

Chapter 5 OCP on Features and Multiple Input-Output Faithfulness Relations in Japanese

5.1 Introduction

In the previous chapters, I have analyzed OCP effects on features based on the typology I predicted. Also, I have pointed out that certain theoretical notions such as local conjunction and Sympathy Theory are necessary to complete the typological analysis. In addition to those discussed, I will now argue for one further theoretical device in this chapter needed to analyze OCP effects on features in Japanese.

The OCP effects on features which I discuss in this chapter are Rendaku and Lyman's Law. Rendaku is a process in Japanese whereby the initial obstruent of the second member of a compound becomes voiced (Otsu 1980, Itô and Mester 1986, 1998). However, when the second member already contains a voiced obstruent, Rendaku is not observed. This is known as Lyman's Law.

Itô and Mester (1986, 1998) characterize Lyman's Law, originally a constraint which prohibits more than one voiced element within a morpheme, as a kind of Morpheme Structure Constraint (MSC) which blocks Rendaku, and which results from the OCP applying on the [voice] feature. Therefore, we expect that the phenomena can be analyzed in a similar way to other cases of MSC such as the Ponapean data examined in section 3.1.

However, some data in Japanese cannot be accounted for solely with the constraint ranking established for other languages with MSCs. An additional assumption is required to account for the entire Japanese grammar. I will propose that faithfulness constraints can be relativized to distinct sub-lexica within a language.

In section 5.2, I illustrate Rendaku and the OCP effects on [voice] (Lyman's Law) in Japanese and point out how the proposed constraint ranking cannot bring forth the correct analysis. Section 5.3 reviews the previous studies of multiple faithfulness relations within a language built on Correspondence Theory. Section 5.4 examines stratum-specific phonological phenomena in Japanese, and elucidates the five phonological patterns depending on the sub-lexicon. The investigation in section 5.3 and 5.4 leads to the formulation of five Input-Output faithfulness relations in Japanese in section 5.5. A full set of faithfulness constraints is established for each stratum, and the analysis of the data with all those constraints shows that Japanese grammar consists of a single ranking. In section 5.6, I will analyze Rendaku and Lyman's Law with the five Input-Output faithfulness constraints. Section 5.7 reviews the approach of reranking faithfulness constraints (Itô and Mester 1995 b), and compares it with the multiple faithfulness relations approach. I will argue that the proposed device in this chapter is superior to the reranking approach not only theoretically but also empirically. I will make it clear not only how my model respects the invariant ranking hypothesis in OT but also how Fukazawa, Kitahara, and Ota (1998, to appear) explain Japanese hybrids which consist of different strata.

5.2 Rendaku (Sequential Voicing) and Lyman's Law

5.2.1 Rendaku (Sequential Voicing)

When two words are compounded into one, the initial obstruent of the second compound member becomes voiced: (Sequential Voicing: *ren* 'sequence', *daku* 'voice'). The following are examples of Rendaku.

(1) Japanese Rendaku

- (a) /ama 'sweet' + **tai** 'sea bream'/ → [amad**ai**] 'tilefish'
- (b) /nobori 'goin up' + **saka** 'slope'/ → [noboriz**aka**] 'uphill slope'
- (c) /ičigo 'strawberry' + **hatake** 'field' / → [ičigob**atake**] 'strawberry field'¹
- (d) /ama 'rain' + **kappa** 'coat'/ → [amag**appa**] 'raincoat'

Itô and Mester (1996) propose the following constraint for Rendaku (Sequential Voicing) listed in (2).

(2) A constraint for Rendaku

SeqVoi (Rendaku) : Initials of second compound members should be voiced.

They indicate that Rendaku occurs in Japanese because this constraint outranks a faithfulness constraint for voicing in the Japanese grammar.

(3)

/ama + tai /	SeqVoi	DEP[voice] ²
☞ a. amad ai		*
b. amatai	*!	

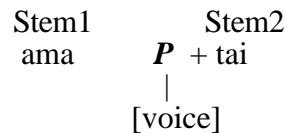
¹ In Japanese, [h] is the voiceless counterpart of [b], since [p] can singly surface only in some sub-lexica in the language, and a voiceless labial fricative [ɸ] occurs only before a labial vowel. The limitation of [p] will be discussed in detail in section 5.5.3.

² Itô and Mester (1995b) use FAITH[voice] or IDENT[voice] for the constraint. I use DEP[voice] to be consistent with the discussion in this thesis. Also, I assume that [voice] is privative following Lombardi (1995a). Thus, a voiced stop bears [voice], while voiceless stop does not.

Candidate (a) is optimal in tableau (3), because it satisfies SeqVoi.

Following Itô and Mester (1986:57), Itô and Mester (1998:27) further argue for the status of the SeqVoi constraint. They indicate that Rendaku voicing is a kind of morpheme. To attach the second member of the compound to the first member, a kind of prefix *P* must be inserted. This prefix underlyingly just bears the feature [voice].

(4)



In order for the prefix to be parsed at the surface, the [voice] feature must be realized as a feature of the initial obstruent of the second member. Thus, Itô and Mester conclude that the constraint SeqVoi can also be called "Realize-Morpheme" which is a better candidate for a universal constraint than SeqVoi.

We also need to introduce another constraint, DEP[assoc.]-IO,³ which prohibits insertion of the association line.

(5)

/ama + P tai/ [voice]	Realize-Morpheme	DEP[assoc.]
☞ a. amadai [voice]		*
b. amatai [voice]	*!	

³ This plays the same role as "No-Spread" in McCarthy's (1997a) term.

Tableau (5) is essentially the same as (3). However, it explicitly states that candidate (b) loses due to the floating [voice] feature which results from the prefix not being realized.

5.2.2 Lyman's Law

I have reviewed how Rendaku has been analyzed in previous research in section 5.2.1. In this section, I discuss Itô and Mester's (1986, 1998) analysis of Lyman's Law to further illustrate Rendaku.

The proposed ranking of the constraints gives rise to the correct analysis for the data which have been introduced in section 5.2.1. However, there are other data which cannot be accounted for by this ranking. Rendaku does not occur in some compound words.

(6)

- (a) /šira 'white' + **s**agi 'heron'/ → [širasagi] 'egret'
- (b) /hito 'human' + **h**ada 'skin'/ → [hitohada] 'body temperature'
- (c) /kita 'north' + **k**aze 'wind'/ → [kitakaze] 'north wind'

As already indicated, Rendaku fails to take place in these examples because the second compound members already contain voiced obstruents. This has been called Lyman's Law, which states that morphemes cannot have more than one voiced obstruent.

Itô and Mester (1986, 1998) claim that we should introduce another markedness constraint to explain the interaction of Rendaku with Lyman's Law. That is, a constraint which forbids obstruent voicing.

- (7) Voiced Obstruent Prohibition (VOP): *[voice, -son] (obstruents must not be voiced) (Itô and Mester 1998).

This constraint specifically targets obstruent voicing and places no restriction on the voicing of sonorants.

It is well-known that Lyman's Law prevents Rendaku from taking place when a second member contains a voiced obstruent, while it does not block Rendaku when a second member includes sonorants. Previous analyses in pre-OT frameworks assumed that the [voice] of sonorants is underspecified (Itô and Mester 1986, 1989).

However, there is evidence provided for full specification of sonorant voicing as Lombardi (1998) points out. For example, [voice] in sonorants must be specified to account for the phenomenon of post nasal voicing in many languages including Japanese. Further, while voiced obstruents are marked, voiced sonorants are unmarked. Itô and Mester capture this by assuming full specification, and using a markedness constraint that refers only to the segments that are marked when voiced: the obstruents.

Itô and Mester (1986, 1998) indicate that Rendaku takes place not only because the constraint Realize-Morpheme outranks the faithfulness constraint for association line, namely, DEP[assoc.] in this chapter, but also because it is higher ranked than VOP.

(8)

/ama + P tai/ [voice]	Realize-Morpheme	VOP
☞ a. amadai [voice]		*
b. amatai [voice]	*!	

In tableau (8), candidate (b) is the better candidate with respect to VOP; however, it loses because VOP is lower ranked than Realize-Morpheme.

The new ranking, however, still cannot account for the blocking effect of Lyman's Law.

(9)

/kita + P kaze/ [voice]	Realize-Morpheme	VOP
*☞ a. kitagaze [voice]		*
b. kitakaze [voice]	*!	

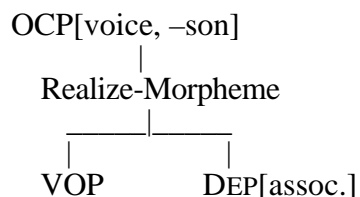
As in tableau (9), candidate (a), in which Rendaku is observed, incorrectly wins due to the ranking.

Itô and Mester propose that a self-conjunction of VOP as a constraint for the OCP effect on [voice] of VOP in (10) outranks Realize-Morpheme as shown in (11).

(10)

OCP[voice, -son]⁴:*[voice, -son][voice, -son]⁵

(11)



The ranking in (11) correctly accounts for both Rendaku and Lyman's Law. I reanalyze both tableaux (8) and (9) with the ranking in (10).

(12) revised analysis of (8)

/ama + P tai/ [voice]	OCP [voice, -son]	Realize- Morpheme	DEP [assoc.]	VOP
☞ a. amadai [voice]			*	*
b. amatai [voice]		*!		

4 Itô and Mester use "VOP²" in order to refer to this self-conjoined OCP constraint. I however use OCP[voice, -son] in order to be consistent with the rest of the chapters in this dissertation.

5 The domain which this OCP constraint specifies is within a morpheme.

(13) revised analysis of (9)

/kita + <i>P</i> kaze/ [voi][voi]	OCP [voice, –son]	Realize- Morpheme	DEP [assoc.]	VOP
a. kitagaze [voi][voi]	*!		*	*
☞ b. kitakaze [voi][voi]		*		

When a second member does not bear [voice], it satisfies the OCP on [voice]; therefore, the candidate which respects the next higher-ranked constraint, Realize-Morpheme becomes optimal. On the other hand, if the second member of the compound already contains [voice], then, the prefix for Rendaku must not be realized so as to not violate the highly ranked OCP constraint.

Thus, the effect of OCP on features in Japanese on the basis of Rendaku and Lyman's Law is accounted for by the ranking in (11).

5.2.3 Stratum-specificity of Rendaku and Lyman's Law

I reviewed in previous sections the claim that Japanese OCP effects on features act as MSC. In this section, I further point out that the proposed ranking in section 2.3.3.2 does not characterize the Japanese grammar in full because Rendaku and Lyman's Law are stratum-specific.

The Japanese vocabulary is divided into five strata based on etymology: *Yamato*, *Sino-Japanese*, *Mimetic*, *Foreign (Assimilated)*, and *Alien (Unassimilated)* (McCawley 1968, Itô & Mester 1995a, b). There are many stratum-specific phonological phenomena in Japanese. I will discuss those phenomena in detail in section 5.4. Rendaku and Lyman's Law are only observed in

the Yamato vocabulary in Japanese. In the rest of the sublexica, they do not take place as the following examples illustrate.

(14)

(a) /ama 'sweet' + tai 'sea bream'/

→ [amadai] 'tilefish' (Yamato)

(b) /kan 'hearty' + tai 'reception'/

→ [kantai] 'the warm reception' (Sino-Japanese)

(c) /saiko 'best' + taimu 'time'/

→ [saikotaimu] 'best time/best record' (Foreign)

As (14) shows, Rendaku only takes place in Yamato. The proposed ranking in section 5.2.2 cannot account for the distinction among the strata as shown in the tableau in (15).

(15) A wrong result for other sub-lexica

/kan + P tai/ [voice]	OCP [voice, -son]	Realize- Morpheme	DEP [assoc.]	*[voice, -son]
*☞ a. kandai [voice]			*	*
actual winner b. kantai [voice]		*!		

Candidate (a) in which Rendaku applies wrongly wins with this ranking.

I will discuss stratum-specific phonological phenomena in Japanese seeking a solution to the problem pointed out in this section.

Section 5.3 first outlines the problem coming from stratum-specific phonological phenomena. I claim that multiple input-output faithfulness constraints are necessary to solve the problem. In section 5.6, I will come back to the analysis of the different status Rendaku and Lyman's Law among sub-lexica.

5.3 Multiple Input-Output Faithfulness Relations

5.3.1 Introduction

As introduced in section 5.2.3, there are five sub-lexica in Japanese, and there are many stratum-specific phonological phenomena. They result in five phonological patterns are delineated in Japanese on the basis of these stratum-specific phenomena. Consequently, five different constraint rankings would be necessary to account for the entire Japanese grammar in Optimality Theory (OT), if the interaction of only the existing faithfulness and markedness constraints were taken into consideration. This would distort the principle of OT which specifies that each single invariant ranking of the constraints accounts for the grammar of each language. In OT, Japanese, as a language, should be evaluated by a single invariant ranking of constraints.

Itô & Mester (1995b)⁶ try to solve this problem by suggesting that faithfulness constraints can be re-ranked within a grammar. They propose that the interaction of the fixed ranking of markedness constraints and the re-ranked faithfulness constraints among the strata determine variant phonological patterns in Japanese. However, their approach still requires several sub-rankings within a language, although the sub-rankings differ from one another in only a limited way; by the re-ranking of faithfulness constraints. Moreover, their model cannot account for

⁶ In their recent proposal (to appear), Itô and Mester independently claim that faithfulness constraints are split depending on the stratum, which is also proposed and discussed in detail in this dissertation.

instances of Japanese hybrids which consist of two or more different strata (Fukazawa, Kitahara, and Ota 1998, to appear).

I propose that there is a system which can account for a language with more than one sub-lexicon without major modifications to the principle that the OT grammar of a language consists of one invariant constraint ranking. I will argue that this system is supported by Correspondence Theory (McCarthy and Prince 1995) which further develops the original idea of faithfulness constraints (Prince and Smolensky 1993). Under the recognition of the different types of faithfulness relations, Input-Output (IO), Base-Reduplicant (BR), Output-Output (OO), Tone-Tone-bearer (TT), etc., Correspondence Theory frames a general model of faithfulness for all the linguistic domains that issue identity relations between representations. What is important for the analysis in this chapter is that this theory recognizes that several sets of faithfulness constraints can coexist in a grammar.

Urbanczyk (1995, 1996) and Benua (1995, 1996, 1997a, b) expand the conception of correspondence by demonstrating that individual linguistic relations such as IO, OO, BR, TT, etc. can be further segmented into multiple strings in a language, and every string is regulated by each full set of faithfulness constraints. Thus, a grammar of a language is evaluated by a single ranking of the complete sets of faithfulness constraints for all formal relations and markedness constraints.

Building on those studies on Correspondence Theory, I claim that Japanese instantiates five sets of IO faithfulness constraints interacting in the same grammar: IO-Yamato, IO-Sino-Japanese, IO-Mimetic, IO-Foreign, and IO-Alien. With these five types of IO faithfulness constraints, I will explain all the stratum-specific phonological phenomena with a single constraint ranking.

By proposing multiple IO faithfulness relations in a language, I will illustrate the special nature of faithfulness constraints, and contend that every language consists of a single grammar, that is a total ordering of constraints.

The following section illustrates how distinct sets of faithfulness constraints are generated in a grammar within the framework of Correspondence Theory.

5.3.2 Multiple Faithfulness Relations in Correspondence Theory⁷

As discussed in section 2.3.2.1, Correspondence Theory (McCarthy and Prince 1995) unifies all the correspondence relations so that every relation generates a comparable set of faithfulness constraints: IO:{MAX-IO, DEP-IO, IDENT[F]-IO, INTEGRITY-IO, ...}; OO:{MAX-OO, DEP-OO, IDENT[F]-OO,...}; BR:{MAX-BR, DEP-BR, ...}; etc. Within the framework of Correspondence Theory, the notion of multiple sets of faithfulness in a grammar is extended by Urbanczyk (1995, 1996) and Benua (1995, 1996, 1997a, b). Their work suggests that each basic correspondence relation such as IO, OO, BR, TT, etc. can be further broken down into more than one component.

Urbanczyk (1995, 1996) notices that there are two patterns of reduplication in Lushootseed depending on the reduplicative morpheme: Diminutive or Distributive. The distributive morpheme reduplicates the first $C_1V_1C_2$ from the base, while the diminutive morpheme copies only the first C_1V_1 . For example, the distributive of [bədáʔ] ($C_1V_1C_2V_2C_3$) 'child, offspring' is not *[bə-bədáʔ] ($C_1V_1-C_1V_1C_2V_2C_3$) but [bəd-bədáʔ] ($C_1V_1C_2-C_1V_1C_2V_2C_3$) 'children'. On the other hand, the

⁷ All the faithfulness constraints reviewed in this section treat features as attributes to the segments (McCarthy & Prince 1995, Urbanczyk 1995, 1996, Benua 1995, 1996, 1997a, b). I introduce these faithfulness constraints as they are used in each original work, and do not adjust them so as to be compatible with the rest of this thesis.

diminutive form for [čaləs] 'hand' is [ča-čaləs] (C₁V₁-C₁V₁C₂V₂C₃) 'little hand', and a C₁V₁C₂-C₁V₁C₂V₂C₃ form, *[čal-čaləs], is incorrect.

Urbanczyk analyzes this as the avoidance of a coda which results in a CV-shape for the diminutive. In contrast, codas are possible in the distributive morpheme, creating a CVC-shape. Therefore, the markedness constraint prohibiting codas, NOCODA, is respected in the diminutive reduplication at the expense of a violation of the faithfulness constraint against deleting a segment, MAX (NOCODA >> MAX). However NOCODA is violated to satisfy MAX in the distributive (MAX >> NOCODA). To resolve this conflict between the two rankings, she claims that each of the reduplicative morphemes has its own correspondence relation to the base; hence, there are two different Base-Reduplicant (BR) relations in Lushootseed.

Consequently, two full sets of BR faithfulness constraints are generated in the grammar of Lushootseed: BR-Diminutive (DIM): {MAX-BR-DIM, DEP-BR-DIM, IDENT[F]-BR-DIM,...} and BR-Distributive (DIS): {MAX-BR-DIS, DEP-BR-DIS, IDENT[F]-DIS,...}. These faithfulness constraints are placed in a single ranking with the markedness constraints. Both the diminutive CV-shape and the distributive CVC-shape result from ranking "MAX-BR-DIS >> NOCODA >> MAX-BR-DIM".

Let us take a look at how the constraint ranking works with the actual analysis. The given ranking accounts for the CV-shape of the reduplicative forms of the diminutive.

(16) The Diminutive CV-shape:

/RED + čaləs/	MAX-BR-DIS	NOCODA	MAX-BR-DIM
a. ča-čaləs			*
b. čal-čaləs		*!	

The same ranking provides the correct analysis for the CVC-shape of distributive reduplication.

(17) The Distributive CVC-shape:

/RED-bədəʔ/	MAX-BR-DIS	NOCODA	MAX-BR-DIM
a. bə-bədəʔ	*!		
☞ b. bəd-bədəʔ		*	

Thus, the two full sets of faithfulness constraints for both distributive and diminutive reduplicative morphemes are instantiated in the grammar of Lushootseed.

Benua (1995, 1996, 1997a, b) shows that there are two patterns of affixation in English. For example, certain coda clusters are simplified in both root morphemes: [kʌndɛm], *[kʌndɛmn] ('condemn'), and class 2 affixation such as when *-ing* is attached to the root: [kʌndɛmɪŋ], *[kʌndɛmnɪŋ] ('condemning'), but not in class 1 affixation: [kʌndɛmneyʃʌn], *[kʌndɛmeyʃʌn] ('condemnation').

Benua notes that class 1 and class 2 affixal morphemes each display a different correspondence relation to the output of the root morphemes; hence, there are two kinds of Output-Output (OO) faithfulness relations in English. Thus, two full sets of faithfulness constraints, namely, OO-class 1 affix: {MAX-OO-class 1 affix, DEP-OO-class 1 affix, IDENT[F]OO-class 1 affix,...} and OO-class 2 affix: {MAX-OO-class 2 affix, DEP-OO-class 2 affix, IDENT[F]OO-class 2 affix,...} are found in the grammar of English.

First, in an unaffixed word, the ranking between $*mn]_{\sigma} \gg \text{MAX-IO}$ explains why the output is not [kʌndɛmn] but [kʌndɛm].

(18) Unaffixed word

/kʌndɛmn/	*mn]σ	MAX-IO
☞ a. kʌndɛm		*
b. kʌndɛmn	*!	

The clusters are simplified due to the ranking in (18). Now, from this output form, two kinds of affixation are possible: class 1 and class 2.

In class 1 affixation, the clusters are not simplified, because DEP-OO-class 1 affix is lower ranked than the phonological constraint *mn]σ and MAX-IO.

(19) Class 1 affixation

Tab	>>	/kʌndɛmn + eyʃʌn/	DEP-OO-class2 affix	*mn]σ	MAX-IO	DEP-OO-class1 affix
	☞ a.	kʌndɛm.neyʃʌn			*	*
	b.	kʌndɛmeyʃʌn			**!	

On the other hand, the clusters are simplified in class 2 affixation, because DEP-OO-class 2 affix and *mn]σ are higher ranked than MAX-IO.

(20) Class 2 affixation

Tab	>>	/kʌndɛmn + Iŋ	DEP-OO-class2 affix	*mn]σ	MAX-IO	DEP-OO-class1 affix
		a. kʌndɛm.nIŋ	*!		*	
		☞ b. kʌndɛmIŋ			**	

Thus, a single ranking explains the occurrence of cluster simplification depending on the class of each affix in English.

Both Urbanczyk's and Benua's research suggest that phonological patterns can vary depending on the difference between morphological categories within a language: a pattern observed in one category may not occur in another. Each morphological group gives rise to its own correspondence relation; therefore, it is possible for each of the basic pairs (IO, OO, BR, TT, etc.) to bear multiple full sets of faithfulness constraints for each morphological class within a language. I conclude from this that the full set of faithfulness constraints in Universal Grammar (UG) has the potential of propagation for any correspondence relation in a language. This claim is illustrated as follows:

(21). Propagation of Faithfulness Constraints:

Correspondence Constraints: {MAX, DEP, IDENT[F], INTEGRITY, UNIFORMITY, CONTIGUITY, ANCHOR, LINEARITY }.

IO: {MAX-IO, DEP-IO, IDENT[F]-IO, INTEGRITY-IO, UNIFORMITY-IO, CONTIGUITY-IO, ANCHOR-IO, LINEARITY-IO }

OO: {MAX-OO, DEP-OO, IDENT[F]-OO, INTEGRITY-OO, UNIFORMITY-OO, CONTIGUITY-OO, ANCHOR-OO, LINEARITY-OO }

English-specific faithfulness constraints:

OO-class 1: {MAX-OO-class1, DEP-OO-class1, IDENT[F]-OO-class1, INTEGRITY-OO-class1, UNIFORMITY-OO-class1, CONTIGUITY-OO-class1, ANCHOR-OO-class1, LINEARITY-OO-class1 }

OO-class 2: {MAX-OO-class2, DEP-OO-class2, IDENT[F]-OO-class2, INTEGRITY-OO-class2, UNIFORMITY-OO-class2, CONTIGUITY-OO-class2, ANCHOR-OO-class2, LINEARITY-OO-class2 }

BR: {MAX-BR, DEP-BR, IDENT[F]-BR, INTEGRITY-BR, UNIFORMITY-BR, CONTIGUITY-BR, ANCHOR-BR, LINEARITY-BR }

Lushootseed-specific faithfulness constraints:

BR-DIS: {MAX-BR-DIS, DEP-BR-DIS, IDENT[F]-BR-DIS, INTEGRITY-BR-DIS, UNIFORMITY-BR-DIS, CONTIGUITY-BR-DIS, ANCHOR-BR-DIS, LINEARITY-BR-DIS }

BR-DIM: {MAX-BR-DIM, DEP-BR-DIM, IDENT[F]-BR-DIM, INTEGRITY-BR-DIM, UNIFORMITY-BR-DIM, CONTIGUITY-BR-DIM, ANCHOR-BR-DIM, LINEARITY-BR-DIM }

TT: {MAX-TT, DEP-TT, IDENT[F]-TT, INTEGRITY-TT, UNIFORMITY-TT, CONTIGUITY-TT, ANCHOR-TT, LINEARITY-TT }

Thus, as (21) describes, the matrix set of faithfulness constraints can be multiplied for each identity string in a language. All the established faithfulness constraints stand

in a single ranking with all the other constraints in a language, obeying the principle of total ordering in OT.

In the following sections, I claim that this system of faithfulness propagation also applies in Japanese. I begin in section 5.4 by elucidating the independent phonological patterns exhibited by the five Japanese sub-lexica.

5.4 Five Phonological Patterns in Japanese

5.4.1 Five Sub-lexica

McCawley (1968), and Itô and Mester (1995 a) classify Japanese vocabulary into four strata: *Yamato*, *Sino-Japanese*, *Mimetic*, and *Foreign*. Yamato is the pure native stratum. The English equivalent would be the Germanic or Anglo-Saxon vocabulary. Sino-Japanese historically has some relations to the native lexicon, although it is derived from the Chinese language. In English, Greek or Latinate vocabulary has a similar status. The Mimetic stratum contains lexical items which represent sounds, characteristics, states, and so on.

The new technical vocabulary of loan-words constitutes the foreign stratum. Itô and Mester (1995b) further divide this stratum into two: the words which are borrowed from foreign vocabularies and phonologically assimilated to Japanese are called *Foreign (Assimilated Foreign)*; and the unassimilated words which retain foreign phonological characteristics are named *Alien (Unassimilated Foreign)*.

I regard all five categories as individual sub-lexica, including the Mimetic stratum which is excluded in Itô and Mester's analysis (1995b) because identification of these strata is phonologically grounded.⁸ Certain phonological phenomena in

⁸ The focus in this chapter is phonology of each sub-lexicon; therefore, some loan-words, which etymologically belong to the Foreign stratum, are treated as components of the native stratum, Yamato, if they are phonologically assimilated. In

Japanese are discerned only in some stratum (or strata). These stratum-specific patterns examined in the next section bring out the distinctive nature of each sub-lexicon.

5.4.2 Stratum-specific Phonological Phenomena

According to Itô and Mester (1995b), some phonological phenomena are stratum-specific in Japanese. For example, obstruents after nasals must be voiced in Yamato and Mimetic; therefore, "nt" or "mp" are impossible sequence in these two strata ([kan-**da**] *[kan-**ta**] 'bite-past', [šom**bori**] *[šom**p**ori] 'sad'). On the other hand, both voiced and voiceless obstruents can surface after nasals in the other strata ([sam**po**] 'a walk', [kom**p**yuutaa] 'computer', [santa] 'Santa').

In OT, whenever some phonological alternation occurs in a language, we assume that some markedness constraint is satisfied at the expense of violating a faithfulness constraint. Therefore, a ranking "markedness >> faithfulness" is established in the language. On the other hand, no alternation is observed in a language when the faithfulness constraint outranks the markedness constraint: "faithfulness >> markedness".

If we examined the phenomenon of post nasal voicing on the basis of this scheme in OT, we would consider that the constraint prohibiting voiceless obstruents after nasals, namely, PNV(Post Nasal Voicing) (Pater 1995)⁹ was satisfied along with the violation of some faithfulness constraint in Japanese, because we actually observe post nasal voicing in some strata, namely, in Yamato and Mimetics. Therefore, we assume the ranking "PNV >> faithfulness"

other words, the classification of the sub-lexica in this chapter is purely phonologically, not etymologically.

⁹ Pater (1995) uses *NC for this constraint.

(22) a provisional ranking (a):

/kan-ta 'bite-past'/	PNV	faithfulness
☞ a. kanda		*
b. kanta	*!	

However, this ranking cannot hold in the rest of the strata, Sino-Japanese, Foreign, or Alien:

*(23) a wrong result:

/kompyuutaa/ 'computer'	PNV	faithfulness
*☞ a. kombyuutaa		*
b. kompyuutaa	*!	

In (23), the actual output is (b). Thus, we must assume that PNV is satisfied only in the Yamato and Mimetic strata, and disobeyed in other strata, resulting in the ranking "faithfulness >> PNV." This conflict of ranking is observed not only in post nasal voicing but also in other phenomena.

Let us turn to the second example. While voiceless labial stops appear only as geminates ([pp]), partial geminates ([mp]), or delabialized ([h]) in Yamato and Sino-Japanese ([kappa] *[kapa] 'river imp', [nippon] [nihon] *[nipon] 'Japan'), they can occur singly ([p]) in the rest of the strata ([pika-pika] 'glittering', [episoodo] 'episode'). Therefore, the constraint which forbids [p] from singly occurring, *[p], is obeyed only in Yamato and Sino-Japanese.

In the third place, voiced geminates do not appear in Yamato, Sino-Japanese, Mimetic, or Foreign (assimilated) ([yukkuri] *[yugguri] 'slowly', [katta] *[kadda] 'buy (past)'), but they do occur in Alien ([doggu] *[dokku] 'dog'). The constraint which bans voiced geminates is thus respected in all the strata in Japanese except the Alien.

Moreover, a root must be mono-syllabic in Sino-Japanese ([go] 'word', [bun] 'sentence'); a foot must be the minimal word of Japanese in Mimetics ([rin-rin] 'ring, jingle', [toko-toko] 'toddling'); and Rendaku (sequential voicing) occurs in Yamato ([ama-gasa] *[ama-kasa] 'umbrella'). Therefore, the constraints for monosyllabism, foot-restriction, and Rendaku are obeyed by Sino-Japanese, Mimetic, and Yamato, respectively.

There are several other stratum-specific phenomena such as Lyman's law, the variation of phonemic inventory, and so on. However, let us summarize what we have examined so far. The following chart shows which stratum complies with which constraint.

Table VIII: Summary of the Satisfaction of the Markedness Constraints in Each Stratum

	Post Nasal Voicing	No single [p]	No Voiced Geminate	Mono-Syllabism	Foot Restriction	Rendaku
Yamato	satisfy	satisfy	satisfy			satisfy
Sino-Japanese		satisfy	satisfy	satisfy		
Mimetics	satisfy		satisfy		satisfy	
Foreign			satisfy			
Alien						

Only six kinds of markedness constraints are shown in Table VIII. Nevertheless, the summary explicitly describes five different phonological patterns, one for each sub-

lexicon in Japanese. The next section will show how the facts of Japanese examined in this section can be accounted for consistently with the principle of total ordering in Optimality Theory.

5.5 Five Input-Output Faithfulness Relations in Japanese

In section 5.4, we have demonstrated the five phonological patterns for each sub-lexicon inherent in the grammar of Japanese. As shown in Table VIII, some constraints satisfied in one stratum (or strata) are violated in others. The conflict of constraint ranking is recognized for all the markedness constraints in Table VIII, resulting in five kinds of rankings in the language. If this were true, a fundamental principle of OT would be called into question. OT assumes that a single constraint ranking defines the entire grammar of a language.

To circumvent this problem, I propose that each sub-lexicon bears its own Input-Output (IO) correspondence relation in Japanese. Following the conclusion of section 5.3, I assume that the basic identity strings such as IO, OO, BR, TT, etc. can be further split into multiple elements for each morphological unit within a language. I thus claim that five IO relations are found in Japanese one for each stratum, and a full set of faithfulness constraints is multiplied for each relation:

(24) Five IO faithfulness constraints in Japanese:

UG:

IO:{MAX-IO, DEP-IO, IDENT[F]-IO, INTEGRITY-IO, UNIFORMITY-IO,
CONTIGUITY-IO, ANCHOR-IO, LINEARITY-IO }

Japanese-specific:

- (a) IO-Yamato(Y):{MAX-IO-Y, DEP-IO-Y, MAX[F]-IO-Y, DEP[F]-IO-Y,
INTEGRITY-IO-Y, UNIFORMITY[F]-IO-Y, CONTIGUITY-
IO-Y, ANCHOR-IO-Y, LINEARITY-IO-Y };
- (b) IO-Sino-Japanese (SJ):{MAX-IO-SJ, DEP-IO-SJ, MAX[F]-IO-SJ,
DEP[F]-IO-SJ, INTEGRITY-IO-SJ, UNIFORMITY[F]-IO-
SJ, CONTIGUITY-IO-SJ, ANCHOR-IO-SJ, LINEARITY-
IO-SJ };
- (c) IO-Mimetics(M):{MAX-IO-M, DEP-IO-M, MAX[F]-IO-M, DEP[F]-IO-
M, INTEGRITY-IO-M, UNIFORMITY[F]-IO-M,
CONTIGUITY-IO-M, ANCHOR-IO-M,
LINEARITY-IO-M };
- (d) IO-Foreign(F):{MAX-IO-F, DEP-IO-F, MAX[F]-IO-F, DEP[F]-IO-F,
INTEGRITY-IO-F, UNIFORMITY[F]-IO-F, CONTIGUITY-
IO-F, ANCHOR-IO-F, LINEARITY-IO-F };
- (e) IO-Alien-(A):{MAX-IO-A, DEP-IO-A, MAX[F]-IO-A, DEP[F]-IO-A,
INTEGRITY-IO-A, UNIFORMITY[F]-IO-A, CONTIGUITY-
IO-A, ANCHOR-IO-A, LINEARITY-IO-A }

All of these faithfulness constraints are evaluated with respect to all other constraints in a single ranking in the grammar of Japanese. The next section provides an analysis of the actual data using these constraints.

Among the stratum specific phonological phenomena examined in section 5.4.2, I will analyze three of them here, post nasal voicing in section 5.5.1, impossibility of voiced geminates in 5.5.2, and prohibition of [p] from occurring singly in 5.5.3.

5.5.1 Post Nasal Voicing

To explain post nasal voicing in Japanese, the following constraints are necessary:

(25) PNV: post nasal voicing: Post-nasal obstruents should be voiced (Itô and Mester 1995a, b) (= *NC (Pater 1995))

MAX[voice]: Every input voice feature has an output correspondent (Lombardi 1995a, Padgett 1995a).

relativized to each stratum:

MAX[voice]-IO-Yamato (Y)
 MAX[voice]-IO-Sino-Japanese (SJ)
 MAX[voice]-IO-Mimetic(M)
 MAX[voice]-IO-Foreign(F)
 MAX[voice]-IO-Alien(A)

In Yamato and Mimetic, all post nasal obstruents are voiced; therefore, PNV is respected at the expense of violating the faithfulness constraints, MAX[voice]-IO-Y and MAX[voice]-IO-M. This results in the ranking "PNV >> MAX[voice]-IO-Y, MAX[voice]-IO-M".

(26) PNV in Yamato/Mimetics:

/kan-ta/ 'bite (past)'	PNV	MAX[voice]-IO-Y MAX[voice]-IO-M
☞ a. kanda		*
b. kanta	*!	

Regardless of the value of the voicing feature in the input, obstruents after nasals are always voiced in Yamato and Mimetic to satisfy the constraint PNV.

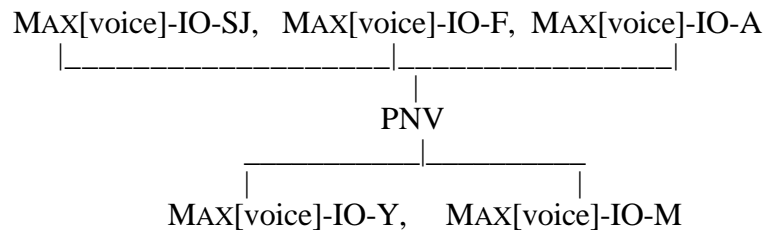
PNV can be violated in the other strata, since both voiced and voiceless obstruents are possible in the output of Sino-Japanese, Foreign, and Alien. Thus, faithfulness constraints for those strata must outrank PNV: "MAX[voice]-IO-SJ, MAX[voice]-IO-F, MAX[voice]-IO-A >> PNV".

(27) PNV in Sino-Japanese/Foreign/Alien:

/kompyuutaa/ 'computer'	MAX[voice]-IO-SJ, MAX[voice]-IO-F, MAX[voice]-IO-A	PNV
☞ a. kompyuutaa		*
b. kombyuutaa	*!	

The rankings in (26) and (27) can be united into a single ranking as displayed below.

(28) A constraint ranking for PNV:



Post nasal voicing phenomenon both in Yamato/Mimetics and in Sino-Japanese/Foreign/Alien is reanalyzed with this ranking:

(29) PNV in Yamato and Mimetic:

/kan-ta/ 'bite (past)'	MAX[voice]-IO-SJ, MAX[voice]-IO-F, MAX[voice]-IO-A	PNV	MAX[voice]-IO-Y, MAX[voice]-IO-M
☞ a. kanda			*
b. kanta		*!	

(30) PNV in Sino-Japanese, Foreign, and Alien:

/kompyuutaa 'computer/'	MAX[voice]-IO-SJ, MAX[voice]-IO-F, MAX[voice]-IO-A	PNV	MAX[voice]-IO-Y, MAX[voice]-IO-M
☞ a. kompyuutaa		*	
b. kombyuutaa	*!		

The ranking in (28), thus, accounts for the phenomenon of post nasal voicing in all the five strata without any conflict.

5.5.2 Impossibility of Voiced Geminate

Voiced geminates are impossible in all the strata with the exception of Alien. Therefore, we expect that the markedness constraint against voiced geminates, NOVOIGEM (No voiced obstruent geminates (Itô and Mester 1995b)), outranks the faithfulness constraints for voicing in all the strata except Alien.

The following constraints are necessary.

(31) Constraints.

NOVOIGEM: voiced obstruents are prohibited
(Itô and Mester 1995a, b)

DEP[voice]: Every output [voice] feature has an input correspondence.

relativized to each stratum:

DEP[voice]-IO-Yamato (Y)
DEP[voice]-IO-Sino-Japanese (SJ)
DEP[Voice]-IO-Mimetic(M)
DEP[voice]-IO-Foreign(F)
DEP[voice]-IO-Alien(A)

(32) NOVOIGEM in Yamato, Sino-Japanese, Mimetic, Foreign:

/yugguri 'slowly'	NOVOIGEM	DEP[voice]-IO-Y, DEP[voice]-IO-SJ, DEP[voice]-IO-M DEP[voice]-IO-F
☞ a. yukkuri		*
b. yugguri	*!	

We presume, due to the Richness of the Base (ROTB) (Prince and Smolensky 1993), that obstruent geminates in the input can be either voiced or voiceless. Even if we assume that the geminate in the input is voiced as in (32), the ranking gears the output to the voiceless one.

The ranking "DEP[voice]-IO-A >> NOVOIGEM" is set, because voiced geminates appear in Alien:

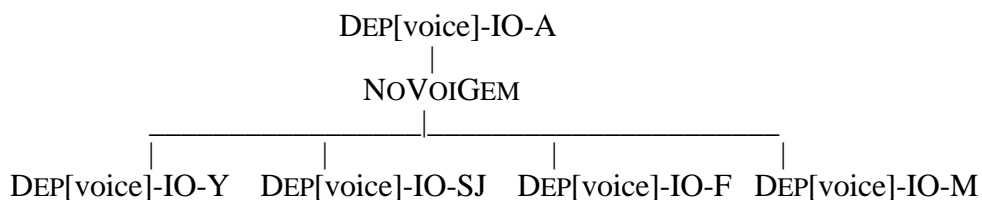
(33) NOVOIGEM in Alien:

/doggu 'dog'/	DEP[voice]-IO-A	NOVOIGEM
☞ a. doggu		*
b. dokku	*!	

Thus, regardless of the voicing in the input, the candidate which is faithful to the input always wins to surface in Alien.

The ranking in (32) and (33) are united into one single ranking.

(34) Ranking



Consequently, the single ranking in (34) captures the phenomenon of possibility and impossibility of voiced geminates in all the strata.

5.5.3 Prohibition of [p]

In Yamato and Sino-Japanese, a single [p] is not allowed in the output form. If a single [p] is found in the input (because of ROTB) in these two strata, the voiceless labial stop in the output is either geminated (or partially geminated) or delabialized: [nippon], [nihon], *[nipon] 'Japan'.

Before going on to the actual analysis, I will refer to the alternation of a voiceless bilabial stop /p/ into a voiceless pharyngeal [h] in Japanese. It is well-

known that [h] is a voiceless counterpart of [b] in Japanese. However, why does /p/ not turn into other possible sounds such as [b], [f], [ϕ], [t], or [ʔ] instead of [h]? First, I assume that the change into a voiced bilabial stop [b] is not possible because the faithfulness constraint for insertion of [voice], DEP[assoc.] is active in Japanese.

Second, a voiceless bilabial [f] is not a possible sound in Japanese because it does not belong to its phonemic inventory. Hence, the markedness constraint against this segment, i.e. *[f] is active in the language.

Third, a voiceless bilabial fricative [ϕ] can occur only before a high back vowel [u] in Japanese. Therefore, I consider that the occurrence of this segment before other sounds is banned due to the active markedness constraint against the sequence.

Fourth, [p] cannot turn into [t] in this case, because the [coronal] feature is universally more marked than the [pharyngeal] feature. Lombardi (1995b) shows that this has the consequence that Place loss normally results in change to [h] or glottal stop.

Then, what about a pharyngeal (glottal) stop [ʔ]? It bears the most unmarked place feature, [pharyngeal], and moreover it shares the same manner feature with [p]. Nevertheless, [h] is preferred to [ʔ] in Japanese. This is because [ʔ] cannot occur in the onset position. Therefore, the constraint against [ʔ] in the onset is active in Japanese. For all five of these reasons, [p] turns into [h] in Japanese.

To explain the variation of repair strategies between gemination and delabialization, we need to argue for the interaction of a markedness constraint with two kinds of faithfulness constraints, namely MAX[lab] and INTEGRITY-IO. However, for ease of exposition, let us focus only on the delabialization case here.

The necessary constraints are as follows.

(35) Constraints

*[p]: a constraint against a single [p] (Itô and Mester 1995a)

MAX[lab]-IO: an input labial feature has an output correspondent;

MAX[lab]-IO-Yamato (Y);
 MAX[lab]-IO-Sino-Japanese (SJ);
 MAX[lab]-IO-Mimetic(M);
 MAX[lab]-IO-Foreign(F);
 MAX[lab]-IO-Alien(A).

Let us turn to our analysis of delabialization in Yamato and Sino-Japanese. Delabialization of [p] occurs to satisfy *[p] by violating the faithfulness constraints, MAX[lab]-Y and MAX[lab]-IO-SJ.

(36) *[p] in Yamato/Sino-Japanese:

/nipon/ 'Japan'	MAX[lab]-IO-M, MAX[lab]-IO-F, MAX[lab]-IO-A	*[p]	MAX[lab]-IO-Y, MAX[lab]-IO-SJ
☞ a. nihon			*
b. nipon		*!	

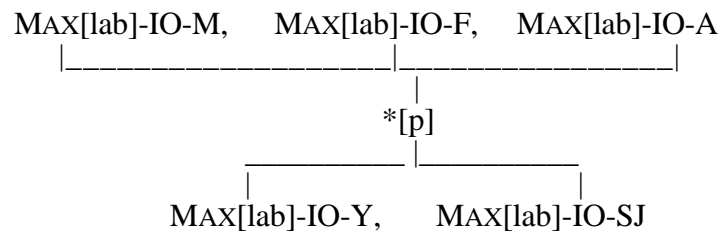
On the other hand, the same ranking in (36) can account for the fact that *[p] is violated in the other strata:

(37) *[p] in Mimetic/Foreign/Alien:

/pika-pika/ 'glittering' (Mimetics)	MAX[lab]-IO-M, MAX[lab]-IO-F, MAX[lab]-IO-A	*[p]	MAX[lab]-IO-Y, MAX[lab]-IO-SJ
☞ a. pika-pika		*	
b. hika-hika	*!		

The single ranking in (38) explains the prohibition of a single [p] in all strata.

(38) A constraint ranking for *[p]:



In this section, I have analyzed three of the stratum-specific phenomena using stratum-specific IO faithfulness constraints, thus demonstrating that a single constraint ranking can be used to explain all the patterns in a grammar where phonological processes are sub-lexicon-specific.¹⁰

By claiming that Japanese instantiates five sets of IO faithfulness relations, I have argued that a single ranking of all the constraints evaluates the grammar of Japanese.

5.6 An Analysis of RENDAKU and Lyman's Law with Multiple Input-Output Faithfulness Relations

In the previous sections, I have discussed why we need to introduce the new notion of multiple faithfulness relations in a language. In this section, I will reanalyze the data of Rendaku and Lyman's Law in Japanese which were left as unresolved problems. The following data introduced in section 5.2.3 have to be explained.

¹⁰ We cannot determine the relative rankings of the constraints in (28), (34), and (38) because the processes do not interact.

(39) (repeated from (14))

(a) /ama 'sweet' + tai 'sea bream'/

→ [amadai] 'tilefish' (Yamato)

(b) /kan 'hearty' + tai 'reception'/

→ [kantai] 'the warm reception (Sino-Japanese)

(c) /saiko 'best' + taimu 'time'/

→ [saikotaimu] 'best time/best record' (Foreign)

While Rendaku is observed in Yamato, it is not observed in the other strata. The asymmetry cannot be accounted for by the ranking proposed in section 5.2.3.

(40) Constraints

(a) *[voice, -son]

(b) OCP[voice, -son]

(c) Realize-Morpheme

(d) DEP[assoc.]-IO

(41) A wrong result for other sub-lexica (repeated from (15))

/kan + P tai/ [voice]	OCP [voice, -son]	Realize- Morpheme	DEP [assoc.]	*[voice, -son]
*☞ a. kandai [voice]			*	*
actual winner b. kantai [voice]		*!		

Both DEP[assoc.] and *[voice, –son] must be lower ranked than Realize-Morpheme to account for Yamato. On the other hand, this ranking incorrectly predicts that Rendaku takes place in the other strata.

I propose on the basis of what I have discussed in section 5.5 that there are five kinds of DEP[assoc.] in Japanese for each stratum.

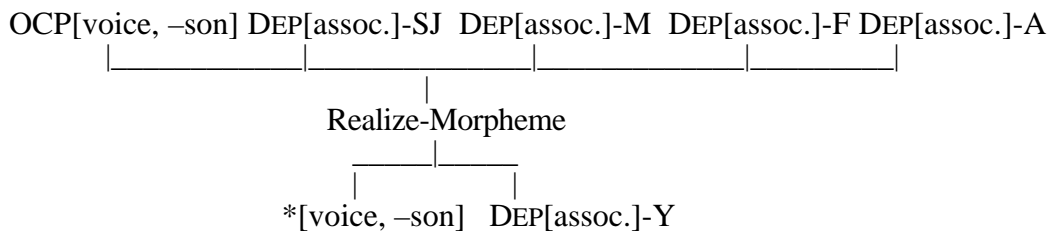
(42)

Multiple DEP[assoc.] in Japanese:

- (a) DEP[assoc.]-Yamato (Y)
- (b) DEP[assoc.]-Sino-Japanese (SJ)
- (c) DEP[assoc.]-Mimetics (M)
- (d) DEP[assoc.]-Foreign (F)
- (e) DEP[assoc.]-Alien (A)

The proposed ranking in section 5.2.3 is revised with these five constraints.

(43) Revised ranking



Let us analyze both the data from Yamato and from the other strata with this ranking. Rendaku should be observed in Yamato, because the constraint, Realize-Morpheme outranks the faithfulness constraint for voicing.

(44) Rendaku in Yamato

/ama + P tai/ [voice]	OCP [voice, -son]	DEP [assoc.] SJ, M, F, A	Realize- Morpheme	*[voice, -son]	DEP [assoc.] Y
☞ a. amadai [voice]				*	*
b. amatai [voice]			*!		

As in (44), introduction of the new ranking does not affect the analysis of Rendaku in Yamato at all. In contrast to Yamato, Rendaku should not be observed in the rest of the strata because the faithfulness constraints for association lines for these strata are higher ranked than Realize-Morpheme.

(45) Rendaku in the other strata

/kan + P tai/ [voice]	OCP [voice, -son]	DEP [assoc.] SJ, M, F, A	Realize- Morpheme	*[voice, -son]	DEP [assoc.] Y
a. kandai [voice]		*!		*	
☞ b. kantai [voice]			*		

Since the faithfulness constraints for all strata except Yamato outrank Realize-Morpheme, candidate (b) in which Rendaku does not take place correctly wins.

I now consider Lyman's Law. As already indicated in section 5.2, Lyman's Law also applies only in the Yamato stratum. In Yamato, when the second compound member contains [voice] already, then Rendaku is blocked. This is because of the ranking in which OCP[voice, -son] outranks Realize-Morpheme.

On the other hand, Rendaku does not occur in any strata but Yamato. It does not matter at all whether the second members of the compounds contain [voice] or not, because OCP[voice, –son] is always satisfied in the optimal candidate.

Let us examine the following example from Sino-Japanese in which the second member of the compound contains [voice].

(46) Sino-Japanese

'koo 'good' + taiguu 'treatment' → [kootaiguu] 'good treatment'

(47) Lyman's Law in the other strata

/koo + P taiguu/ [voi] [voi]	OCP [voice, –son]	DEP [assoc.] SJ, M, F, A	Realize- Morpheme	*[voice, –son]	DEP [assoc.] Y
a. koo da iguu [voi][voi]	*!	*!		*	
☞ b. koo t aiguu [voi][voi]			*		

Candidate (a) loses due not only to its violation of the faithfulness constraint but also to the OCP constraint.

The ranking proposed in this section can give rise to the correct analysis for the data with/without Rendaku and Lyman's Law in all the sub-lexica in Japanese. The ranking between the OCP constraint, OCP[voice,–son] and the faithfulness constraints for voicing in Sino-Japanese, Mimetics, Foreign and Alien is not determined in this analysis.

5.7 Comparison of the Multiple Input-Output Model with the System of Re-ranking of Faithfulness Constraints

Optimality Theory postulates that Universal Grammar (UG) consists of a full set of violable constraints, and that a single invariant ranking of these constraints represents the grammar of each language. Therefore, OT assumes as the null hypothesis that each grammar consists of a single invariant ranking.

However, in previous research, this hypothesis has been partially or totally compromised to account for languages which exhibit stratum-specific phonology: lexical stratification. As I have already argued, my proposal of multiple input-output faithfulness constraints succeeds in explaining lexical stratification without compromising the hypothesis.

This section introduces a previous account of the stratum-specific phonological phenomena (Itô and Mester 1995b), and compares my model with it. From both a theoretical and an empirical perspective, I will point out the problems of the previous analysis, and the necessity and superiority of my approach.

5.7.1 Re-ranking of Faithfulness Constraints (Itô and Mester 1995b)

Itô and Mester (1995b) approach the stratum-specific phonological phenomena by proposing that faithfulness constraints are re-rankable depending upon the sub-lexicon within a language, which we may call the Reranking of Faithfulness constraint (RF) system. They indicate that the ranking of markedness constraints are fixed through the entire grammar, while faithfulness constraints are re-ranked for each stratum. In their analysis, therefore, a markedness constraint outranks a faithfulness constraint in the strata in which some phonological alternation is

observed: "markedness >> faithfulness", whereas the markedness constraint is violated to satisfy the faithfulness constraint in the other strata.

For example, in post nasal voicing, the ranking of "PNV >> FAITH[voice]¹¹" is necessary for the Yamato and Mimetic¹² strata, while "FAITH[voice] >> PNV" is established for Sino-Japanese, Foreign, and Alien. The following two tableaux illustrate the phenomenon of post nasal voicing in their system.

(48) PNV in Yamato/Mimetic:

/kan-ta/ 'bite (past)'	PNV	FAITH[voice]
☞ a. kanda		*
b. kanta	*!	

(49) PNV in Sino-Japanese/Foreign/Alien:

/sampo/ 'a walk'	FAITH[voice]	PNV
☞ a. sampo		*
b. sambo	*!	

Unlike my analysis of the same phenomenon discussed in section 5.5, the rankings in (48) and (49) cannot be unified, because the two rankings are in conflict with each other. Thus, two rankings are necessary to account for the post nasal voicing phenomenon in their analysis:

¹¹ Itô and Mester (1995b) do not adopt Correspondence Theory in their analysis; therefore, the actual faithfulness constraint for voicing they use is "FAITH[voice]". I use their constraints as they are.

¹² Itô and Mester (1995b) do not include the Mimetic strata in their analysis. In this section, I take the liberty of adding the analysis of the Mimetic stratum to their system.

(50) The two rankings for post nasal voicing:

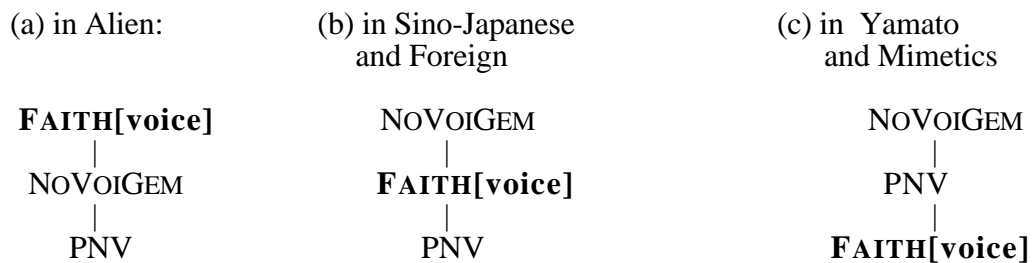
(a) for Yamato and Mimetics: (b) for Sino-Japanese, Foreign, and Alien:



This will still require the grammar to have multiple rankings; and hence, does not respect the invariant ranking hypothesis.

Itô and Mester further discuss the interaction of the two markedness constraints with the faithfulness constraint. They postulate that the ranking between PNV and NOVOIGEM is fixed in the entire grammar of Japanese: "NOVOIGEM >> PNV", and that the faithfulness constraint will rank in one of three positions depending on the stratum: higher than NOVOIGEM, in-between NOVOIGEM and PNV, or lower than PNV, resulting in the following three sub-rankings in Japanese:

(51) The three sub-rankings for PNV and NOVOIGEM in all the five strata in Japanese by Itô and Mester:



Thus, we need these three sub-rankings for the explanation of post nasal voicing and no voiced geminates in all the strata.

Let us look at one more example. To explain the distribution of [p], their model also requires two kinds of rankings: one for the strata where a single-[p] is permitted, and one for those in which [p] is not allowed:

(52) *[p] in Yamato/Sino-Japanese:

/n ip on/ 'Japan'	*[p]	FAITH[lab] ¹³
☞ a. n ihon		*
b. n ipon	*!	

(53) *[p] in Mimetic/Foreign/Alien:

/ p ika- p ika/ 'glittering'	FAITH[lab]	*[P]
☞ a. p ika- p ika		**
b. h ika- h ika	*!*	

The tableaux in (52) and in (53) lead to the conclusion that the following two rankings are necessary:

(54) The rankings for *[p]:

(a) for Yamato and Sino-Japanese

(b). for Mimetic, Foreign, and Alien

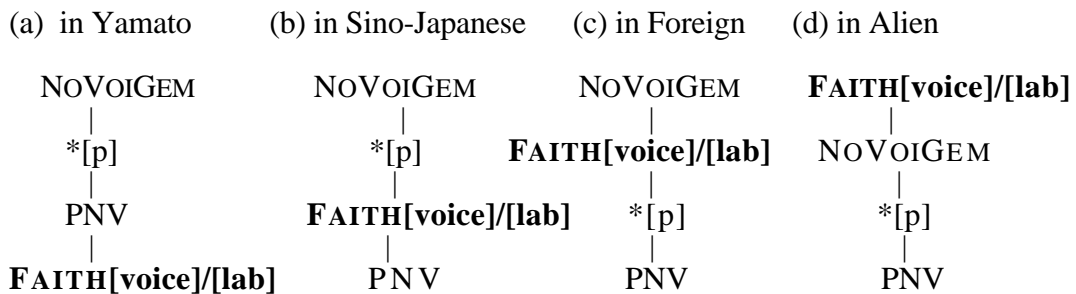
$$\begin{array}{c} *[p] \\ | \\ \text{FAITH[lab]} \end{array}$$

$$\begin{array}{c} \text{FAITH[lab]} \\ | \\ *[p] \end{array}$$

¹³ Again, I follow Itô and Mester (1995b) in using FAITH[lab] instead of IDENT[lab].

The three sub-rankings in (51) and the two rankings in (54) are combined into four sub-rankings. The four sub-rankings entail a fixed ranking of three markedness constraints, "NOVOIGEM >> *[p] >> PNV", and the faithfulness constraint will be ranked in one of the four available places:

(55)



As a consequence of the analysis of all the stratum-specific phenomena with this system, Japanese consists of five sub-grammars: one fixed ranking of markedness constraints with five positions for the faithfulness constraint for each sub-lexicon.¹⁴

5.7.2 Invariant Ranking Hypothesis (IRH) in OT

The first question which arises in regard to the Reranking of Faithfulness constraint (RF) system is the invariant ranking hypothesis in OT. Can a language consist of sub-grammars? Although the sub-grammars are differentiated only in a limited way, by re-ranking of faithfulness constraints, this model still requires five sets of sub-rankings for Japanese. Is constraint ranking sub-lexicon specific rather than language-specific? To make the proposal valid, the RF system must radically

¹⁴ In Itô and Mester's (1995 b) proposal, there are only four sub-rankings in Japanese. However, if we add the Mimetic stratum, the total number of sub-grammars will be five.

alter a fundamental principle of OT: variation among languages is explained by a language-particular single invariant constraint hierarchy. This principle is respected in my approach.

5.7.3 Why Faithfulness Is Different from Markedness

The second question for the RF approach is: why can only the faithfulness constraints be re-ranked within a grammar? Why do faithfulness constraints behave differently from markedness constraints in terms of ranking? This has not been made clear in the RF system. On the other hand, the unique nature of faithfulness constraints are explained within the framework of Correspondence Theory in this section. The theory implies that the set of faithfulness constraints can be multiplied for each identity relation along morphological lines.

5.7.4 Interpretation of Faithfulness and Ranking of Markedness Constraints

The RF system implies that the following fixed ranking of markedness constraints is obeyed in the entire Japanese grammar:

(56) Fixed ranking of markedness constraints in Japanese (Itô and Mester (1995b), pp.186):

_ "SyllStruc" _	_>>_ "NoVoicedGeminates" _>>_	*[p] _>>_	_>>_ Post NasalVoicing _	
(e)	(d)	(c)	(b)	(a)
FAITH	FAITH	FAITH	FAITH	FAITH

Depending on the stratum, "FAITH" will be re-ranked in the places indicated by (a) through (e). In Yamato, the most native stratum, it is ranked the lowest position (a), while it ranks in (d) in the least native Alien.

However, I argue that there are two major problems in this claim. First, the RF system requires the assumption that there is a single constraint for faithfulness, or that all faithfulness constraints rank together in one of the positions for faithfulness of each stratum from (a) through (e). Without this assumption, there is no evidence for the ranking of markedness; but with this assumption other problems arise.

Although the RF system does not follow Correspondence Theory, it still decomposes faithfulness into constraints affecting different properties, FAITH[voice], FAITH[lab], and so on in the actual analysis. This is because we could not explain the whole grammar of Japanese (or any language), if we had only one kind of faithfulness constraint, which would require all properties of a language to pattern together. When we spell out their proposal as in (57), it seems to make this problematic assumption.

For example, in Sino-Japanese, *[p] is respected, while PNV can be violated. Thus, we conclude that the position for all the faithfulness constraints is as in (56b). This subpart of the ranking in (56) actually looks like:

(57) Sino-Japanese

*[p] >> FAITH[voice] >> Post Nasal Voicing
FAITH [lab]
FAITH [etc.]

When we turn to the Mimetic stratum, which the RF system does not consider, we see a problem for this assumption. In Mimetics, *[p] can be violated, while PNV must be satisfied. Thus, if all the faithfulness constraints must rank

together, the Mimetics stratum contradicts their claim that markedness constraints do not rerank; it would require reversing the ranking of PNV and *[p]:

(58)

Post Nasal Voicing >> FAITH[voice] >> *[p]
 FAITH [lab]
 FAITH [etc.]

Consequently, we have the following ranking paradox:

(59)

(a) Sino-Japanese

NOVOIGEM
 |
 *[p]
 |
 FAITH[voice]/[lab]
 |
 PNV

(b) Mimetics

NOVOIGEM
 |
 PNV
 |
 FAITH[voice]/[lab]
 |
 *[p]

We could solve this problem if we allow each faithfulness constraint to rank separately. Then, there is no conflict in ranking.

(60) Sino-Japanese

*[p] >> FAITH[lab]
 FAITH[voice] >> PNV

(61) Mimetics

FAITH[lab] >> *[p]
 PNV >> FAITH[voice]

But once each type of faithfulness such as FAITH[lab] or FAITH[voice] is ranked separately, there is no argument for the fundamental assumption of the RF system that the ranking of markedness is fixed in Japanese. These markedness constraints do not interact themselves, so only evidence for their ranking was transitivity given the grouped ranking of faithfulness.

Now that FAITH is decomposed, we see that PNV interacts with FAITH[voice], on the other hand, *[p] interacts with FAITH[lab]. Thus, we can prove the rankings in (60) and (61), but can prove nothing about the ranking between PNV and *[p].

Thus, we can retain the grouped faithfulness constraints (and their two potential cross-linguistic problems above), which allows us to maintain that ranking of markedness does not change. However, this assumption does not incorporate the Mimetics stratum, since there will be ranking paradox.

Or, we allow differently ranked individual faithfulness constraints, which will explain all data, without any argument for the claim about the fixed markedness constraints. I therefore conclude that the RF system does not work regarding the interpretation of faithfulness constraints and the fixed ranked markedness constraints.

5.7.5 Counter Evidence for "Hierarchy of Foreignness"

In section 5.7.4, we have discussed that the RF system does not work regarding the interpretation of faithfulness constraints and the fixed ranked markedness constraints. Which results in the counter evidence for the "Hierarchy of Foreignness": the more native the sub-lexicon is, the lower the faithfulness constraint

ranks" which the RF system proposes. Moreover, there are several other phenomena to show that "the Hierarchy of Foreignness does not hold in Japanese grammar.

(62)

- (a) Only Mimetics and Sino-Japanese are subject to certain prosodic size restrictions on stems and roots (Hamano 1986, 1998, Tateishi 1990);
- (b) Yamato and Foreign are more faithful to the underlying accent location in compounds than Sino-Japanese is (Kubozono 1997);
- (c) Yamato, Mimetic and Sino-Japanese do not form a subset-relation in intra-syllabic phonotactics (Kitahara 1996).

In the phenomenon (a), the faithfulness constraint for Mimetics or Sino-Japanese is lower ranked than that of Yamato, because Mimetics or Sino-Japanese is a marked stratum with respect to the size-restriction of morpheme. Similarly, as for (b), the faithfulness constraint for Foreign is ranked below that for Sino-Japanese.

Thus, Japanese does not completely follow "the universal Hierarchy of Foreignness" which the RF system proposes. This is because Japanese sub-lexica do not form the perfect core-periphery structure.

5.7.6 Multiple Input-Output Faithfulness Constraints and the Core-Periphery Structure (Fukazawa, Kitahara, and Ota 1998, to appear)

In section 5.7.5, I have argued that the Hierarchy of Foreignness does not represent supporting evidence for the RF system, and have provided several counter-examples to the core-periphery organization.

Fukazawa, Kitahara, and Ota (1998, to appear) indicate that the core-periphery structure does not derive from the inherent property of the grammar regulating the ranking of faithfulness constraints. However, in spite of evidence against a strict subset relation among the sub-lexica, there is no denying that there is an apparent trend for a core-periphery organization in the Japanese lexicon.

Fukazawa, Kitahara, and Ota (1998, to appear) claim that the trend is a result of a diachronic re-ranking process involved in the formulation of the loanword lexicon. When a language (Host Language) borrows some words from another language (Donor Language), both marked and unmarked structures for the host language arrive.

When some markedness constraint is ranked above a relevant faithfulness constraint in the donor language, but is ranked below the same faithfulness constraint in the host language, then, the speakers of the host language do not see the crucial positive evidence that the rankings are reversed for the donor lexicon, since the donor inventory is a subset of the host language inventory.

(63) Unmarked data entering the host language:

The donor language permits only the unmarked structures

Ranking: M » F

The host language permits both marked and unmarked structures

Ranking: F » M

Thus, the speakers of the host language do not realize any conflict of the ranking of the constraints, because the existing ranking already accounts for the data.

On the other hand, when some markedness constraint is ranked below faithfulness in the donor language, and when it is ranked above the same faithfulness constraint in the host language, then, the speakers of the host language do see the crucial positive evidence for ranking the faithfulness constraint above the markedness constraint, because the entering data will be marked for violations of the markedness constraint.

(64) Marked data entering the host language:

The donor language permits both marked and unmarked structures

Ranking: F » M

The host language permits only the unmarked structures

Ranking: M » F

This calls for a ranking that is inconsistent with the current ranking in the host language, triggering splitting of the faithfulness constraint. And one faithfulness will be ranked above the markedness constraints for the incoming lexical items.

Thus, the asymmetry in the ranking adjustments caused by borrowing marked surface structures in foreign words motivates upward movement of faithfulness constraints, but unmarked surface structures make little impact to the host language phonology.

Also, the timing of borrowing is likely to be a contributing factor for the core-periphery structure. Naturally, the longer foreign words stay in a language, the more assimilated to the native phonology (e.g. The Sino-Japanese stratum vs. The Foreign/Alien strata) they become.

5.7.7 Empirical Evidence for Superiority of the Model of Multiple Input-Output Faithfulness Constraints (Fukazawa, Kitahara, and Ota 1998, to appear)

In section 5.7.2, I claimed that the RF system does not respect the invariant ranking hypothesis; therefore, I conclude that my system is theoretically superior to it. In this section, I introduce empirical evidence for the superiority of my system.

The RF system cannot account for Japanese hybrids which are composed of different strata (Fukazawa, Kitahara, and Ota 1998, to appear). There are some Japanese words which consist of more than one stratum. For example, the word [tombokeŋkyuuka] 'researchers of dragonflies' consists of both Yamato and Sino-Japanese. ([tombo]'dragonflies' is Yamato, and [keŋkyuuka] 'researchers' is Sino-Japanese.)

(65) Japanese hybrid words

- (a) [tombo-keŋkjuuka] 'a dragonfly-researcher'
([tombo]Yamato - [keŋkjuuka]Sino-Japanese)
- (b) [toŋkatsu-domburi] 'bowl of rice with pork cutlet'
([[toN]Sino-Japanese - [katsu]Foreign] - [domburi]Yamato)
- (c) [supootsugappa] 'a sport raincoat'
([supootsu]Foreign - [kappa]Yamato)
- (d) [tʃiimu-tiitʃiŋgu] 'team-teaching'
([tʃiimu]Foreign - [tiitʃiŋgu]Alien)
- (e) [arupeŋgappa] 'a raincoat for climbing mountain'
([arupeN]Foreign - [kappa]Yamato)

In such a hybrid, two kinds of IO faithfulness constraints for each sub-lexicon are crucial. In the word [tombokeŋkyuuka], the markedness constraint PNV (Post Nasal

Voicing) is satisfied in the Yamato part, while PNV is violated to satisfy the faithfulness constraint for voicing in the Sino-Japanese part. Without two different IO faithfulness constraints for Yamato and Sino-Japanese applying simultaneously within a single calculation, this datum cannot be accounted for.

As the following tableau in (66) shows, this hybrid can be explained only with simultaneous attendance of multiple IO faithfulness constraints.

(66) Multiple IO faithfulness constraints interaction in a hybrid:

/tompoken η kyuuka/	MAX[voice] S-J	PNV	MAX[voice] Yamato
a. tompoken η kyuuka		**!	
b. tomboken η gyuuka	*!		*
☞ c. tompoken η kyuuka		*	
d. tompoken η gyuuka	*!		*

In the re-ranking system, PNV >> MAX[voice] can account only for the first Yamato part of this hybrid at a stage.

(67) PNV >> MAX[voice]

/tampo/ (Yamato)	PNV	MAX[voice]
☞ a. tombo		*
b. tampo	*!	

The re-ranked ranking MAX[voice] >> PNV has to be explained in the latter Sino-Japanese part in a different stage.

(68) MAX[voice] >> PNV

/keŋkyuuka/ (Sino-Japanese)	MAX[voice]	PNV
a. keŋgyuuka		*
☞ b. keŋkyuuka	*!	

However, there is no single ranking to account for the entire word [tombokeŋkyuuka] in a same tableau. Therefore, the RF model cannot bring forth the correct analysis of hybrids in OT.

Fukazawa, Kitahara, and Ota (1998, to appear) further discuss clearer examples of hybrids. When a phonological process that crosses a morpheme boundary takes place in a hybrid, the problem for the re-ranking approach becomes more serious. In the word, [supootsugappa], the constraint which prohibits a bilabial stop [p] from singly surfacing, namely, *[p] is violated in the first member of the compound (Foreign), while it is respected in the second member (Yamato). Thus, the faithfulness constraint which forbids gemination for Yamato, INTEGRITY-IO-Y, must be lower ranked than *[p]. On the other hand the constraint for Foreign, INTEGRITY-IO-F must outrank *[p].¹⁵

¹⁵ INTEGRITY-IO states that no segment in the input has multiple correspondents in the output. Therefore, gemination results in violation of this constraint

(69) Multiple IO faithfulness interaction in a hybrid with Rendaku:

/supootsu+kapa/	INTEG-IO-F	*[p]	INTEG-IO-Y	Rendaku (SeqVoi/Realize -Morpheme)
a. suppootsugappa	*!		*	
b. suppootsugapa	*!	*		
☞ c. suppootsugappa		*	*	
d. suppootsugapa		**!		
e. suppootsukappa		*	*	*!

The requirement of the simultaneous attendance of all these constraints becomes clearer in this sequence, because Rendaku takes place at the beginning of the second member of the compound. In the re-ranking system, the ranking of INTEG-IO >> *[p] accounts for the first Foreign part, [supootsu], and the re-ranked ranking, *[p] >> INTEG-IO accounts for the latter Yamato part, [kappa]

(70) INTEG-IO >> *[p]:

/supootsu/	INTEG-IO	*[p]
☞ a. supootsu		*
b. suppootsu	*!	

(71) *[p] >> INTEG-IO:

/kapa/	*[p]	INTEG-IO
a. kapa	*!	
☞ b. kappa		*

[supootsu] and [kappa] can be independently explained in each stage by the re-ranking system. However, the system can never account for the entire word, [supootsugappa]; hence, it cannot account for the occurrence of Rendaku at the beginning of the second member of the compound.

When a phonological process that bi-directionally crosses the morpheme boundary takes place, the necessity of simultaneous attendance of the multiple Input-Output faithfulness constraints become even more explicit.

In the word [arup**ɲ**gappa], the following four phenomena are observed.

(72) Phenomena in [arup**ɲ**gappa] ([arup**N**]Foreign - [k**pp**a]Yamato):

- 1) [p] singly occurs in Foreign;
- 2) [p] is geminated to surface in Yamato;
- 3) [N] becomes velar before the velar sound;
- 4) Rendaku occurs at the beginning of the second component.

(73) Multiple IO faithfulness interaction in a hybrid with bi-directional processes:

/arup N +k pp a/	INTEG-IO-F	*[p]	INTEG-IO-Y	Rendaku (SeqVoi/ Realize- Morpheme)	*Ng
a. arup pp ɲgappa	*!		*		
b. arup pp ɲgapa	*!	*			
☞ c. arup ɲ gappa		*	*		
d. arup ɲ gapa		***!			
e. arup ɲ kappa		*	*	*!	
f. arup e Ngappa		*	*		*!

In order to explain all four phenomena in the word, the simultaneous attendance of all the constraints with split faithfulness constraints is crucial. The re-ranking system can

only separately account for [arupeN] in the Foreign stratum with one ranking, and [kappa] in the Yamato stratum with the re-ranked ranking.

(74) INTEG-IO >> *[p]:

/arupeN/ (Foreign)	INTEG-IO	*[p]
☞ a. arupeN		*
b. aruppeN	*!	

(75) *[p] >> INTEG-IO:

/kapa/ (Yamato)	*[p]	INTEG-IO
a. kapa	*!	
☞ b. kappa		*

Therefore, the re-ranking system can explain neither the velarization of the nasal at the end of the first member of the compound, nor Rendaku at the beginning of the second compound.

Thus, the Japanese hybrids make it clear that the multiple faithfulness system is superior to the re-ranking faithfulness model not only conceptually but also empirically.

5.8 Conclusion of the Chapter

In this chapter, I have discussed another OCP effect on features. In Japanese, the OCP effects on [voice] are observed as a blocking tool of Rendaku. Although it looks similar to other MSCs, a particular kind of constraint interaction obtains in

which the OCP constraint OCP[voice, –son] outranks Realize-Morpheme which outranks the faithfulness constraint *[voice, –son].

Also, multiple input-output faithfulness constraints must be introduced to account for the asymmetry of Rendaku and Lyman's Law between the Yamato stratum and the rest of the sub-lexica. I claim that the difference of the ranking of the sub-lexicon specific faithfulness constraints for voicing brings forth the asymmetry.

I have also argued that the problem of Japanese stratum-specific phenomena is settled simply when those phenomena are analyzed using Correspondence Theory. Multiple sets of correspondence relations coexist in a grammar, and all types are regulated by each full set of faithfulness constraints. Building on this theory, I have claimed that there are five Input-Output relations in Japanese (one per sub-lexicon) and that each bears its own full set of faithfulness constraints. The total ordering of all these faithfulness constraints and markedness constraints evaluates the grammar of Japanese. My proposal accounts for all the stratum-specific phonological phenomena in Japanese without giving up any fundamental principles of Optimality Theory.