Ranking paradox in consonant voicing in Japanese *

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1. Introduction

It is quite often that some phonological phenomena are found only in a certain vocabulary class but not in others within a single language. However, the basic tenet in OT, a single invariant ranking, apparently seems incompatible to those multiple vocabulary classes with inconsistent phonological phenomena. Recent OT analyses have developed useful notions in their arsenal to attack this problem.

First, multiple sub-lexica are defined when their phonological properties are distinct enough. For instance, Japanese has at least four phonological sub-lexica, such as Yamato, Sino-Japanese, Mimetics, and Foreign (Itô and Mester, 1995; Itô and Mester, 1999; Fukazawa et al., 1998).

Second, those sub-lexica are organized in a core-periphery structure (Itô and Mester, 1995). Generally (and historically), the native vocabulary tends to form the core part while non-native vocabularies tend to form the periphery. A constraint-based implementation of the core-periphery structure is to assume that the more native the sub-lexicon is, the more markedness constraints it may obey. So, for example, in the most native sub-lexicon Z, constraints *F, *G, and *H are all respected. In the least native sub-lexicon X, however, only the constraint *F is satisfied. Figure 1 shows these relations in a set of concentric ellipses.

Faithfulness constraints must be ranked between any two markedness constraints for this core-periphery structure to work. For example, in the sub-lexicon X, *F is respected but *G and *H are violated. What ensures the latter two to be violated is a relevant faithfulness constraint for the sub-lexicon X. By the same token, the sub-lexicon Y has its own version of faithfulness constraint where *F and *G are respected but *H is violated. [1] The overall ranking for this example is shown in (1).

(1) *F ≫ Faith-X ≫ *G ≫ Faith-Y ≫ *H ≫ Faith-Z

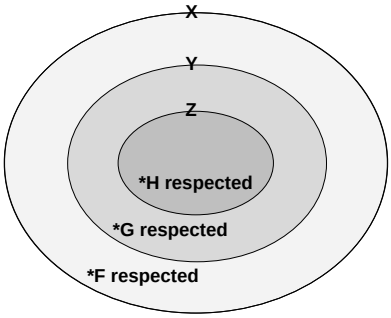

Figure 1: A schematic diagram of the core-periphery structure in a constraint-based system.

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[1] Sub-lexicon specific faithfulness constraints are derived from a general faithfulness constraint, which is called relativization, or split of faithfulness (Fukazawa, 1999).

In this system, the ranking of markedness constraints is what determines the order of posited sub-lexica. In other words, the ranking of markedness constraints must be consistent anywhere in the phonology of the language. A piece of evidence for a ranking paradox in the markedness hierarchy totally confuses the sub-lexicon analysis. However, we have found three apparent ranking paradoxes around consonant voicing phenomena in Japanese. The markedness hierarchy for the consonant voicing in Japanese established in Itô and Mester (2001) cannot account for the data which were first brought up in Tateishi (2001).

In this paper, we will re-examine the constraint ranking regarding consonant voicing in Japanese. Through the analysis in the following sections, our goal is to show three theoretical claims. First, building on Fukazawa, Kitahara, and Ota (2002), we argue that any etymologically-motivated sub-lexica should not exist in the phonological grammar of Japanese. We will introduce a new system of sub-lexica which is based solely on grammatical/morphological information. The gist of our claim is that Japanese phonological lexicon is classified not into "native", "non-native" ... etc. but into "marked" and "unmarked" groups with respect to a particular markedness constraint.

Second, these groups are defined by the relativized faithfulness constraints. The trigger for relativizing the set of faithfulness constraints is again grammatical/morphological information. Historical/etymological categories cannot become evidence for relativizing the faithfulness constraints. We will propose that the relativization is triggered by "stem/affix" distinction in the case of consonant voicing in Japanese.

Third, we thrash out a question: can markedness constraints be relativized as well as faithfulness constraints? In Fukazawa and Kitahara (2001), we have argued that only the faithfulness constraints can be relativized. This point is further reinforced by the analysis in the present paper.

The organization of this paper is as follows: In section 2, we will show that the constraint ranking proposed by Itô and Mester (2001) leads to three cases of ranking paradox against the data presented in Tateishi (2001). Section 3, then, will give our solution to these cases. In section 4, we will discuss theoretical implications of the present analysis in OT, such as sub-lexicalization of lexicon without etymological knowledge, removing domains from markedness constraints, and relativization of faithfulness constraints.

2. Data and issue

2.1 Consonant voicing and Japanese phonological lexicon

As reviewed in introduction, the recent OT analyses for the grammar with phonological sub-lexica assume that a core-periphery structure arises through the interaction of faithfulness constraints and markedness constraints. A partial constraint ranking relevant for consonant voicing in Japanese has been considered as in (2).

(2) Ranking for consonant voicing (adapted from Itô and Mester 2001)

IDENT[voice]-Foreign
|
*VoiObs$^2_{\text{stem}}$
|
IDENT[voice]-Sino-Japanese(SJ)
|
ExpressAffix
|
IDENT[voice]-Common-Sino-Japanese(CSJ)
|
*NT
|
IDENT[voice]-Yamato
|
*VoiObs

In this ranking, *VoiObs$^2_{\text{stem}}$, Express Affix, *NT, and *VoiObs are markedness constraints whose definitions are given in (3).

(3) Definition of relevant markedness constraints

a. *VoiObs$^2_{\text{stem}}$: no double obstruent voicing in a stem. (Lyman's Law)

b. ExpressAffix: affixes must be realized in the output.

c. *NT: no voiceless obstruent after a nasal.

d. *VoiObs: no voiced obstruents.

These markedness constraints are respected most in the Yamato sub-lexicon, but none in the Foreign sub-lexicon, which is enforced by the intervening faithfulness constraints. The ranking in (2) further shows that there are two sub-lexica between Yamato and Foreign: the Sino-Japanese(SJ) sub-lexicon and the Common-Sino-Japanese(CSJ) sub-lexicon. The only difference between them is whether Rendaku occurs or not. Itô and Mester (2001) posit ExpressAffix as the regulating markedness constraint for Rendaku since, in their treatment, Rendaku is an insertion of a [voice] feature as an affix in compounding (see Itô and Mester, 1986; 1998 for more on this).

Due to the fact that Rendaku is typically a characteristic of Yamato words, we see that CSJ words are more nativized than SJ words. In a constraint-based view, this is represented in such a way that ExpressAffix is ranked between the faithfulness constraint for CSJ and that for SJ. Let us see just one example from Itô and Mester's analysis where all the markedness constraints appeared in (3) are relevant.

(4) Tableau for [oyako geNka]–'parent-child quarrel' in Itô and Mester (2001)

/oyako-keNka/	*VoiObs$^2_{\text{stem}}$	ExpressAffix	ID[voice]$_{\text{CSJ}}$	*NT	*VoiObs
☞ a. oyako-geNka			*	*	*
b. oyako-keNka		*!		*	
c. oyako-keNga		*!	*		*
d. oyako-geNga	*!		**		**

The word [oyako-genka] is a Yamato-CSJ compound, which triggers only the IDENT[voice]$_{\text{CSJ}}$ constraint to watch voicing modification in /kenka/. A violation of that constraint by Rendaku

in candidate (a) is not fatal since other markedness constraints are ranked higher. Candidates without Rendaku (b and c) are penalized by ExpressAffix constraint. Candidate (d) has Rendaku and voiced obstruent after [N], which is penalized severely by the highest ranked *VoiObs$^2_{\text{stem}}$. Note that the "stem" domain specified for this self-conjoined constraint is crucial in the analysis. The constraint only sees two voiced obstruents as in [geNga]: another voiced obstruent in the first stem does not matter as in, for instance, [mizu-geNka]–'fight for water'.

2.2 Ranking Paradoxes

2.2.1 Paradox between markedness and faithfulness

Tateishi (2001) provides the data of loanwords from English plural forms which pose problems for the ranking in (2). Those words are team names of Major League Baseball and National Hockey League in the US, which have become popular quite recently in Japan. The data in (6) are added to show that words in other areas are also relevant.

Tateishi indicates that English plural forms are not just borrowed into Japanese as they are in English but alternated so as to fit into Japanese phonology. In English, the voicing of the plural morpheme "-s" depends on that of the last segment of the stem. However, the voicing contrast in plural forms does not necessarily follow the pattern in English when they are taken into Japanese.

(5) Data from Tateishi(2001)

a. [howaito sokkusu] 'White Socks'
b. [iNdiaNzu] 'Indians'
c. [saNzu] 'Suns'
d. [kabusu] 'Cubs'
e. [reddo uingusu] 'Red Wings'

(6) Additional data

a. [shuuzu] 'shoes'
b. [jiiNzu] 'jeans'
c. [bibusu] 'bibs'
d. [daburusu] 'doubles'

Words in (5a)–(5c) show that loanwords are copying the voicing value of the plural morpheme in the original. However, those in (5d)–(5e) and (6c)–(6d) suggest that the situation is not that simple. The pronunciation of the plural morpheme of those words in English is always [z] since the stem ends in a voiced segment. However, corresponding Japanese loanwords have [-su]. It is obvious that this is not a simple final devoicing phenomenon because of the existence of [-zu] forms in (5b) and (5c). The pattern here seems that (i) plural "-s" is voiced after a nasal as in (5b), (5c) and (6b), (ii) plural "-s" is voiceless when the stem contains at least one voiced obstruent as in (5d), (5e), (6c) and (6d), (iii) otherwise, plural "-s" copies the voicing of the original pronunciation as in (5a) and (6a). Thus, the data suggests that there is a phonological alternation of some sort.

Tateishi points out that relevant markedness constraints for this phenomenon are *NT and *VoiObs$^2_{\text{stem}}$. [2] In Japanese, especially in the native vocabulary, these two markedness constraints are considered to be high-ranked due to the phenomena of post nasal voicing (PNV) and Lyman's Law, respectively. There is no voicing contrast after nasals in Yamato since voiceless obstruents are not allowed in the environment. A morpheme does not include more than one voiced obstruent in Yamato (Lyman's Law). These phenomena lead to the following

[2]Tateishi suggests that a faithfulness constraint called "Neighborhood[voice]" might be relevant here. It essentially bans a change in a non-derived environment. His argument is rather directed to the free ranking of faithfulness constraints among multiple sub-lexica, such as Yamato and Foreign. We will not go into this issue because our solution in Section (3.) does not require those labelled sub-lexica anymore.

constraint ranking.

(7) *NT, *VoiObs$^2_{\text{stem}}$ ≫ IDENT[voice]-Yamato

In contrast to Yamato, voicing contrast after a nasal is observed and a morpheme can contain more than one voiced obstruent in the Foreign sub-lexicon, which leads to the following constraint ranking.

(8) IDENT[voice]-Foreign ≫ *NT, *VoiObs$^2_{\text{stem}}$

It is evident that Tateishi's data in (5) contradict to the ranking for Foreign words in (8) although those words are undoubtedly Foreign. It is true that there are some "assimilated-foreign" words in Japanese lexicon, such as [karuta] 'card'(loaned from Portuguese 'carta' in 16th century). Assimilated-foreign words are phonologically quite close to Yamato words. For example, [karuta] shows Rendaku in a compound [iroha garuta] 'cards of the Japanese syllabary'. However, we cannot say the words in (5) are well-assimilated to Japanese because they are loaned quite recently and are still not very familiar to people other than sports fans.

Looking closely, due to the fact that "-s" must be voiced after a nasal as in (5b)–(5c), *NT needs to be ranked higher than the faithfulness constraint for the Foreign sub-lexicon. Thus, the data suggest that either we abandon the membership of the words in (5) to Foreign sub-lexicon, or admit a paradoxical ranking (9).

(9) *NT ≫ IDENT[voice]-Foreign

Also, *VoiObs$^2_{\text{stem}}$ must be ranked higher than the faithfulness constraint for Foreign to account for the data in (5e)–(5g), which is shown in (10).

(10) Tableau for "Cubs" → /kabusu/

	/kabu-zu/	*VoiObs$^2_{\text{stem}}$	IDENT[voice]-Foreign
	a. kabu-zu	*!	
☞	b. kabu-su		*

These are the first two problematic cases for the current OT analyses of multiple sub-lexica in Japanese. The ranking paradoxes here occur between a markedness constraint and a faithfulness constraint. The next subsection introduces a more serious case where the ranking paradox arises between two markedness constraints.

2.2.2 Paradox within markedness

As we have seen in (2), Itô and Mester (2001) propose a ranking where *VoiObs$^2_{\text{stem}}$ is ranked higher than *NT. However, we need a reversed ranking, *NT ≫ *VoiObs$^2_{\text{stem}}$ to account for the data in (5b) and (6b). In those words, English plural morpheme "-s" is pronounced as [zu] after a nasal although there is a voiced obstruent in the stem.

Tableau (11) shows that the reversed ranking is justified from the data. Candidate (a) has two voiced obstruents, violating the *VoiObs$^2_{\text{stem}}$ constraint. However, it wins over candidate (b) which has a voiceless obstruent after a nasal. To get a correct output, the *NT constraint must be ranked higher than the *VoiObs$^2_{\text{stem}}$ constraint.

(11) Tableau for "Indians" → /iNdiaNzu/

	/iNdiaN-zu/	*NT	*VoiObs$^2_{\text{stem}}$	IDENT[voice]-Foreign
☞	a. iNdiaN-zu		*	
	b. iNdiaN-su	*!		

2.2.3 Summary of ranking paradoxes

We have seen three paradoxical cases for the ranking in (2) from the data in Tateishi (2001). To account for Tateishi's data, we need the rankings in (12).

(12) Partial rankings conforming Tateishi's data

a.	*NT ≫ IDENT[voice]-Foreign	for (5b) [iNdiaN-zu]
b.	*VoiObs$^2_{\text{stem}}$ ≫ IDENT[voice]-Foreign	for (5d) [kabu-su]
c.	*NT ≫ *VoiObs$^2_{\text{stem}}$	for (5b) [iNdiaN-zu]

On the other hand, Itô and Mester (2001) proposed the ranking in (2) to account for consonant voicing in Japanese. The relevant partial rankings are summarized in (13).

(13) Partial rankings proposed by Itô and Mester (2001)

a.	IDENT[voice]-Foreign ≫ *NT	for e.g. [furaNsu]–'France'
b.	IDENT[voice]-Foreign ≫ *VoiObs$^2_{\text{stem}}$	for e.g. [gagu]–'gag'
c.	*VoiObs$^2_{\text{stem}}$ ≫ *NT	for (4) [oyako-geNka]

Itô and Mester's rankings are thus in contradiction to the ranking for the new data introduced by Tateishi (2001). In the following section, we will give a solution to these ranking paradoxes.

3. Solution

Two of the three paradoxes in the previous section are essentially coming from mixing up etymological knowledge with phonological knowledge. We want to put IDENT[voice]-Foreign higher than *NT because we etymologically *know* that "Indians" is a foreign word in Japanese. Meanwhile, we cannot phonologically *know* "Indians" as a foreign word because the obstruent after the nasal is voiced.

Fukazawa, Kitahara and Ota (2002) show the necessity of reconsidering etymology-based Japanese sub-lexica. The previous literature have claimed that sub-lexica are phonologically motivated and etymology-oriented labelling of sub-lexica is just a convention (Itô and Mester, 1995; Fukazawa et al., 1998). Subscript numbers or letters are often used instead. However, just substituting labels to anonymous numbers or letters does not guarantee the independence of phonology from etymology. Fukazawa et.al (2002) have proposed a concrete alternative that phonological sub-lexica can totally be independent of etymological information. In lieu of etymology-based categorization, lexical items are classified into a marked or an unmarked group with respect to a particular markedness constraint. In other words, there is no items with [+Yamato] diacritics nor faithfulness constraints labelled as Yamato which is sensitive to the diacritics.

(14) Markedness-driven system (Fukazawa, Kitahara and Ota, 2002)

IDENT[voice]-X	←	Marked (both NT and ND possible)
|		[no alternations: PNV contrastive]
*NT		
|		
IDENT[voice]-Y	←	Unmarked (only ND possible)
		[alternations in all morphemes: PNV redundant]

In the schematic partial ranking in (14), the upper IDENT constraint designates the marked sub-lexicon where there is no alternation in voicing after a nasal. That is, both voiced and

voiceless obstruents are possible after a nasal for words in this sub-lexicon. When a word has an voicing alternation in post nasal position, such as verb roots and the past tense /ta/, it belongs to the unmarked sub-lexicon designated by the lower IDENT constraint. *NT is the determining constraint in this case.

But, what X and Y in (14) can be? Our proposal in the present paper is that general morpho-phonological domains and categories, such as stem, affix, and word might replace those letters. This is not a new trick of any sort but a quite standard approach to the relativization of faithfulness. Morpho-phonologically natural domains are the basics of Correspondence Theory (McCarthy and Prince, 1995) where base, reduplicant and such are specified for the domain of faithfulness constraints. On the contrary, we argue against any relativization and domain specification of markedness constraints. This is the approach advocated in Fukazawa and Kitahara (2001) where we tried to eliminate the domain specification of the Obligatory Contour Principle(OCP) constraint. *VoiObs$^2_{\text{stem}}$ constraint is the equivalent of the OCP in the present analysis for the case of Rendaku. As we have seen in (3), the domain "stem" is the crucial part of the definition. However, there is no restriction which domain can be specified for a self-conjoined markedness constraint. [3] Introducing arbitrary domains for self-conjunction leads to the relativization of markedness if the same markedness constraint with different domains are put in a single ranking. Therefore, we will use a plain *VoiObs^2 without "stem" domain in the present analysis.

Having those considerations in mind, let us analyze the data in (5) and (6). We assume English plural morpheme "-s" belongs to the unmarked sub-lexicon in Japanese because Japanese speakers are tacitly aware of the voicing alternation of that morpheme. We assume only morphological alternation is the driving factor for the split of a faithfulness constraint. IDENT[voice]$_{\text{stem}}$ and IDENT[voice]$_{\text{affix}}$ are thus introduced and they are ranked in that order. With the *VoiObs^2 ranked at the top, these split IDENT constraints produce the correct output [kabu-su] as shown in Tableau (15). The ranking essentially says "avoid two voiced obstruents, but voicing change in the stem is worse than that in the affix", leading candidate (b) wins over candidate (c).

(15) Tableau for "Cubs" → /kabusu/

	/kabu-zu/	*VoiObs^2	IDENT[voice]$_{\text{stem}}$	IDENT[voice]$_{\text{affix}}$
	a. kabu-zu	*!		
☞	b. kabu-su			*
	c. kapu-zu		*!	

As in the schematic ranking in (14), *NT is ranked below IDENT[voice]$_{\text{stem}}$, which is evident from a case without affix, such as /furaNsu/–'France' as in (16).

(16) Tableau for "France" → /furaNsu/

	/furaNsu/	IDENT[voice]$_{\text{stem}}$	*NT
	a. furaNzu	*!	
☞	b. furaNsu		*

Thus, we have established a partial ranking: *VoiObs^2 ≫ IDENT[voice]$_{\text{stem}}$ ≫ *NT ≫ IDENT[voice]$_{\text{affix}}$. However, this ranking cannot account for [iNdiaN-zu] in (5b). The highest ranked *VoiObs^2 kills the desired output (a), leaving candidate (b), without voicing change in the stem, as the selected output.

[3] Self-conjunction is an extension of Local Conjunction (Smolensky,1993; 1995; 1997) where the domain is given *a priori*.

(17) Tableau for "Indians" → /iNdiaNzu/

	/iNdiaN-zu/	*VoiObs^2	IDENT[voice]$_{\text{stem}}$	*NT	IDENT[voice]$_{\text{affix}}$
	a. iNdiaN-zu	*!			
! ☞	b. iNdiaN-su			*	*
	c. iNtiaN-zu		*!		
	d. iNtiaN-su		*!	*	*

The problem here is that the highest ranked *VoiObs^2 constraint immediately kills the desired output because there are apparently two [voice] features for obstruents in /iN**d**iaN-**z**u/. However, is it really true? In Fukazawa and Kitahara (2001), we have proposed that UNIFORMITY[F] can be relativized to a morpheme to regulate the fusion of features as a repair strategy for the OCP violation. In the present paper, we will explore more candidates with featural fusion for /iNdiaN-zu/ and other examples.

In addition to IDENT[F] and UNIFORMITY[F], relativized MAX[F] will be necessary in the present analysis. For the sake of brevity, the definitions are all given in (18) and the proposed overall ranking of relevant constraints is shown in (19).

(18) Definition of relativized faithfulness constraints relevant for the present analysis

a. IDENT[voice]$_{\text{stem}}$: the correspondent segments in a stem in the input and the output have identical values for the feature [voice].

b. IDENT[voice]$_{\text{affix}}$: the correspondent segments in an affix in the input and the output have identical values for the feature [voice].

c. UNIFORMITY[voice]$_{\text{stem}}$: no feature [voice] in a stem in the output has multiple correspondents in the input (i.e., no coalescence regarding the feature [voice] in a stem).

d. UNIFORMITY[voice]$_{\text{word}}$: no feature [voice] in a word in the output has multiple correspondents in the input (i.e., no coalescence regarding the feature [voice] in a word).

e. MAX[voice]$_{\text{stem}}$: every feature [voice] attached to a segment in a stem in the input has a correspondent in the output.

f. MAX[voice]$_{\text{affix}}$: every feature [voice] attached to a segment in an affix in the input has a correspondent in the output.

(19) Proposed ranking for consonant voicing in Japanese (Shortened names for tableaux in parentheses)

*VoiObs^2
|
MAX[voice]$_{\text{stem}}$ (MAX$_{\text{st}}$)
|
UNIFORMITY[voice]$_{\text{stem}}$ (UNI$_{\text{st}}$)
|
ExpressAffix (EXPAFF)
|
IDENT[voice]$_{\text{stem}}$ (ID$_{\text{st}}$)
|
*NT
|
UNIFORMITY[voice]$_{\text{word}}$ (UNI$_{\text{wd}}$)
|
IDENT[voice]$_{\text{affix}}$ (ID$_{\text{aff}}$)
|
MAX[voice]$_{\text{affix}}$ (MAX$_{\text{aff}}$)

With this new ranking, not only the problem in (17) but also all the ranking paradoxes mentioned in the previous section are solved. [4] First, as shown in (20), the fused candidate (a) is selected in spite of the violation of UNIFORMITY$_{\text{word}}$.

(20) Tableau for "Indians" → /iNdiaNzu/

	/iNdiaN-zu/	*Voi Obs^2	MAX$_{\text{st}}$	UNI$_{\text{st}}$	EXP AFF	ID$_{\text{st}}$	*NT	UNI$_{\text{wd}}$	ID$_{\text{aff}}$
☞	a. iNdiaN-zu ⟩ [voi]							*	
	b. iNdiaN-zu | | [voi] [voi]	*!							
	c. iNdiaN-su | [voi]						*!		*
	d. iNtiaN-zu | [voi]		*!			*	*		
	e. iNtiaN-su		*!			*	**		*

In (20), candidate (b) has two [voice] features resulting in a violation of the highest ranked constraint *VoiObs^2. The violation of MAX[voice]$_{\text{stem}}$ penalizes candidates (d) and (e). In those candidates, the feature [voice] attached to the segment [d] in the input is lost in the output: [iNtiaN- zu/su]. Devoicing in the stem is worse than that in the affix because MAX[voice]$_{\text{stem}}$ is ranked far higher than MAX[voice]$_{\text{affix}}$. In the optimal candidate (a), two [voice] features are fused into one. Therefore, it does not violate *VoiObs^2. Coalescence of the features in the word violates the faithfulness constraint, the low-ranked UNIFORMITY[voice]$_{\text{word}}$, but does not violate UNIFORMITY[voice]$_{\text{stem}}$ since one of the [voice] features belongs to the stem but the other belongs to the affix. That is, the coalescence takes place not within a stem but within a word. Candidate (a) wins over candidate (c) since *NT outranks UNIFORMITY[voice]$_{\text{stem}}$.

(21) Tableau for "oyako-genka"

	/oyako-keNka/	*Voi Obs^2	MAX$_{\text{st}}$	UNI$_{\text{st}}$	EXP AFF	ID$_{\text{st}}$	*NT	UNI$_{\text{wd}}$	ID$_{\text{aff}}$
	a. oyako-geNga ⟩ [voi]$_{\text{D}}$			*!		**		*	
	b. oyako-geNga | | [voi]$_{\text{D}}$ [voi]	*!				**			
☞	c. oyako-geNka | [voi]$_{\text{D}}$					*	*		
	d. oyako-keNga | [voi]				*!	*			
	e. oyako-keNka				*!		*		

[4] MAX[voice]$_{\text{affix}}$ is skipped in the followin tableaux since it is so low-ranked that it plays little role in selecting the given candidate set.

Now, let us reanalyze the example in (4) from Itô and Mester (2001). In (21), candidate (b) loses due to the violation of *VoiObs^2. Candidate (a) in which two [voice] features are fused within a stem violates UNIFORMITY[voice]$_{\text{stem}}$. Candidates (d) and (e) lose since Rendaku does not take place, resulting in the violation of EXPRESSAFFIX. Consequently, candidate (c) in which Rendaku takes place becomes optimal. It violates both IDENT[voice]$_{\text{stem}}$ and *NT, but neither violation is more serious than those in other candidates.

(22) Tableau for "bibs" → /bibu-su/

	/bibu-zu/	*Voi Obs^2	MAX$_{\text{st}}$	UNI$_{\text{st}}$	EXP AFF	ID$_{\text{st}}$	*NT	UNI$_{\text{wd}}$	ID$_{\text{aff}}$
☞ a.	b i b u-su \ / [voi]			*				*	*
b.	b i b u-zu | | | [voi][voi][voi]	*!**							
c.	b i b u-su | | [voi] **[voi]**	*!							*
d.	b i p u-zu | | [voi] [voi]	*!	*			*			
e.	b i p u-su | [voi]		*!			*			*
f.	b i b u-zu | \ / [voi] [voi]	*!						*	
g.	b i b u-zu \ / | [voi] [voi]	*!		*				*	

In (22), both candidates (a) and (c) have the same segmental structure [bibu-su], but the featural structures are different. Candidate (c) has two independent [voice] features violating the highest ranked constraint *VoiObs^2. On the contrary, candidate (a) violates UNIFORMITY[voice]$_{\text{stem}}$, since two features are fused within a stem. Similarly, we can consider three different featural structures for [bibu-zu] as shown in candidates (b), (f), and (g). All of them lose because they result in violating the highest ranked constraint *VoiObs^2 regardless of their featural structures. Candidate (e) violates MAX[voice]$_{\text{stem}}$ because the [voice] feature in the stem in the input loses the correspondent in the output, resulting in a violation of MAX[voice]$_{\text{stem}}$. On the contrary, the loss of [voice] feature in candidate (a) occurs in the affix, resulting in a violation of low-ranked IDENT[voice]$_{\text{stem}}$. Consequently, candidate (a) becomes optimal.

(23) Tableau for "Cubs" → /kabu-su/

	/kabu-zu/	*Voi Obs^2	Max$_{st}$	Uni$_{st}$	Exp Aff	Id$_{st}$	*NT	Uni$_{wd}$	Id$_{aff}$
	a. kabu-zu ⋁ [voi]							*!	
☞	b. kabu-su | [voi]								*
	c. kabu-zu | | [voi] [voi]	*!							
	d. kapu-zu | [voi]		*!			*			

In (23), candidate (c) loses due to its violation of *VoiObs^2. Candidate (d) loses since devoicing takes place in the stem, resulting in the violation of high-ranked Max[voice]$_{stem}$. The violation of Uniformity[voice]$_{word}$ in candidate (a) is more serious than that of Ident[voice]$_{affix}$ in candidate (b) although both of them are relatively low-ranked. Two [voice] features are fused not in the stem but in the word in candidate (a). Devoicing in the affix makes candidate (b) violate Ident[voice]$_{affix}$. However, (b) becomes optimal since other candidates commit more serious violations. [5]

4. Conclusion

We have seen paradoxical cases for the previously proposed system of multiple phonological sub-lexica in Japanese. Our proposal to resolve the paradoxes is simple: relativize faithfulness constraints with standard morpho-phonological categories. All the patterns brought up in Tateishi (2001) and additional data of our own are all accounted for in our analysis.

The analysis so far brings up some theoretical implications. First, as we have claimed earlier in introduction, any etymological information should not be mixed up with phonological information for setting up sub-lexica. This position is enforced by a simple consideration about language acquisition. There is no *a priori* knowledge for children that a certain item belongs to a particular sub-lexicon. At the early stage of acquisition, the grammar, vocabulary, and the structure of lexicon are all acquired through phonological input.

Second, we have discussed elsewhere that relativization of a markedness constraint is not a viable idea (Fukazawa and Kitahara, 2001). That is the background reason why we eliminate the "stem" domain from the self-conjoined *VoiObs^2 constraint. If we allow arbitrary domain specification in a markedness constraint and allow the same markedness constraint with different domain specifications co-exist in a single ranking, the result will be a relativization of markedness.

Finally, we would like to point out that relativization of faithfulness is a fairly standard and well-motivated idea in recent OT studies. What domain-relative faithfulness constraints represent is, we believe, that different domains have different phonological "tightness". For example, stem is less vulnerable to modification than affix is since it is more tightly woven.

[5] We have analyzed other data such as [gagu]–'gag', a usual Rendaku word like [tabi- bito] 'travelers', a usual Lyman's law case like [kita-kaze] 'north winds' with the proposed ranking, and have found out that they are all accounted for without any paradox. We do not put the analyses in this paper due to the space limitation.

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