i>kan, sun, šaku, ken, tan, šoo, to, koku</i> )	8 ( <i>pon, piki, pai, kai, ken, soku, tan, koku</i> )
voiced	1 ( <i>goo</i> )	7 ( <i>b<sup>y</sup>oo, ĵi, do, bu, dai, ĵoo, ban</i> )
sonorant	2 ( <i>ri, r<sup>y</sup>oo</i> )	4 ( <i>mai, nin, nen, en</i> )

Old units listed in (19) were used for length, area, volume, weight, and money from quite old days. However, they are now very limited to specific use only. Among them, alternating ones are more common than constantly voiceless ones. Alternation also occurs with other classifiers, even though the ratio is smaller compared to that of old units.

Thus, the ratio of alternating classifiers are not small enough to ignore and their alternation is due to satisfy \*NT. The difference of alternating ratio between old units and other classifiers are due to historical change, which will be discussed in 4.1.

We have seen that Sino-Japanese has many exceptions. Foreign, on the other hand, does not have exceptions and keeps the value of voicedness in the original word without alternation. Examples are shown in (20) and (21):

- (20) a. *kombi* < combination  
 b. *hambaagaa* < hamburger
- (21) a. *kompyuutaa* < computer  
 b. *tempura* < tempuro (Portuguese)

<sup>3</sup> The alternation with the same classifier also occur with a morpheme *nan* 'what'.

<sup>4</sup> Some of the classifiers are monophones, which might look as if they are just repeated.

Units borrowed from foreign languages never alternate either.

- (22) a. san + kiro => san<sub>h</sub>kiro 'three kilometers; three kilograms'  
 b. san + furan => sam<sub>h</sub>furan 'three francs'  
 c. san + herutu => san<sub>h</sub>herutsu 'three hertz'

As for Mimetic, there are exceptions which has post-nasal voiceless obstruents.

- (23) a. tonton 'sounds of (light) knocks'  
 b. dondon 'sounds of hard knocks'
- (24) pompon 'stomach (infants' word)

Words like those in (23) and (24) are from sounds and often show a contrast with its counterpart with voiced obstruents as shown in (23). (24) is a word which came from the sound of patting stomach. Post-nasal obstruent in this word does not become voiced, either.

Although some Mimetic words are hard to tell whether their origins are Sino-Japanese or not, others are definitely not Sino-Japanese.

- (25) tsuntsuruten 'bold; wearing clothes which is too short'  
 (<tsurutsuruten)
- (26) a. tončir<sub>h</sub>kan 'inconsistent; absurd'  
 b. ampontan 'fool, stupid' (<ahodara)  
 c. čimpun<sub>h</sub>kan 'jargon, nonsense'  
 d. činčikurin 'very short, dwarfish'

It is obvious that the example in (25) is not Sino-Japanese, since tsuru cannot be Sino-Japanese morpheme. Examples in (26) are not Sino-Japanese, either; they are created in Japan without using any Sino-Japanese morpheme.

Thus, Mimetic does not always satisfy \*NT.

We have seen various data on NC clusters. The result is summarized in (27). According to the origin-based prediction, white column should be "none".

- (27) Correspondence between classes and alternations

	voiceless	alternating	voiced
Yamato	rare	many	many
Sino	many	some	some
Foreign	many	none	many
Mimetic	some(or many)	none (N/A)	many (or some)

Here, another problem raises:

- (28) **Problem2:** How do you deal with exceptions? And why some class doesn't have exceptions, while others do?

### 2.2.2. Words which are hard to classify

In the previous subsection, we have seen the data which do not follow the prediction for their classes. In this subsection, we will see that there are words whose class is not clear. Consider (29):

- (29) a. čimpira 'urchin, hooligan, juvenile delinquent'  
b. yanča 'naughty'  
c. inčiki 'cheating'

These words are relatively new words and contain post nasal voiceless obstruents. However, their origin is not clear and seems that they are newly created in Japan (without using foreign nor Sino morphemes). As for nonsense words in (30), they are clearly created in Japan (within a decade or two).

- (30) a. pompokorin  
(from a rylic titled "Odoru Pompokorin (=dancing pompokorin)")  
b. tampokotan  
(from a story in TV animation "Manga Nihon Mukashi-banashi" series)

From these data, another problem on classification raises:

- (31) **Problem 3:** Which class do they belong to?

### 2.2.3. Suffixes

In Section 2.1, we have seen that suffix *ta* alternates to *da* after nasals to satisfy \*NT. Examples are repeated here:

- (10) a. yom + ta => yonda (\*yonta) 'read (past)'  
b. šin + ta => šinda (\*šinta) 'died'  
(11) a. mi + ta => mita 'saw'  
b. tor + ta => totta 'took'  
c. kaw + ta => katta 'bought'

However, not all the suffixes have such an alternation.

- (32) a. *wakar+an+kamo* => *wakarankamo* 'may not know'  
       know+neg+may(be)  
 b. *wakar+an+kara* => *wakarankara* 'since (I) don't know'  
 c. *wakar+an+to ši+te* => *wakaranto šite* 'suppose that (I) don't know'  
       know+neg+complementizer do+gerund
- (33) a. *mikan + to (+ riŋgo)* => *mikanto (riŋgo)* 'orange and apple'  
 b. *mikan + ka (+ riŋgo)* => *mikanka (riŋgo)* 'orange or apple'
- (34) a. *amontan + to* => *amontanto* '(a) fool and'  
 b. *tsuntsuruten + ka* => *tsuntsurutenka* 'whether (it is) too short'

In (32), suffixes *-kamo*, *-kara*, and *-to* do not alternate even though they attach to Yamato vocabulary. Suffixes *-to* and *-ka* following nasals in (33) and (34) do not alternate, either. Although it is not very clear to me whether *mikan* in (33) is Yamato or Sino-Japanese, *amontan* and *tsuntsuruten* in (34) are clearly Mimetic.

Nasal-final Yamato vocabulary is very rare, and we cannot determine many data using Yamato vocabulary. Since we have seen that Sino-Japanese also may alternate in many cases, I will show some more data in which suffix is attached to nasal-final Sino-Japanese or Mimetic without alternation.

- (35) a. *an* ('bean jam') + *ko* => *aŋko* 'bean jam'  
       *han* ('seal') + *ko* => *haŋko* 'seal'  
 b. *pečan* (sound of being crushed) + *ko* => *pečaŋko* '(being) crushed'
- (36) a. *ken* (a boy's name) + *čan* => *kenčan* 'Ken'  
 b. *wan* (sound of dog's bark) + *čan* => *wančan* 'doggie'

Suffix *-ko* can attach to nouns without meaning (35a) or can be used to describe a state (35b). Suffix *-čan* is used to show affection or friendly feeling. They do not alternate when they attach to nasal-final Sino-Japanese (35a, 36a) nor to nasal-final Mimetic (35b, 36b).

Suffixes can generally be classified into two groups as shown in (37):

- (37) a. alternating suffixes: *ta* (past), *te* (gerund), *tari* (coordination of verb), *tara* (if...)  
 b. non-alternating (fixed) suffixes: other suffixes

The question raised here would be:

(38) **Problem 4:** How can you distinguish alternating suffixes and non-alternating ones?

In this section, I have shown various data on the distribution of voice feature and raised four problems. In the next section, I will give an analysis to solve these problems.

### 3. Analysis

#### 3.1. Word Structures and Proposals

In order to solve the problems we have discussed, I will give two proposals as shown below:

- (39) a. Japanese has only one ranking rather than separate ones for each class.  
 b. The information for each input is stored in the lexicon of individuals at stem level rather than root level.

The first proposal (39a) is related to the problems raised in 2.2.1. and in 2.2.2. Using only one ranking, we do not have to worry about classification and origin-based exceptions. Therefore, such unified ranking solves Problem 2 and 3.

The second proposal (39b) is related to the alternation of Sino-Japanese. In order to examine word structures of each word, I will informally use the following guidelines:

- (40) a. **Root (RT):** a morpheme which plays the basic part of a word  
 b. **Stem (ST):** the part of a word which determine the meaning of a word and whose meaning is clear from the word  
 c. **Word (WD):** the smallest unit that can be used independently.

Followings are some examples of word structures based on these guidelines:

- (41) a. [WD[ST[RTtombo]]]            'dragonfly'        (Yamato)  
 b. [WD[ST[RTyom]] ta]            'read (past)'     (Yamato)  
       read - past(suffix)  
 c. [WD[ST[RTkan][RTšin]]]        'interest'        (Sino-Japanese)  
       relate- heart  
 d. [WD[ST[RTkan] si ] ta]        'related'         (Sino-Japanese)  
       relate-verbalizer-past

As shown in (41), most roots of Sino-Japanese have to combine with other morphemes to make a stem, while Yamato roots can be stem by themselves. Without knowledge of



(42) [WD [WD ] + [ ] + [WD ]]  
           +v

In this structure, two words are combined as a larger word mediated by a conjunction which only has voiced feature. To account for Rendaku phenomena correctly, I will introduce ALIGN-L(WD,+v) and OBS/VOI.

(43) **ALIGN-L(WD, +v)**: The initial segment of every word is voiced.

(44) **OBS/VOI**: Obstruent must be voiceless.

Rendaku phenomenon is motivated by ALIGN-L(WD, +v). This must be ranked higher than OBS/VOI in order to enable voicing alternation. This is illustrated in (45).

(45) **ALIGN-L(WD, +v) >> OBS/VOI**

	/hosi +[+v] + kaki/	PARSE	FILL (ST)	NO- VC	S/V	FILL (WD)	O/V <sup>2</sup>	ALIGN -L	O/V	No- NC
a.	hosi   gaki   +v				*** *			*	*	
b.	hosi   kaki +v				*** *			***!		

### 3.2.2. Lyman's Law

We have seen in 2.1 that Rendaku phenomena is not seen when the second member contains a voiced obstruent, such as /onna + kotoba/ => onnakotoba (\*onnagotoba). This is due to Lyman's Law, which prevents two voiced obstruents in a morpheme. In order to explain this phenomena, I will introduce the notion of splitting ranking positions of a constraint according to the degree of violation.<sup>5</sup>

(46) Splitting ranking positions of a constraint according to the degree of violation  
 Constraint X<sup>2</sup> >> Constraint Y >> Constraint X

In (46), violations of Constraint Y is worse than single violation of Constraint X, but it is better than double violation of Constraint X. Using the constraint OBS/VOI, we can

<sup>5</sup> This notion resembles to the idea of Smolensky (1995)'s but distinguishes on the point that the violation does not have to be different types or in different domain.

paraphrase Lyman’s Law as prohibition of double violation of OBS/VOI. In 3.2.1., we have seen that Rendaku is motivated by the constraint ALIGN-L(WD,+V), which dominates OBS/VOI. Since Lyman’s Law prevents Rendaku, constraints are ranked as follows:

(47) OBS/VOI<sup>2</sup> >> ALIGN-L(WD,+V) >> OBS/VOI

This is shown in (48):

(48) Lyman’s Law prevents Rendaku (OBS/VOI<sup>2</sup> >> ALIGN-L(WD,+V))

	/onna +[+v] +kotoba/   +v	PARSE	FILL (ST)	NO- VC	S/V	FILL (WD)	O/V <sup>2</sup>	AL -L	O/V	NO- NC
a.	onna kotoba     +v +v				**** ***			**	*	
b.	onna gotoba     +v +v				**** ***		*!	*	**	

### 3.2.3. \*NT

We have seen that suffixes that attach to the stem such as past tense ta held voicing alternation when the stem ends with a nasal as in (49b):

- (49) a. [s<sub>T</sub>mi] + ta => mita ‘saw’  
 b. [s<sub>T</sub>sum] + ta => sunda ‘lived’

On this phenomenon, I will follow IMP(to appear)’s analysis using the following constraints:

- (50) a. **NO-VC-LINK**: Linkage of a feature between a vowel and an obstruent must be avoided.  
 b. **NO-NC-LINK**: Linkage of a feature between a nasal and an obstruent must be avoided.
- (51) **SON/VOI**: Sonorants must be voiced.
- (52) **FILLFEAT**: All features are part of the input.

Constraints in (50) belong to a constraint family NOLINK, which is universally ranked as

follows, where the letters V, G, L, N, and C denote vowels, glides, liquids, nasals, and obstruents, respectively:

- (53) Constraint family: NO LINK  
 NO-VC-LINK > NO-GC-LINK >> NO-LC-LINK >> NO-NC-LINK

Application of these constraints to examples in (49) are shown in (54)-(55):

- (54) Alternation of verbal suffix with nasal-final stem

	/sum+ta/	PARSE	FILL (ST)	NO-VC	S/V	FILL (WD)	O/V <sup>2</sup>	ALIGN-L	O/V	No-NC
a. ☞	sunda ↓ +v				**	*	*		*	*
b.	sunta				***!			*		

(56) and (57) show the constraint rankings in (54) and (55), respectively:

- (55) No alternation of verbal suffix with V-final stem

	/mi+ta/	PARSE	FILL (ST)	NO-VC	S/V	FILL (WD)	O/V <sup>2</sup>	ALIGN-L	O/V	No-NC
a. ☞	mita				***			*		
b.	mida ↓ +v				***	*!			*	
c.	mida ↓ +v			*!	**	*			*	

(56) and (57) show the constraint rankings in (54) and (55), respectively:

(56) SON/VOI >> NO-NC-LINK, FILL

- (57) a. NO-VC-LINK >> SON/VOI  
 b. FILL >> ALIGN-L (WD,+v)

The following example show that Lyman's Law does not apply for suffixation of verbs:

(58) [stɪkagam] + ta => kaganda 'stooped'

Thus SON/VOI dominates OBS/VOI<sup>2</sup> as shown in (59):

(59) SON/VOI >> OBS/VOI<sup>2</sup>

	/kagam+ta   +v	PARSE	FILL (ST)	NO- VC	S/V	FILL (WD)	O/V <sup>2</sup>	ALIGN-L	O/V	NO- NC
a.	kaganda     +v +v				***	*	*	*	**	*
b.	kaganta   +v				*** *!	*	*	*	*	*

The constraint rankings we have seen so far is summarized in (60):

(60) NO-VC-LINK >> SON/VOI >> { FILL >> ALIGN-L(WD,+v) >> OBS/VOI  
 NO-NC-LINK

### 3.2.4. Lexical Specification of [voice]

Voiced obstruents, which is specified as input appear in various positions within a stem. To maintain such specification for output, PARSELINK and FILL must be satisfied. This is shown in (62)-(64) below.

(61) **PARSELINK**: All input association relations are kept.

(62) **FILLFEAT**: All features are part of the input.

(62) kanšin 'interest'

	/kanšin/	PARSE	FILL (ST)	No-VC	S/V	FILL (WD)	O/V <sup>2</sup>	ALIGN-L	O/V	No-NC
a.	kanšin ☞				*** *			*		
b.	kanjin ∇ +v		*!		*** *	*		*	*	*
c.	ganšin   +v		*!		**	*			*	
d.	ganjin   ∇ +v+v		*!*		**	***	*		***	*

(63) kanjin 'crucial'

	/kanjin/   +v	PARSE	FILL (ST)	No-VC	S/V	FILL (WD)	O/V <sup>2</sup>	ALIGN-L	O/V	No-NC
a.	kanzin ☞ ∇ +v				*** *			*		*
b.	kanšin	*!			*** *	*		*	*	
c.	ganšin   +v	*!			**	*			*	
d.	ganjin   ∇ +v+v		*!		**		*		**	*

(64) genĵin 'primitive man'

	/genĵin/     +v+v	PARSE	FILL (ST)	No- VC	S/V	FILL (WD)	O/V <sup>2</sup>	ALIGN-L	O/V	No- NC
a.	genĵin     +v+v				**		*		**	*
b.	kenŝin	*!*			*** *			*		
c.	kenĵin   +v	*!			*** *			*	*	*
d.	genŝin   +v	*!			**				*	

As for FILL, we have seen in (56) that SON/VOI outranks FILL, which motivates voicing of post-nasal obstruents. However, FILL must outrank SON/VOI at stem level to avoid such alternation, as shown in (64). This paradox can be solved if we adopt splitting ranking positions of a constraint according to the morphological level, as shown in (65).

(65) FILL(STEM) >> ALIGN-L >> FILL (WORD)

This is based on the following universal ranking, which is discussed in Archangeli and Pulleyblank (1994b):

(66) Constraint X (root) >> Constraint X (stem) >> Constraint X (word)

Note also that Lyman's Law is not satisfied in (64). More generally, it is not satisfied when there is lexical specification of more than one voiced obstruent. This is shown in the following examples:

- (67) a. New words  
           goĵira                   'Godzilla' (a movie character)  
           gandamu               '?(an animation character who is popular among Japanese boys)'  
       b. Sino-Japanese  
           genĵin                 'primitive man'

- c. Foreign  
 makudonarudo 'McDonald'  
 gurando 'ground'

To summarize the discussion so far, we have the following constraint ranking:

$$(68) \left. \begin{array}{l} \text{PARSE} \\ \text{FILL(STEM)} \\ \text{NO-VC-LINK} \end{array} \right\} \gg \text{SON/VOI} \gg \left\{ \begin{array}{l} \text{FILL(WD)} \gg \text{ALIGN-L(WD,+V)} \gg \text{OBS/VOI} \\ \text{NO-NC-LINK} \end{array} \right.$$

This ranking accounts for Rendaku, Lyman's Law, \*NT, and lexical specification of [voice], independently from origin of each vocabulary.

In this section, a unified constraint ranking (68) is established to account for any classes of words. In the next section, I will present other support for my proposals.

#### 4. Other support for The proposals

##### 4.1. Historical Facts

The following is a brief history of Japanese sound changes, which are discussed in Okimori (1989), Okumura (1972), and Toyama (1972). They support the view that Japanese has changed ranking, and the different properties among different classes are due to such historical change of ranking.

- (69) Nara Period (710-794)  
 a. All syllables were V-final, except Sino-Japanese (and Mimetic).  
 b. Sino-Japanese had *m*, *n*, and *O* syllable finally. Intellectuals distinguished them.  
 c. Generally, pronunciations of Sino-Japanese words were close to those of Chinese.
- (70) Heian Period (794-1192)  
 a. N-final syllables appeared in Yamato vocabulary.  
 Eg. *yomite* → *yonde* (*/yom+te/*) 'reading'  
 b. Orthographically, *m* and *n* were distinguished.
- (71) Kamakura Period - Muromachi Period (1192-1573)  
 a. Confusion of syllable-final *m* vs. *n* occurred both in Yamato and Sino-Japanese. And then the distinction disappeared between syllable-final *m* and *n*.  
 b. Pronunciations of Sino-Japanese changed to Japanese ways. Voicing alternation of Sino-Japanese was an example.  
 c. Yamato & Sino-Japanese began to be seen in a sentence, a word, etc.

- (72) Edo Period (1603- 1868)
- a. There was tendency to change pronunciations of Sino-J. from Japanese ways to Chinese ways. Following this tendency, many voiced obstruents became voiceless.
- E.g. an + šin => anšin (\*anjin)
- b. The masses created Mimetic which sounded like Sino-Japanese. Examples are (26) repeated below.
- (26)
- |               |                        |            |
|---------------|------------------------|------------|
| a. tončiŋkan  | 'inconsistent; absurd' |            |
| b. ampontan   | 'fool, stupid'         | (<ahodara) |
| c. čimpuŋkan  | 'jargon, nonsense'     |            |
| d. činčikurin | 'very short, dwarfish' |            |

This historical change shows that the same constraints used to apply to both Yamato vocabulary and Sino-Japanese before Edo Period. In Edo Period, appearance of new types of Mimetic and change of pronunciations of Sino-Japanese suggest that the ranking changed at this period. Also relationships with Europeans started right before Edo Period, which triggered appearance of Foreign vocabulary. Thus, Japanese used to have a constraint ranking that did not allow post-nasal voiceless obstruent. Later, the ranking was replaced by one which allows post-nasal voiceless obstruent. Rareness of post-nasal voiceless obstruent in Yamato vocabulary is due to the lack of such input, which was caused by the former ranking.

#### 4.2. Acquisition

Another support comes from language acquisition. Children learn the classification of Yamato, Sino-Japanese, and Foreign through writing system (usually at elementary school level). Thus, a huge amount of orthographic training is necessary for such classification. However, preschool children use words from different classes. For example, (73)-(76) are lists of words which most of them would know.

- (73) Yamato:
- |           |                  |
|-----------|------------------|
| a. tombo  | 'dragonfly'      |
| b. sakura | 'cherry blossom' |
- (74) Sino:
- |            |                  |
|------------|------------------|
| a. sensee  | 'teacher'        |
| b. hoikuen | 'nursery school' |
- (75) Foreign:
- |             |          |
|-------------|----------|
| a. buranko  | 'swing', |
| b. basu     | 'bus'    |
| c. čuurippu | 'tulip'  |
- (76) Yamato + Sino:
- |               |           |
|---------------|-----------|
| a. suberi-dai | 'slide'   |
| b. suna-ba    | 'sandbox' |

This shows that they can use different classes of words before they know the

classification. It would be quite difficult to account for this fact if different ranking is necessary for each classes.

## 5. Conclusion

In this paper, we have seen three phenomena with respect to the distribution of voice in Japanese; namely, Rendaku, Lyman's Law, and post-nasal voicing (\*NT). Since these phenomena are mostly seen in Yamato vocabulary, traditional approaches used constraints or constraint rankings which are specific to Yamato vocabulary. Looking at various kinds of data, we have found problems on the analysis using origin-based classification. Instead of using origin-dependent constraint rankings, I have proposed to use only one ranking, which is used for vocabulary of any origin. Looking at the interaction of the three phenomena and lexical specification, I have established such a unified ranking. We have also seen that the existence of the unified ranking is supported by historical facts and the issue of acquisition.

The remaining problem is how to deal with non-alternating suffixes. It seems that it is largely dependent on the word structure and is problematic for both origin-based analysis and my analysis. I will leave this issue for further research.

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