Variation and Change in the Accentual System of Japanese Compounds: Implications for the Debate over Indexing vs. Reranking*
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1. Introduction

There has recently been a hot debate over the issue of how subgrammars are defined in Optimality Theory (Zoll & Inkelas (2003)). At present, approaches to this issue are taken in two ways: indexing of constraints (multiple faithfulness) and reranking of constraints (cophonologies). There is something in common with the two approaches where, in defining subgrammars, indexing or reranking is crucially limited to faithfulness constraints. However, their empirical consequences are naturally quite different.

In this article, I will consider accentual variations in Japanese compounds and demonstrate that all and only possible variations are produced by reranking of a faithfulness constraint but not by indexing in multiple faithfulness theory. In other words, the latter theory sometimes creates impossible variations and gives wrong predictions in accounting for variation and diachronic change. In the following discussion, I will make a simple comparison between the two theories in terms of 1) possible and impossible variations, 2) the maximal number of variations, and 3) the relation of variations to diachronic change. I will show that all the three naturally follows from minimality of reranking, a condition on reranking algorithm (Anttila (2002), Tanaka (2003)). For segmental arguments in favor of reranking over indexing, see Anttila (2002) and Zoll & Inkelas (2003), among others.

2. Possible and Impossible Variations
2.1. Variations among Lexical Classes: Accent Loss

First, let us consider possible and impossible variations of accent in Japanese compounds by paying special attention to their lexical classes. As shown in (1), foreign and native compounds usually receive accent on the same syllable as their head nominals, and some speakers in younger generation allow accent on the last syllable of each penultimate foot as well. However, their unaccented counterparts are strictly prohibited:

(1) Variation: Preserved / Penultimate-Footed / *Unaccented

  a. Foreign Compounds

    tíi: (mi)(ruku)(tíi) / (mi)(rukú)(tii) / *(mi)(ruku)(tii) 'milk tea'

    tén: (be)(suto)(tén) / (be)(sutó)(ten) / *(be)(suto)(ten) 'best ten'

    syóo: (wai)(do)(syóo) / (wai)(dó)(syoo) / *(wai)(do)(syoo) 'long TV show'

    purée: (net)(to)(pu)(rée) / (net)(to)(pú)(ree) / *(net)(to)(pu)(ree) 'net play'

    koohíi: (ai)(su)(koo)(híi) / (ai)(su)(kóo)(hii) / *(ai)(su)(koo)(hii) 'ice coffee'

    sukíi: (sui)(zyou)(su)(kíi) / (sui)(zyou)(sú)(kii) / *(sui)(zyou)(su)(kii) 'water-skiing'

    buróo: (he)(yaa)(bu)(róo) / (he)(yaa)(bú)(roo) / *(he)(yaa)(bu)(roo) 'hair blow'

dée: (ba)(ren)(ta)(in)(dée) / (ba)(ren)(ta)(in)(dee) / *(ba)(ren)(ta)(in)(dee) 'St. Valentine's Day'

turíi: (ku)(risu)(masu)(tu)(ríi) / (ku)(risu)(masu)(tú)(rii) / *(ku)(risu)(masu)(tu)(rii) 'Christmas tree'

b. Native Compounds

áme: (ni)(waka)(áme) / (ni)(waká)(ame) / *(ni)(waka)(ame) 'sudden rainfall'

kóe: (ka)(sure)(góe) / (ka)(suré)(goe) / *(ka)(sure)(goe) 'husky voice'

íta: (ga)(rasu)(íta) / (ga)(rasú)(ita) / *(ga)(rasu)(ita) 'glass board'

kása: (kou)(mori)(gása) / (kou)(morí)(gasa) / *(kou)(mori)(gasa) 'Western umbrella'

kúmo: (nyuu)(dou)(gúmo) / (nyuu)(dóu)(gumo) / *(nyuu)(dou)(gumo) 'thunderhead'

húne: (ya)(kata)(búne) / (ya)(katá)(bune) / *(ya)(kata)(bune) 'houseboat'

tamágo: (yude)(ta)(mágo) / (yude)(tá)(mago) / *(yude)(ta)(mago) 'boiled egg'

utíwa: (hi)(dari)(u)(tíwa) / (hi)(dari)(ú)(tiwa) / *(hi)(dari)(u)(tiwa) 'comfortable life'

omútu: (kami)(o)(mútu) / (kami)(ó)(mutu) / *(kami)(o)(mutu) 'paper diaper'

itóko: (mata)(i)(tóko) / (mata)(í)(toko) / *(mata)(i)(toko) 'second cousin'

This is not true for Sino-Japanese compounds and foreign simplex words in (2), where their basic accents are all on the penultimate foot and for younger speakers, unaccented variations are more comfortable to pronounce. But note here that these lexical classes don't receive such preserved accent as seen in (1).

(2) Variation: Penultimate-Footed / Unaccented

a. Sino-Japanese Compounds

kéi: (tai)(ón)(kei) / (tai)(on)(kei) 'thermometer'

zyóu: (kan)(syá)(zyou) / (kan)(sya)(zyou) 'letter of gratitude'

sén: (sui)(héi)(sen) / (sui)(hei)(sen) 'horizon on the sea'

sén: (ti)(héi)(sen) / (ti)(hei)(sen) 'horizon on the ground'

nín: (ku)(róu)(nin) / (ku)(rou)(nin) 'natural worrier'

syóu: (ku)(róu)(syou) / (ku)(rou)(syou) 'worrying nature'

ryóku: (nyúu)(ryoku) / (nyuu)(ryoku) 'input'

b. Foreign Words

(bái)(ku) / (bai)(ku) 'bike'	(dée)(ta) / (dee)(ta) 'data'
(kú)(rabu) / (ku)(rabu) 'club'	(gyáp)(pu) / (gyap)(pu) 'gap'
(mée)(kaa) / (mee)(kaa) 'maker'	(gú)(rahu) / (gu)(rahu) 'graph'
(bó)(toru) / (bo)(toru) 'bottle'	(dó)(ramu) / (do)(ramu) 'drum'
(su)(níi)(kaa) / (su)(nii)(kaa) 'sneakers'	(su)(kúu)(taa) / (su)(kuu)(taa) 'scooter'
(ma)(née)(zyaa) / (ma)(nee)(zyaa) 'manager'	(puro)(dyúu)(saa) / (puro)(dyuu)(saa) 'producer'

To account for this difference in alternation based on lexical classes, I introduce here some background information on the constraint-ranking system for Japanese accentuation. Following Tanaka ((2001), (2003), and (to appear)), I assume the ranking of constraints in (3), whose definitions and motivations are given in (4). The most important thing in (3) is that only a faithfulness constraint, Max (accent) here, is rerankable with another constraint,

which lead to subgrammars (here, lexical classes) and their variations in the accentual system. That is, constraints can be reranked only in the ways of dotted lines (a), (b), and (c):

(3) The Constraint-Ranking System for Compound Accent

NON-FINALITY (μ', σ', F')

(a)

MAX (accent)

(b) (c)

ALIGN-L (σ', root) NON-FINALITY (PrWd')
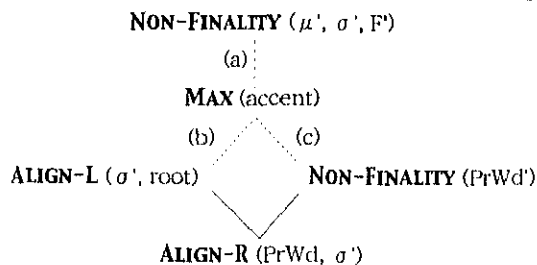
ALIGN-R (PrWd, σ') (cf. Kubozono (1995), (1997))

(4) Definition and Motivation of Constraints

  a. **NON-FINALITY** (μ', σ', F'): The accented mora, syllable, and foot are not final in PrWd.

    e.g. (si)(rou)(tó)(gei) / **(si)(rou)(to)(géi) 'amateur performance'

    e.g. (re)(in)(kóo)(to) / ***(re)(in)(koo)(tó) 'raincoat'

  b. **MAX** (accent): The accent of a head root has a correspondent in the compound.

    e.g. kágaku: (si)(zen)(ká)(gaku) / *(si)(zén)(ka)(gaku) / **(si)(zen)(ka)(gaku) 'natural science'

  c. **NON-FINALITY** (PrWd'): The accented prosodic word is not final in PrWd (Accent is not present in PrWd).

    e.g. (ou)(saka)(ben) / *(ou)(saka)(bén) / *(ou)(saká)(ben) 'Osaka dialect'

  d. **ALIGN-L** (σ', root): The left edge of any accented syllable is aligned with the left edge of a head root.

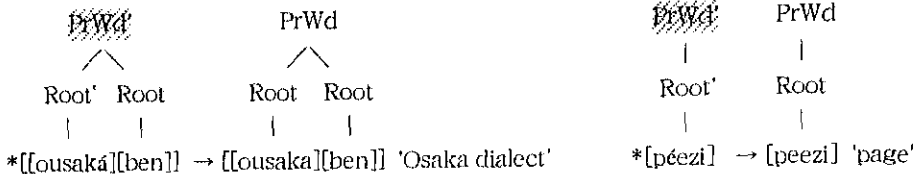   e.g. (kita)+(áme)(rika) / *(kita)+(amé)(rika) / *(kitá)+(ame)(rika) 'North America'

  e. **ALIGN-R** (PrWd, σ'): The right edge of any PrWd is aligned with the right edge of an accented syllable.

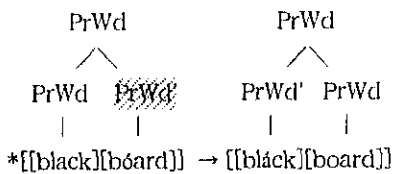   e.g. (kafe)(báa) / *(kafé)(baa) / **(káfe)(baa) / ***(kafe)(baa) 'cafe bar'

As for the examples in (4), ***(re)(in)(koo)(tó) in (4a) has three violations for Non-Finality, because the accent is final on the level of mora, syllable, and foot. *(si)(zén)(ka)(gaku) and **(si)(zen)(ka)(gaku) in (4b) suffer from one and two violations of Max (accent), respectively, and this difference depends on whether the compound accent is moved (shifted) or removed (deleted) from the original accent of the head root *kágaku*. (4c) is one of the constraints in the Non-Finality family, but it actually requires de-accentuation due to the morphological structure of Japanese compounds. As shown in (5a), a Japanese compound consists of a single PrWd, so its accent, if any, is always final. This is prohibited by Non-Finality (PrWd') and causes accent loss. In contrast, an English compound consists of two (or more) PrWds, so its final accent is not deleted but simply shifted to the non-final position. This point is illustrated in (5b):

(5) Non-Finality (PrWd') and Morphological Structures

a. Japanese: De-accentuation

PrWd'   PrWd   PrWd'   PrWd
/\   /\ | |
Root' Root   Root Root   Root'   Root
  | | | | | |
*[[ousaká][ben]] → [[ousaka][ben]] 'Osaka dialect'   *[péezi] → [peezi] 'page'

b. English: Accent Retraction

PrWd   PrWd
/\   /\
PrWd PrWd'   PrWd' PrWd
  | | | |
*[[black][bóard]] → [[bláck][board]]

Thus, it may be said that the component nouns in an English compound (i.e. PrWds) are more independent of each other than the ones in a Japanese compound (i.e. Roots), and this difference is directly related to the fact that only the former component words receive secondary accent as well, as in *bláck bòard, gréen hòuse, bláck bìrd*, and so on. In other words, English compounds have more wordhood than Japanese compounds. Anyway, the de-accentuation phenomena in Japanese are accounted for as one of the Non-Finality effects.

Given the ranking of constraints above, my account of the difference in variation between (1) and (2) is straightforward. As shown in (6a), accent is basically preserved in foreign and native compounds, and penultimate-footed accent is also made possible by minimally reranking Max (accent) below Non-Finality (μ', σ', Ft '). Unaccented variants are impossible because they involve non-minimal (i.e. two-step) demotion of Max (accent).

(6) Minimal Demotion of Max (accent) (Tanaka and Yamane (2000))

a. Foreign and Native Compounds	
Preserved:	Max(accent) >> Non-Finality (μ', σ', Ft') >> Non-Finality (PrWd') >> Align-R (PrWd, σ')
Penultimate-Footed:	Non-Finality (μ', σ', Ft') >> Max(accent) >> Non-Finality (PrWd') >> Align-R (PrWd, σ')
*Unaccented:	Non-Finality (μ', σ', Ft') >> Non-Finality (PrWd') >> Max(accent) >> Align-R (PrWd, σ')
b. Sino-Japanese Compounds and Foreign Simplex Words	
Preserved:	Max(accent) >> Non-Finality (μ', σ', Ft') >> Non-Finality (PrWd') >> Align-R (PrWd, σ')
Penultimate-Footed:	Non-Finality (μ', σ', Ft') >> Max(accent) >> Non-Finality (PrWd') >> Align-R (PrWd, σ')
Unaccented:	Non-Finality (μ', σ', Ft') >> Non-Finality (PrWd') >> Max(accent) >> Align-R (PrWd, σ')

On the other hand, as in (6b), Sino-Japanese compounds and foreign simplex words originally have accent on their penultimate foot, so minimal demotion of Max leads to accent loss because of Non-Finality (PrWd'). Tableaux (7) and (8) are showing this point by taking up *(be)(suto)(tén) / (be)(sutó)(ten) / *(be)(suto)(ten)* 'best ten' and *(tai)(ón)(kei) / (tai)(on)(kei)* 'thermometer', respectively:

(7) Preserved / Penultimate-Footed / *Unaccented

a. BASIC RANKING:	Max (accent)	Non-Finality (μ', σ', F)	Non-Finality (PrWd')	Align-R (PrWd, σ')
/bésuto + tén/				
☞ (be)(suto)+(tén)		**	*	
(be)(sutó)+(ten)	* !		*	*
(be)(súto)+(ten)	* !		*	**
(be)(suto)+(ten)	** !			****

b. Reranking:	Non-Finality (μ', σ', F)	Max (accent)	Non-Finality (PrWd')	Align-R (PrWd, σ')
/bésuto + tén/				
(be)(suto)+(tén)	** !		*	
☞ (be)(sutó)+(ten)		*	*	*
(be)(súto)+(ten)		*	*	** !
(be)(suto)+(ten)		** !		****

c. *Reranking:	Non-Finality (μ', σ', F)	Non-Finality (PrWd')	Max (accent)	Align-R (PrWd, σ')
/bésuto + tén/				
(be)(suto)+(tén)	** !	*		
(be)(sutó)+(ten)		* !	*	*
(be)(súto)+(ten)		* !	*	**
☜ (be)(suto)+(ten)			**	****

(8) Penultimate-Footed / Unaccented

a. BASIC RANKING:	Non-Finality (μ', σ', F)	Max (accent)	Non-Finality (PrWd')	Align-R (PrWd, σ')
/táion + kéi/				
(tai)(on)+(kéi)	** !		*	
☞ (tai)(ón)+(kei)		*	*	*
(tái)(on)+(kei)		*	*	** !
(tai)(on)+(kei)		** !		***

b. Reranking:	Non-Finality (μ', σ', F)	Non-Finality (PrWd')	Max (accent)	Align-R (PrWd, σ')
/táion + kéi/				
(tai)(on)+(kéi)	** !	*		
(tai)(ón)+(kei)		* !	*	*
(tái)(on)+(kei)		* !	*	**
☞ (tai)(on)+(kei)			**	***

In this way, minimal reranking of a faithfulness constraint can generate possible variations and excludes impossible variations correctly.
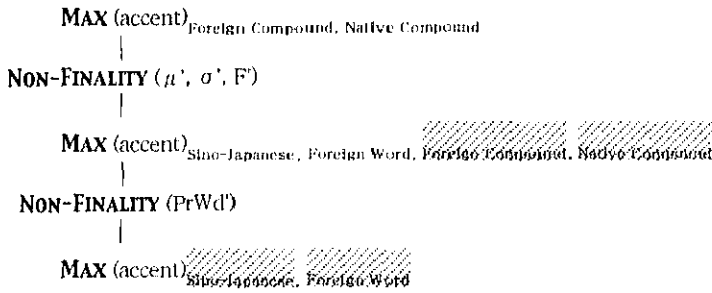
In the same way, indexing in multiple faithfulness theory might appear to account for the observed accent variations with all rankings kept invariant, without recourse to minimal reranking of Max. This is illustrated in (9), which is a simple application of Fukazawa, Kitahara, & Ohta (1998) and Itô & Mester (1999) to the accentual field:

(9) Multiple Faithfulness with Indexing

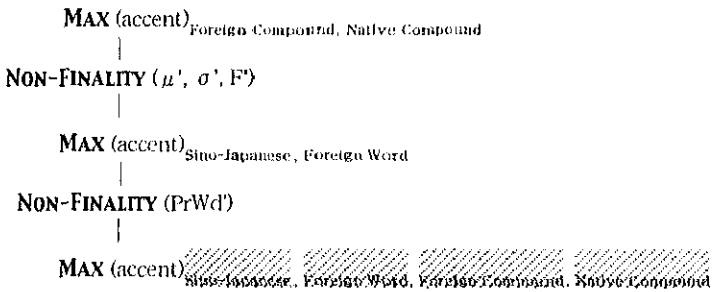a. Basic Patterns

$$\text{MAX (accent)}_{\text{Foreign Compound, Native Compound}}$$
|
$$\text{NON-FINALITY } (\mu', \sigma', F)$$
|
$$\text{MAX (accent)}_{\text{Sino-Japanese, Foreign Word}}$$
|
$$\text{NON-FINALITY (PrWd')}$$
|
$$\text{MAX (accent)}$$

364

b. Variations

$$\text{MAX (accent)}_{\text{Foreign Compound, Native Compound}}$$
$$|$$
$$\text{NON-FINALITY } (\mu\text{'}, \sigma\text{'}, F\text{'})$$
$$|$$
$$\text{MAX (accent)}_{\text{Sino-Japanese, Foreign Word, Foreign Compound, Native Compound}}$$
$$|$$
$$\text{NON-FINALITY (PrWd')}$$
$$|$$
$$\text{MAX (accent)}_{\text{Sino-Japanese, Foreign Word}}$$
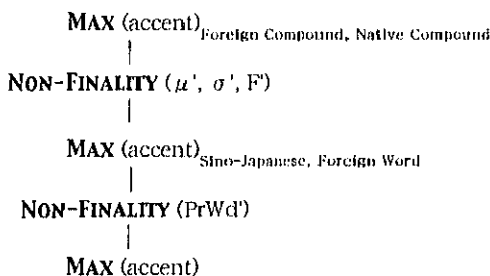
However, this approach assigning labels of lexical classes to each Max not only is more complex than the minimal-reranking approach in (6), but also there is no reason that the same labels are assigned to any two non-local Max's. This is because labeling is a mere specification in the lexicon and specification exhibits no locality, as given in (10):

(10) Non-Local Indexing

$$\text{MAX (accent)}_{\text{Foreign Compound, Native Compound}}$$
$$|$$
$$\text{NON-FINALITY } (\mu\text{'}, \sigma\text{'}, F\text{'})$$
$$|$$
$$\text{MAX (accent)}_{\text{Sino-Japanese, Foreign Word}}$$
$$|$$
$$\text{NON-FINALITY (PrWd')}$$
$$|$$
$$\text{MAX (accent)}_{\text{Sino-Japanese, Foreign Word, Foreign Compound, Native Compound}}$$

Needless to say, the labelings in (10) would result in some impossible variations of foreign and native compounds: unaccented variations are prohibited, as was already seen in (1). It follows then that what is specified in the lexicon is not the labels of lexical classes for each Max but the basic position of Max in the ranking for each lexical class, in a way like (6). Possible and impossible variations are accounted for by the minimality of reranking of Max in a fairly natural way.

2.2. Variations among Lexical Classes: Root-Initial Accent

Reranking also accounts for whether or not a compound with a four-mora head root can bear root-initial accent as well as its basic accent. The observed fact is that as in (11), foreign and native compounds are resistant to root-initial accent while as in (12), Sino-Japanese compounds accept it as their variation (note here that preserved accent and penultimate-foot accent are realized at the same position, because each head root has its original lexical accent on the antepenultimate mora):

(11) Variation: Preserved and Penultimate-Foot Accent / *?Root-Initial Accent

a. Foreign Compounds (RIA is entirely unacceptable)

toráburu: (zyuu)(min)+(torá)(buru) / *(zyuu)(min)+(tóra)(buru) 'trouble with neighbors'

adáruto: (yan)(gu)+(adá)(ruto) / *(yan)(gu)+(áda)(ruto) 'young adult'

zyakáruta: (mi)(nami)+(zyaká)(ruta) / *(mi)(nami)+(zyáka)(ruta) 'Southern Djakarta'

asísuto: (kin)(sen)+(así)(suto) / *(kin)(sen)+(ási)(suto) 'financial assistance'

repúrika: (ree)(saa)+(repú)(rika) / *(ree)(saa)+(répu)(rika) 'replicant of racing motorcycle'

tyerísuto: (yuu)(mei)+(tyerí)(suto) / *(yuu)(mei)+(tyéri)(suto) 'famous cellist'

toráberu: (kaku)(yasu)+(torá)(beru) / *(kaku)(yasu)+(tóra)(beru) 'cheap travel'

iémen: (kita)+(ié)(men) / *(kita)+(ie)(men) 'Northern Yemen'

b. Native Compounds (RIA is disfavorable or unnatural)

kudámono: (yu)(nyuu)+(kudá)(mono) / ?(yu)(nyuu)+(kúda)(mono) 'imported fruits'

orígami: (iro)+(orí)(gami) / ?(iro)+(óri)(gami) 'colored folded paper'

hatímaki: (siro)+(hatí)(maki) / ?(siro)+(háti)(maki) 'white headband'

kutúsita: (te)(ami)+(kutú)(sita) / ?(te)(ami)+(kútu)(sita) 'hand-made knitted socks'

habúrasi: (den)(dou)+(habú)(rasi) / ?(den)(dou)+(hábu)(rasi) 'electric toothbrush'

hamígaki: (neri)+(hamí)(gaki) / ?(neri)+(hámi)(gaki) 'toothpaste'

murásaki: (aka)+(murá)(saki) / ?(aka)+(múra)(saki) 'red purple'

hukúroo: (siro)+(hukú)(roo) / ?(siro)+(húku)(roo) 'snowy owl'

(12) Variation: Preserved and Penultimate-Foot Accent / Root-Initial Accent

a. Sino-Japanese Compounds (RIA is perfectly OK)

tetúgaku: (ri)(ron)+(tetú)(gaku) / (ri)(ron)+(tétu)(gaku) 'theoretical philosophy'

rikígaku: (kou)(kuu)+(rikí)(gaku) / (kou)(kuu)+(ríki)(gaku) 'aerodynamics'

syokúbutu: (kan)(you)+(syokú) / (butu)(kan)(you)+(syokú)(butu) 'foliage plant'

kokúmotu: (yu)(nyuu)+(kokú)(motu) / (yu)(nyuu)+(kóku)(motu) 'imported grain'

gakúryoku: (ip)(pan)+(gakú)(ryoku) / (ip)(pan)+(gáku)(ryoku) 'general academic ability'

gakúmon: (mimi)+(gakú)(mon) / (mimi)+(gáku)(mon) 'superficial learning'

itínen: (maru)+(ití)(nen) / (maru)+(íti)(nen) 'a whole year'

etízen: (kita)+(etí)(zen) / (kita)+(éti)(zen) 'Northern Etizen'

b. Foreign Words (irrelevant and omitted)

Like the way in (6), minimal demotion of Max gives a principled account for the difference in variation between the lexical classes, but the above alternations involve interaction of Max to Align (σ', root), not to Non-Finality (PrWd'). In other words, (6) was the case of reranking in (3a, c), and these alternations are the case of reranking in (3a,b):

(13) Minimal Demotion of Max (accent)

a. Foreign and Native Compounds	
Preserved:	Max (accent) >> Non-Finality (μ', σ', Ft') >> Align-L(σ', root) >> Align-R (PrWd, σ')
Penultimate-Footed:	Non-Finality (μ', σ', Ft') >> Max (accent) >> Align-L(σ', root)) >> Align-R (PrWd, σ')
*Root-Initial:	Non-Finality (μ', σ', Ft') >> Align-L (root, σ') >> Max (accent) >> Align-R (PrWd, σ')
b. Sino-Japanese Compounds	
Preserved:	Max (accent) >> Non-Finality (μ', σ', Ft') >> Align-L(σ', root) >> Align-R (PrWd, σ')
Penultimate-Footed:	Non-Finality (μ', σ', Ft') >> Max (accent) >> Align-L(σ', root) >> Align-R (PrWd, σ')
Root-Initial:	Non-Finality (μ', σ', Ft') >> Align-L(σ', root) >> Max (accent) >> Align-R (PrWd, σ')

Specific examples are given below. In (14c), *(zyuu)(min)(tóra)(buru) 'trouble with neighbors' is correctly blocked by its non-local way of demotion from the basic ranking in (14a):

(14) Preserved and Penultimate-Foot Accent / *Root-Initial Accent

a. BASIC RANKING:	Max (accent)	Non-Finality (μ', σ', Ft')	Align-L (σ', root)	Align-R (PrWd, σ')
/zyuumin + toráburu/				
☞ (zyuu)(min) + (torá)(buru)			*	**
(zyuu)(min) + (tóra)(buru)	* !			***
(zyuu)(min) + (tora)(buru)	** !			******

b. Reranking:	Non-Finality (μ', σ', Ft')	Max (accent)	Align-L (σ', root)	Align-R (PrWd, σ')
/zyuumin + toráburu/				
☞ (zyuu)(min) + (torá)(buru)			*	**
(zyuu)(min) + (tóra)(buru)		* !		***
(zyuu)(min) + (tora)(buru)		** !		******

c. *Reranking:	Non-Finality (μ', σ', Ft')	Align-L (σ', root)	Max (accent)	Align-R (PrWd, σ')
/zyuumin + toráburu/				
(zyuu)(min) + (torá)(buru)			* !	**
☞ (zyuu)(min) + (tóra)(buru)		*		***
(zyuu)(min) + (tora)(buru)		** !		******

(15) Preserved and Penultimate-Foot Accent / Root-Initial Accent

a. BASIC RANKING:	Non-Finality (μ', σ', Ft')	Max (accent)	Align-L (σ', root)	Align-R (PrWd, σ')
/riron + tetúgaku/				
☞ (ri)(ron) + (tetú)(gaku)			*	**
(ri)(ron) + (tétu)(gaku)		* !		***
(ri)(ron) + (tetu)(gaku)		** !		******

b. Reranking:	Non-Finality (μ', σ', Ft')	Align-L (σ', root)	Max (accent)	Align-R (PrWd, σ')
/riron + tetúgaku/				
(ri)(ron) + (tetú)(gaku)		* !		**
☞ (ri)(ron) + (tétu)(gaku)		*		***
(ri)(ron) + (tetu)(gaku)		** !		******

Again, possible and impossible variations are correctly captured by the minimal reranking of Max, and the variation of root-initial accent is another case for favoring a reranking-based grammar over that with multiple faithfulness and indexing.

3. Other Arguments for Reranking-Based Subgrammars

3.1. The Maximal Number of Variations

The second argument for reranking theory concerns the number of variations for a single compound. In general, how many forms are allowed maximally when a compound has some variations? To take up NHK ed. (1998) as an example, which is the main source of data for this article, a vast majority of compounds vary in two ways, as we have already seen in (1), (2), (11), and (12), and some cases allow three-way variations such as the ones below. They are not seen in foreign and native compounds but only in Sino-Japanese compounds and foreign words:

(16) Variation: Preserved / Penultimate-Footed / Unaccented

a. Sino-Japanese Compounds

(zei)(mu)(syó) / (zei)(mú)(syo) / (zei)(mu)(syo) 'tax office'

(ki)(tyou)(mén) / (ki)(tyóu)(men) / (ki)(tyou)(men) ' methodical nature'

(seki)(hán) / (sekí)(han) / (seki)(han) 'rice boiled with red beans'

(kasi)(kín) / (kasí)(kin) / (kasi)(kin) 'loan'

(sin)(zitu)(mí) / (sin)(zitú)(mi) / (sin)(zitu)(mi) 'truth'

(ka)(syoku)(syóu) / (ka)(syokú)(syou) / (ka)(syoku)(syou) 'bulimia'

b. Foreign Words

(ré)(koo)(do) / (re)(kóo)(do) / (re)(koo)(do) 'record'

(pai)(o)(nía) / (pai)(ó)(nia) / (pai)(o)(nia) 'pioneer'

(bó)(ryuu)(mu) / (bo)(ryúu)(mu) / (bo)(ryuu)(mu) 'volume'

(a)(máru)(gamu) / (a)(marú)(gamu) / (a)(maru)(gamu) 'amalgam'

(má)(nee)(zyaa) / (ma)(née)(zyaa) / (ma)(nee)(zyaa) 'manager'

(puró)(gura)(maa) / (puro)(gurá)(maa) / (puro)(gura)(maa) 'programmer'

One might naturally wonder why the maximal number is three and not two, four, or five. This question can be answered quite easily in reranking theory: a variant can simply be created either by Max demotion or Max promotion from the position of basic ranking:

(17) Preserved / Penultimate-Footed / Unaccented

a. Reranking:	Max (accent)	Non-Finality (μ', σ', F')	Non-Finality (PrWd')	Align-R (PrWd, σ')
/zéimu + syó/				
☞ (zei)(mu)+(syó)		***	*	
(zei)(mú)+(syo)	* !		*	*
(zéi)(mu)+(syo)	* !		*	**
(zei)(mu)+(syo)	** !			***
b. BASIC RANKING:	Non-Finality (μ', σ', F')	Max (accent)	Non-Finality (PrWd')	Align-R (PrWd, σ')
/zéimu + syó/				
(zei)(mu)+(syó)	*** !		*	
☞ (zei)(mú)+(syo)		*	*	*
(zéi)(mu)+(syo)		*	*	** !
(zei)(mu)+(syo)		** !		***
c. Reranking:	Non-Finality (μ', σ', F')	Non-Finality (PrWd')	Max (accent)	Align-R (PrWd, σ')
/zéimu + syó/				
(zei)(mu)+(syó)	*** !	*		
(zei)(mú)+(syo)		* !	*	*
(zéi)(mu)+(syo)		* !	*	**
☞ (zei)(mu)+(syo)		**	**	***

Note here that both demotion and promotion are minimal, and that is why the maximal number is always three. It is easy to imagine that indexing cannot predict the maximal number.

The maximal three-way variations seem to be true for lexical accent and other phonological phenomena as well as compound accent. This is because any grammar is defined only through (re)ranking, according to the basic tenet of Optimality Theory.

3.2. The Relation of Variations to Diachronic Change

Although there is no doubt that the tree-way variations are maximal, it is also true that the most natural and unmarked number of variations is two. This shows the asymmetry of reranking from the basic position of a faithfulness constraint, and from a diachronic point of view, demotion of a faithfulness constraint is a more natural movement than its promotion

(Yamane and Tanaka (2002)).

Specifically, as a change in progress, *(be)(suto)(tén)* tends to change into *(be)(sutó)(ten)* in (7), *(tai)(òn)(kei)* into *(tai)(on)(kei)* in (8), and *(ri)(ron)(teri)(gaku)* into *(ri)(ron)(tétu)(gaku)* in (15): the latter form of each example is more common in younger generation than the former one. Also, in (17), younger speakers clearly favor the de-accented variant *(zei)(mu)(syo)* over its accented counterpart *(zei)(mu)(syò)* and *(zei)(mù)(syo)*. Of course, of the two accented versions, the preserved accent sounds more archaic than the penultimate-footed accent.

In short, the asymmetry of the direction of reranking follows from the precedence of faithfulness demotion over faithfulness promotion in diachronic change, which results in the fact that most forms vary in two ways, even though maximal possibilities are three in synchronic grammar. Thus, the relation between variation and diachronic change can be accounted for quite clearly in a reranking-based grammar. In multiple faithfulness theory, however, indexing is a kind of lexical specification that seems to be made in a random way or without any principle. So an index-based account such as the one in (9) does not tell us what synchronic variation has to do with diachronic change.

4. Conclusion

This article was devoted to arguing that unlike the theory of indexed multiple faithfulness, reranking theory provides a principled account of why three important facts are as they are in the accentual grammar of Japanese: 1) possible and impossible variations, 2) the maximal number of variations, and 3) the relation of variations to diachronic change. It was also demonstrated that the three facts stem from the minimal nature and unmarked direction of reranking. In a sense, this conclusion is quite natural, because the basic tenet of Optimality Theory is that a grammar is defined only through (re)ranking of constraints.

NOTES

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