Multiple Input-Output Faithfulness Relations in Japanese*

Haruka Fukazawa
University of Maryland at College Park
haruka@wam.umd.edu

1. Introduction

Japanese vocabulary is divided into five strata based on etymology: ***Yamato, Sino-Japanese, Mimetic, Foreign (Assimilated),*** and ***Alien (Unassimilated)*** (McCawley 1968, Itô & Mester 1995 a, b).[1] Identification of each stratum is phonologically grounded, because some phonological phenomena are observed only in a certain sub-lexicon (or sub-lexica). For example, **rendaku** (sequential voicing) is observed only in the Yamato stratum; we find phonological alternations of **post nasal voicing** only in the Yamato and Mimetic strata; and so on. Even phonemic inventories vary depending on the stratum.[2]

Five phonological patterns are delineated in Japanese on the basis of those stratum-specific phenomena. Consequently, five constraint rankings would be necessary to account for the entire Japanese grammar in Optimality Theory (OT) (Prince and Smolensky 1993), if the interaction of

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[1] Four kinds of sub-lexica in Japanese: Yamato, Sino-Japanese, Mimetic, and Foreign are introduced by McCawley (1968), and Itô and Mester (1995 a). Itô and Mester (1995 b) further classify the Foreign stratum into two: Foreign (Assimilated Foreign) and Alien (Unassimilated Foreign).

[2] Kitahara's recent research on phonotactic markedness of Japanese sub-lexica (1996) suggests that each stratum is also phonetically identified.

only the existing faithfulness and markedness constraints were taken into consideration. This would distort the principle of OT which specifies that Universal Grammar (UG) be composed of a full set of violable constraints, and that grammatical variation among languages is derived from the difference of the ranking of those constraints. In OT, Japanese, as a language, should be evaluated by a single invariant ranking of constraints.

Itô & Mester (1995 b) 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 instances of Japanese hybrids which consist of two or more different strata (Fukazawa, Kitahara, and Ota 1998).

This paper proposes that there is a system which can account for a language with more than one sub-lexicon without major modification of 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 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 present paper is that this theory denotes that several sets of faithfulness constraints coexist in a grammar.

Urbanczyk (1995, 1997) and Benua (1995, 1997) 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, 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 clarify the special nature of faithfulness constraints, and contend that a language consists of a single grammar, that is a total ordering of constraints.

The paper is organized as follows. Section 2 illustrates how distinct sets of faithfulness constraints are generated in a grammar within the framework of Correspondence Theory. Section 3 examines the stratum-specific phonological phenomena in Japanese, and elucidates the five phonological patterns depending on the sub-lexicon. The investigation in section 2 and 3 leads to the formulation of five IO faithfulness relations in Japanese in section 4. 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. Section 5 reviews the approach of re-rankable faithfulness constraints (Itô and Mester 1995 b), and compares it with the single ranking device proposed in this paper. I will make it clear not only how my model in this paper respects the invariant ranking hypothesis in OT but also how Fukazawa, Kitahara, and Ota (1998) explain Japanese hybrids which consist of different strata with the single ranking model. Section 6 discusses conclusion.

2. Multiple Faithfulness Relations in Correspondence Theory

Correspondence Theory (McCarthy and Prince 1995) revises the original concept of the faithfulness constraint in Optimality Theory (Prince and Smolensky 1993). Attention is given to correspondence between representations, and faithfulness constraints are itemized from the

segmental, featural, or structural viewpoint: {MAX, DEP, IDENT[F], CONTIGUITY, LINEARITY, INTEGRITY, UNIFORMITY, ANCHOR, ALIGN, etc.}.

Moreover, Correspondence Theory recognizes identity between distinct types of the representations such as IO, OO, BR, TT, etc. The following definition of correspondence subsumes all the types:

(1). Correspondence (McCarthy and Prince (1995), pp. 262))

Given two strings S_1 and S_2, **correspondence** is a relation **R** from the elements of S_1 to those of S_2. Elements $\alpha \in S_1$ and $\beta \in S_2$ are referred to as **correspondence** of one another when $\alpha \mathbf{R} \beta$.

All correspondence relations are generalized under this definition, and every relation generates a full 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, 1997). Both of their studies suggest 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 one 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 diminutive form for [čaləs] 'hand' is [ča-čaləs](C_1V_1-$C_1V_1C_2V_2C_3$) little hand', and a $C_1V_1C_2$-$C_1V_1C_2V_2C_3$ 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 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".

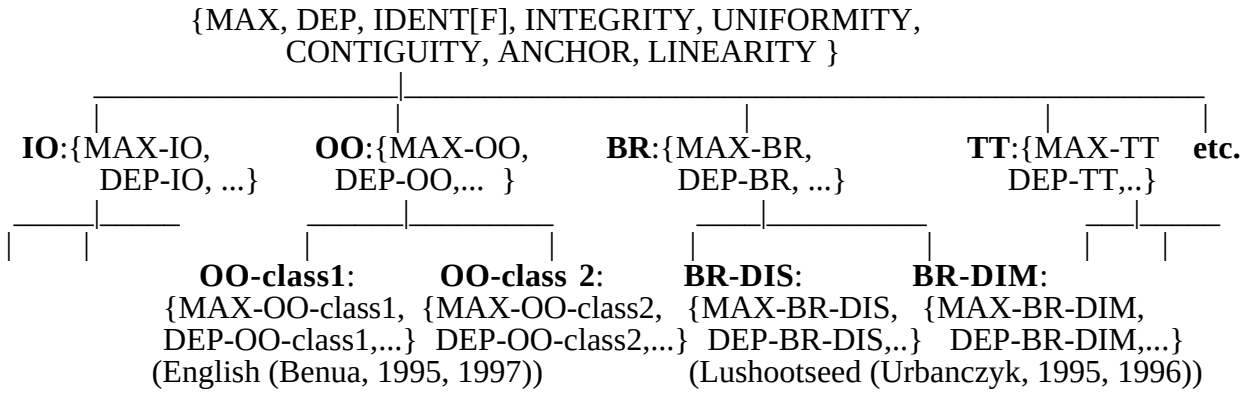
Benua (1995, 1997) shows that there are two patterns of affixation in English. For example, certain coda clusters are simplified in both root morphemes: [kʌndɛm],*[kʌndɛm**n**] ('condemn'), and class 2 affixation such as when *-ing* is attached to the root: [kʌndɛmIŋ], *[kʌndɛm**n**Iŋ] ('condemning'), but not in class 1 affixation: [kʌndɛm**n**eysʌ̆n], *[kʌndɛmeysʌ̆n] ('condemnation').

Benua remarks 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 set 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.

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 cannot occur in another. Each morphological group gives rise to its own correspondence relation; therefore, it is possible for each of the basic strings, namely, 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:

(2). Propagation of Faithfulness Constraints:



Thus, as the tree (2) 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 3 by elucidating the independent phonological patterns exhibited by the five Japanese sub-lexica.

3. Five Phonological Patterns in Japanese

3.1. 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 vocabularies. 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. Mimetic is a class of lexical items which represent sounds, characteristics, states, and so on.

The new technical vocabulary of loan-words constitutes the foreign stratum. Itô and Mester (1995 b) further specify this stratum into two: the words which are borrowed from foreign

vocabularies, and phonologically assimilated by Japanese are called ***Foreign (Assimilated Foreign)***; and the unassimilated words which retain foreign phonological characteristics are named ***Alien (Unassimilated Foreign).***

For the following two reasons, I regard all five categories introduced by McCawley, and Itô and Mester (1995 a, b) as individual sub-lexica, including the Mimetic stratum which is excluded in Itô and Mester's analysis (1995 b). First, Kitahara (1996) claims that the five sub-lexica are phonetically distinguished from one another in his analysis of phonotactic markedness of Japanese sub-lexica. Secondly, identification of those strata are phonologically grounded. Certain Japanese phonological phenomena are discerned only in some stratum (or strata). Those stratum-specific patterns scrutinized in the next section bring out the distinctive nature of each sub-lexicon in relief.

3.2. 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 cluster in those two strata ([kan-**d**a] *[kan-**t**a] 'bite-past', [šom**b**ori]*[šom**p**ori] 'sad'). On the other hand, both voiced and voiceless obstruents can surface after nasals in the other strata ([sam**p**o]'a walk', [kom**p**yuutaa]'computer', [san**t**a] 'Santa').

In Optimality Theory (OT) (Prince and Smolensky 1993), 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) were satisfied along with the violaiton of some faithfulness

constraint in Japanese, because we actually observe post nasal voicing in some strata, namely, in Yamato and Mimetics. Therefore, we anticipate the ranking "PNV >> faithfulness"

(3). a provisional ranking (a):

/kan-**t**a 'bite-past'/	PNV	faithfulness
☞ a. kan**d**a		*
b. kan**t**a	*!	

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

*(4). a wrong result:

kompyuutaa 'computer'	PNV	faithfulness
*☞ a. kom**b**yuutaa		*
b. kom**p**yuutaa	*!	

In (4), 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 ([ka**pp**a] *[ka**p**a] 'river imp', [ni**pp**on] [ni**h**on] *[ni**p**on] 'Japan'), they can occur singly ([p]) in the rest of the strata ([**p**ika-**p**ika] 'glittering', [e**p**isoodo] 'episode'). Therefore, the constraint which forbids a single-handed [p], *[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) ([yu**kk**uri] *[yu**gg**uri] 'slowly', [ka**tt**a] *[ka**dd**a] 'buy (past)'), but they do occur in Alien ([do**gg**u] *[do**kk**u] 'dog'). The constraint which bans voiced geminates is thus respected in all the strata in Japanese except the Alien.

What is more, 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-**g**asa] *[ama-**k**asa] 'unbrella') . Therefore, the constraints for monosyllabism, foot-restriction, and rendaku are abided 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 here. The following chart shows which stratum complies with which constraint.

(5). 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		
Mimetic	satisfy		satisfy		satisfy	
Foreign			satisfy			
Alien						

Only the six kinds of markedness constraints are shown in chart (5). Nevertheless, the summary explicitly describes that there are five phonological patterns depending on the sub-lexicon in Japanese. The next section will clarify how the grammar of Japanese examined in this section is explained under the principle of total ordering in Optimality Theory.

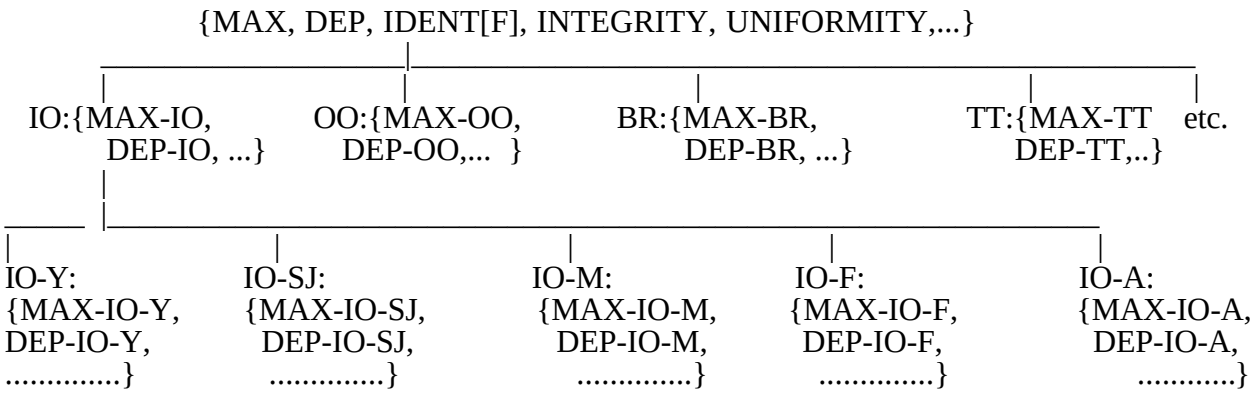
4. Five Input-Output Faithfulness Relations in Japanese

In section 3, we have understood that five phonological patterns for each sub-lexicon inhere in the grammar of Japanese. As in chart (5), some constraints satisfied in one stratum (or strata) are violated in others. The conflict of ranking of constraints is recognized for all the markedness constraints in chart (5), resulting in five kinds of rankings in the language. If this were the fact, 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 2, I deem 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:IO-Yamato(Y):{MAX-IO-Y, DEP-IO-Y, IDENT[F]-IO-Y, INTEGRITY-IO-Y,...}; IO-Sino-Japanese

(SJ):{MAX-IO-SJ, DEP-IO-SJ, IDENT[F]-SJ,...}; IO-Mimetics(M):{MAX-IO-M, DEP-IO-M, ...}; IO-Foreign(F):{MAX-IO-F, DEP-IO-F, ...}; and IO-Alien-(A):{MAX-IO-A, DEP-IO-A,...} as the following tree shows:

(6). Five IO faithfulness constraints in Japanese:



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 those constraints.

4.1. An Analysis

Among the stratum specific phonological phenomena examined in section 3, I will analyze three of them, post nasal voicing, impossibility of voiced geminates, and prohibition of single-handed [p], here.

4.1.1. Post Nasal Voicing

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

(7) PNV: post nasal voicing: Post-nasal obstruents should be voiced (Pater 1995)

IDENT[voice]: correspondence elements in the input and the output must have the identical value for voicing (McCarthy and Prince 1995)

(relativized to each stratum: IDENT[voice]-IO-Yamato (Y), IDENT[voice]-IO-Sino-Japanese (SJ), IDENT[Voice]-IO-Mimetic(M),IDENT[voice]-IO-Foreign(F), and IDENT[voice]-IO-Alien(A)).

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

(8) PNV in Yamato/Mimetic:

/kan-**t**a/ 'bite (past)'	PNV	IDENT[voice]-IO-Y, IDENT[voice]-IO-M
☞ a. kan**d**a		*
b. kan**t**a	*!	

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.

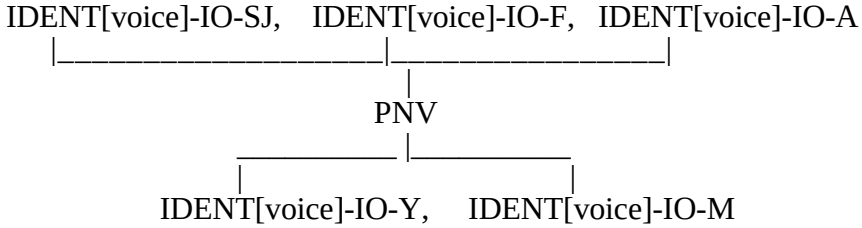
PNV can be violated in the other strata, since both voiced and voiceless obstruents are possible in the output of Sino-Japanese, Foreign, and Alien. Thus, faithfulness constraints for those strata must outrank PNV: "IDENT[voice]-IO-SJ,IDENT[voice]-IO-F,IDENT[voice]-IO-A >> PNV".

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

/ kompyuutaa 'computer'/	IDENT[voice]-IO-SJ, IDENT[voice]-IO-F, IDENT[voice]-IO-A	PNV
☞ a. kom**p**yuutaa		*
b. kom**b**yuutaa	*!	

The rankings in (8) and (9) can be united into a single ranking:

(10). A constraint ranking for PNV:



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

(11) PNV in Yamato and Mimetic:

/kan-**t**a/ 'bite (past)'	IDENT[voice]-IO-SJ, IDENT[voice]-IO-F, IDENT[voice]-IO-A	PNV	IDENT[voice]-IO-Y, IDENT[voice]-IO-M
☞ a. kan**d**a			*

b. kan**t**a		*!	

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

/kom**p**yuutaa 'computer'/	IDENT[voice]-IO-SJ, IDENT[voice]-IO-F, IDENT[voice]-IO-A	PNV	IDENT[voice]-IO-Y, IDENT[voice]-IO-M
☞ a. kom**p**yuutaa		*	
b. kom**b**yuutaa	*!		

The ranking in (10), thus, accounts for the phenomenon of post nasal voicing in all the five strata without any conflict.

4.1.2. Impossibility of Voiced Geminates

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 1995 b)), outranks the faithfulness constraints for voicing in all the strata except Alien:

(13) NoVoiGem in Yamato, Sino-Japanese, Mimetic, Foreign:

/yu**gg**uri 'slowly'	NoVoiGem	IDENT[voice]-IO-Y, IDENT[voice]-IO-SJ, IDENT[voice]-IO-M IDENT[voice]-IO-F
☞ a. yu**kk**uri		*
b. yu**gg**uri	*!	

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 (13), the ranking gears the output to the voiceless one.

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

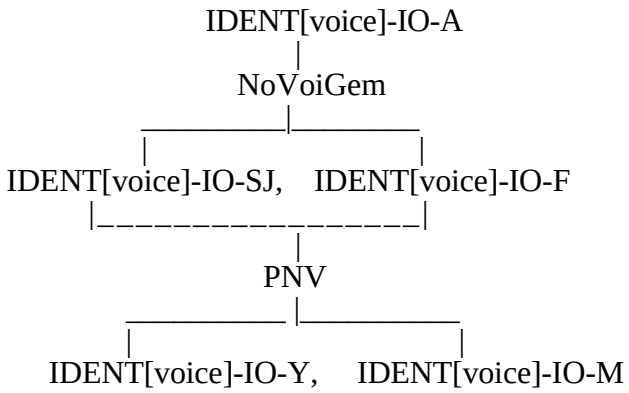
(14) NoVoiGem in Alien:

/do**gg**u 'dog'/	IDENT[voice]-IO-A	NoVoiGem
☞ a. do**gg**u		*

b. do**kk**u	*!	

The rankings in (13) and (14) are unified into one ranking which can explain impossibility or possiblity of voiced geminates in all the strata. Also, the ranking in (10) as well as in (13) and (14) will furnish a single ranking, since all the three rankings involve the same faithfulness constraint, IDENT[voice]:

(15) A unified ranking of (10), (14), and (15):



Consequently, the ranking in (15) recapitulate both the data of post nasal voicing and impossibility of voiced geminates in all the strata in Japanese.

4.1.3. Prohibition of [p]

In Yamato and Sino-Japanese, a single-handed [p] is not allowed in the output form. If a single [p] is found in the input (because of ROTB) in those two strata, the voiceless labial stop in the output is either geminated (or partially geminated) or delabialized: [ni**pp**on], [ni**h**on], *[ni**p**on] 'Japan'. To expound 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. However, for the sake of convenience, let us focus only on the delabialization case here.

The necessary constraints are:

(16). *[p]: a constraint against a single-handed [p] (Itô and Mester 1995 a)
IDENT[lab]: corresponding elements in the input and the output must have the identical value for the feature [lab] (McCarthy and Prince 1995).
IDENT[lab]-IO-Yamato (Y), IDENT[lab]-IO-Sino-Japanese (SJ),

IDENT[lab]-IO-Mimetic(M),IDENT[lab]-IO-Foreign(F), and
IDENT[lab]-IO-Alien(A).

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

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

/ni**p**on/ 'Japan'	*[p]	IDENT[lab]-IO-Y, IDENT[lab]-IO-SJ
☞ a. ni**h**on		*
b. ni**p**on	*!	

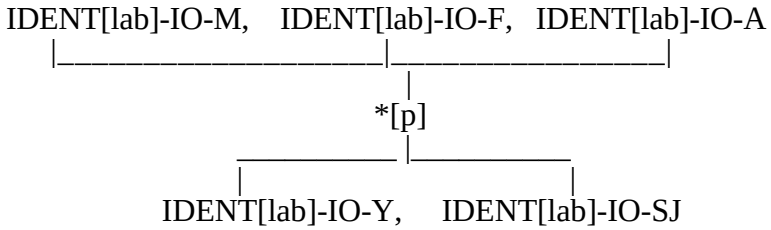
On the other hand, *[p] is violated in the other strata:

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

/ **p**ika-**p**ika/ 'glittering'	IDENT[lab]-IO-M, IDENT[lab]-IO-F, IDENT[lab]-IO-A	*[P]
☞ a. **p**ika-**p**ika		**
b. **h**ika-**h**ika	*!*	

The ranking in (17) and (18) can also be integrated into a single ranking:

(19). A constraint ranking for *[p]:



The ranking in (19) explicates prohibition of a single [p] in all the strata.

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-lexica-specific. Although the rankings in (15) and in (19) stand in a single ranking in Japanese.

By claiming that Japanese instantiates five sets of IO faithfulness relations, I have manifested that a single ranking of all the constraints evaluates the grammar of Japanese. In the following section, I will compare my proposal with Itô and Mester's system (1995 b) of re-ranking of faithfulness constraints.

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

Itô and Mester (1995 b) approach to the stratum-specific phonological phenomena by proposing that faithfulness constraints are re-rankable depending upon the sub-lexicon within a language. They indicate that the ranking of markedness constraints are fixed though 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 >> IDENT[voice][3]" is necessary for the Yamato and Mimetic[4] strata, while "IDENT[voice] >> PNV" is established for Sino-Japanese, Foreign, and Alien. The following two tableaus illustrate the phenomenon of post nasal voicing in their system:

(20) PNV in Yamato/Mimetic :

/kan-**t**a/ 'bite (past)'	PNV	IDENT[voice]
☞ a. kan**d**a		*
b. kan**t**a	*!	

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

/sam**p**o/ 'a walk'	IDENT[voice]	PNV
☞ a. sam**p**o		*
b. sam**b**o	*!	

Unlike my analysis of the same phenomenon discussed in section 4, the rankings in (20) and (21) 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:

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[3] Itô and Mester (1995 b) do not adopt Correspondence Theory in their analysis; therefore, the actual faithfulness constraint for voicing they use is "FAITH[voice]". For the sake of comparison, I use IDENT[voice] here.

[4] Itô and Mester (1995 b) do not include the Mimetic strata in their analysis. It is I that add the analysis of Mimetics in section 5 by conforming the Mimetic stratum to their system.

(22) The two rankings for post nasal voicing:

(a) for Yamato and Mimetic:

PNV
|
IDENT[voice]

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

IDENT[voice]
|
PNV

This does not seem to solve the problem of multiple rankings in a language in OT at all which I have discussed at the beginning of section 4. However, Itô and Mester's claim will be made clear when we observe the interaction of the two markedness constraints with the faithfulness constraint. They designate that the ranking between PNV and NoVoiGem is fixed in the whole grammar of Japanese: "NoVoiGem >> PNV", and the faithfulness constraint will rank in one of the three positions depending on the stratum: higher than NoVoiGem, in-between NoVoiGem and PNV, or lower than PNV, evoking the following three sub-rankings in Japanese:

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

(a) in Alien:

IDENT[voice]
|
NoVoiGem
|
PNV

(b) in Sino-Japanese and Foreign

NoVoiGem
|
IDENT[voice]
|
PNV

(c) in Yamato and Mimetics

NoVoiGem
|
PNV
|
IDENT[voice]

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:

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

/ni**p**on/ 'Japan'	*[p]	IDENT[lab][5]
☞ a. ni**h**on		*
b. ni**p**on	*!	

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

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

The tableaus (24) and (25) lead to a conclusion that the following two rankings are necessary:

(26) The rankings for *[p]:

(a) for Yamato and Sino-Japanese

*[p]
|
IDENT[lab]

(b). for Mimetic, Foreign, and Alien

IDENT[lab]
|
*[p]

Itô and Mester combine the three sub-rankings in (23) and the two rankings in (26) into four sub-rankings. First, they introduce a fixed ranking of three markedness constraints,"NoVoiGem >> *[p] >> PNV", and the faithfulness constraint will rank one of the four available places:

(27)

(a) in Yamato

NoVoiGem
|
*[p]
|
PNV
|
IDENT[voice]/[lab]

(b) in Sino-Japanese

NoVoiGem
|
*[p]
|
IDENT[voice]/[lab]
|
PNV

(c) in Foreign

NoVoiGem
|
IDENT[voice]/[lab]
|
*[p]
|
PNV

(d) in Alien

IDENT[voice]/[lab
|
NoVoiGem
|
*[p]
|
PNV

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.[6]

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5 Again, they use FAITH[lab] instead of IDENT[lab].

6 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.

Now, some questions arise. First, can a language consist of sub-grammars? Although the sub-grammars are differentiated in a only 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 not language-specific? To make their proposal valid, Itô and Mester must radically alter the principle of OT: UG is composed of a set of constraints, and the variation among languages is explained by a single invariant constraint hierarchy, which is respected in my system.

Furthermore, 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 Itô and Mester's analysis. On the other hand, the unique nature of faithfulness constraints are well-explained within the framework of Correspondence Theory in this paper. The theory implies that the matrix full set of faithfulness constraints can be multiplied for each identity relation along morphological lines.

More importantly, the re-ranking system cannot account for Japanese hybrids which are composed of different strata within a parallelist OT (Fukazawa, Kitahara, and Ota 1998). There are some Japanese words which consist of more than one different stratum. For example, the word [tombokenkyuuka] 'researchers of dragonflies' consists of both Yamato and Sino-Japanese. ([tombo]'dragonflies' is Yamato, and [kenkyuuka] 'researchers' is Sino-Japanese.) In such a hybrid, two kinds of IO faithfulness constraints for each sub-lexicon are crucial. In the word [tombokenkyuuka], the markedness constraint PNV (Post Nasal Voicing) is satisfied in the Yamato part, while PNV is not respected to satisfy the faithfulness constraint for voicing in Sino-Japanese part. Without two different IO faithfulness constraints for Yamato and Sino-Japanese, this datum cannot be accounted for.

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

/tom**p**oken**k**yuuka/	IDENT[voice]S-J	PNV	IDENT[voice]Yamato
a. tom**p**oken**k**yuuka		**!	
b. tom**b**oken**g**yuuka	*!		*
☞c. tom**b**oken**k**yuuka		*	

d. tom**p**oken**g**yuuka	*!		*

As tableau (28) shows, this hybrid can be explained only with simultaneous attendance of multiple IO faithfulness constraints in parallelist OT. In the re-ranking system, PNV >> IDENT[voice]Yamato can account only for the first Yamato part of this hybrid at a stage, and the re-ranked ranking IDENT[voice] >> PNV has to explain the latter Sino-Japanese part in a different stage. Therefore, the re-ranking model cannot bring forth the correct analysis of hybrids in OT.[7]

Finally, I refer to the cross-linguistic validity of Itô and Mester's system (1995 b) and mine. They introduce an idea of "the Hierarchy of Foreigness" as supportive evidence for the cross-linguistical validity of their remark. According to them, the more native the sub-lexicon is, the lower the faithfulness constraint ranks in it in a language, and vice versa. For example, in the most native stratum in Japanese, Yamato, the faithfulness constraint ranks lowest as in (27 a), while it moves up to the highest position in the least native stratum, Alien as in (27 d). Although this generalization seems to work, the examination of specific data in Japanese reveals some problems in their claim.

Itô and Mester (1995 b) explain that the following fixed ranking of markedness constraints is obeyed in the entire Japanese grammar:

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

____ "SyllStruc" __>>__"NoVoicedGeminates"__>>_ *[p] __>>____Post Nasal Voicing___
(e) (d) (c) (b) (a)

Depending on the stratum, the faithfulness constraint will be re-ranked in the places of (a) through (e). In Yamato, the most native stratum, it ranks the lowest position (a), while it ranks in (d) in the least native Alien.

However, I argue that the ranking of markedness constraints in (27) or (29) cannot be determined in Japanese. Although Itô and Mester (1995 b) do not follow Correspondence Theory, they still classify faithfulness constraints into some categories in their analysis such as

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7 The detail discussion for this issue, see Fukazawa, Kitahara, and Ota 1998.

FAITH[voice] (IDENT[voice] in this paper), FAITH[lab] (IDENT[lab] in this paper), and so on. This is because we could not explain the whole grammar of Japanese (or any language), if we had only one kind of faithfulness constraint.

Once each type of faithfulness such as IDENT[lab] (FAITH[lab]) or IDENT[voice] (FAITH[voice]) is ranked separately, there is no evidence for the ranking between NoVoiGem and *[p] or that between *[p] and PNV in Japanese. Both NoVoicedGeminates and Post Nasal Voicing interact with the faithfulness constraint IDENT[voice](FAITH[voice]) so that the ranking between NoVoiGem and PNV are established. On the other hand, *[p] interacts not with IDENT[voice] (FAITH[voice]) but with IDENT[lab] (FAITH[lab]); therefore, the ranking of *[p] cannot be determined based on the constraint NoVoiGem or PNV.

Logically, the raking "NoVoiGem >> *[p] >> PNV" in (27) and (29) cannot be obtained based on the data of those three phenomena. This problem is significant, because the fixed ranking of markedness constraints is the major premise in this hierarchy. Therefore, the picture of the hierarchy of foreigness would not become clear until the raking of all the markedness constraints were determined.

Also, the well-formedness of the hierarchy in (29) will be spoiled if the Mimetic stratum is added to it. Let us consider where the Mimetic stratum can actually join in the hierarchy (29) which is repeated as follows:

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

"SyllStruc"	>>	"NoVoicedGeminates"	>>	*[p] >> Post Nasal Voicing
(e)		(d)	(c)	(b) (a)

In Mimetics, the faithfulness constraint should be lower ranked than NoVoicedGeminates and Post Nasal Voicing, because voiced geminates and voiceless obstruents after nasals are impossible. Therefore, we have the following ranking:

(30) No Voiced Geminates, Post Nasal Voicing >> faithfulness

Then, only the possible position for the faithfulness constraint in Mimetics in the hierarchy in (29) is (a) so far. However, the faithfulness constraint must outrank *[p], since a single-handed [p] is possible in Mimetics:

(31). faithfulness >> *[p]

Now, the faithfulness constraint in Mimetics has to be put in at least in (c) or higher to account for the single [p]. Consequently, there is no position for the Mimetic stratum to attend in this ranking.

This fact supports my first argument that we cannot tell the ranking between No Voiced Geminates and *[p], or between Post Nasal Voicing and *[p], because No Voiced Geminates and Post Nasal Voicing interact with IDENT[voice] (FAITH [voice]), and *[p] interacts with another faithfulness constraint IDENT[lab](FAITH [lab]. Otherwise, we cannot explain the conflict of the rankings between (29), (30), and (31).

I thus conclude that the Hierarchy of Foreigness in (27) or (29) cannot be the evidence for Itô and Mester's theory unless the fixed ranking of markedness constraints in the hierarchy is provided.

My proposal based on Correspondence Theory has already corroborated its cross-linguistic generalization: the full set of faithfulness constraints are established for each formal correspondence relation. Once all the faithfulness constraints are established, then, all the constraints are put in a single ranking in each grammar.

6. Conclusion

I have argued in this paper that the problem of Japanese stratum-specific phenomena is settled simply when those phenomena are analyzed on the basis of Correspondence Theory. Multiple sets of correspondence relations coexist in a grammar, and all types are regulated by each full set of faithfulness constrains. Building on this theory, I have claimed that there are five Input-Output relations in Japanese (one per sub-lexicon), and each bears its own full set of faithfulness constraints. The total ordering of all those 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.

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Haruka Fukazawa
haruka@wam.umd.edu
Department of Linguistics
1401 Marie Mount Hall

University of Maryland
College Park, MD, 20742-7505