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The Canadian Journal of Linguistics / La revue canadienne de
linguistique, 48(1/2), March-June/mars-juin 2003, pp. 1-37 (Article)

Published by Cambridge University Press

DOI: <https://doi.org/10.1353/cjl.2004.0010>

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Systematic Irregularity in Japanese Rendaku: How the grammar mediates patterned lexical exceptions

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1. INTRODUCTION

Rendaku voicing in Japanese has been subject to much recent investigation (McCawley 1968; Vance 1980; Otsu 1980; Itô and Mester 1986, 1998; Mester and Itô 1989), but previous analyses have focussed mainly on exceptions that are due to Lyman's Law (Lyman 1894; Ogura 1910). This article examines exceptions to *rendaku* voicing that are independent of Lyman's Law and which much of the relevant literature either ignores or treats as random and unsystematic (McCawley 1968; Otsu 1980; Vance 1987). I argue that there is in fact a systematicity to these exceptions which can largely be accounted for by the effects of the grammar on possible output forms, if input representations are sufficiently specified.

Exceptions to regular phonological processes are known to often occur in systematic ways; for example, the irregular forms of the English past tense show phonological patterning (Bybee and Slobin 1982; Stemberger and MacWhinney 1988; Myers 1999). Within rule-based theories, exceptions to regular processes have been explained through exception features (Aronoff 1976; Kiparsky 1982). This article proposes that the systematicity of exceptions to *rendaku* voicing can be accounted for in a principled way through featural specification.¹

I wish to thank Doug Pulleyblank for valuable advice and suggestions during all stages of the research that led to this article. I also benefitted from suggestions, assistance, and comments at various stages from Henry Davis, Bryan Gick, Heather Goad, Keiko Ishihara, Haruo Kubozono, Armin Mester, Pat Shaw, Joe Stemberger, and Shin-Ichi Tanaka. I am additionally grateful for valuable comments and suggestions from two anonymous CJL reviewers. All errors are my own.

¹For other approaches to exceptions, see, for instance, Itô and Mester (1995); Giegerich (1999; lexical stratification) or Inkelas and Orgun (1995); Itô and Mester (1995; cophonologies).

The patterning of exceptions in phonology is also addressed by such recent work as Zuraw (2000) and Albright and Hayes (2002), both of whom argue that systematic irregularity can be encoded in the speakers' mental representation of the generalizations of their language. For example, Zuraw (2000:24) observes that exceptions to regular lexical patterns do not occur randomly but are more likely to occur under certain phonological conditions. She proposes that knowledge of lexical regularities occurs in a speaker's grammar in the form of low- and variably-ranked constraints.

Albright and Hayes (2002) propose a learning model through which a speaker might learn the kinds of detailed generalizations that constitute a knowledge of the patterning of exceptions. They give the example of English past tense often changing [ɪ] to [ʌ] when the final consonant is a velar nasal, arguing that English speakers do learn such generalizations. They refer to experimental evidence which demonstrates that speakers can make predictions about the form of novel words based on this kind of detailed knowledge.

If speakers do in fact have knowledge of the patterning that irregular forms take, then our task is to explain how, in current models of grammar, such knowledge is represented. In this context, the goals of this article are to show that (a) exceptions to *rendaku* voicing are strongly systematic and (b) that this systematicity can be encoded in a speaker's knowledge through (i) an appropriate choice of underlying representations and (ii) a grammar that is sensitive to the kinds of phonological environments in which these exceptions are likely or are not likely to occur.

1.1. *Rendaku* voicing and its irregularity

The process of *rendaku* voicing (McCawley 1968; Vance 1980; Itô and Mester 1986, 1998; Mester and Itô 1989) voices the initial obstruent of the second member of a Japanese compound word and applies mainly to compounds of *Yamato* (native Japanese) origin. Although *rendaku* voicing is notorious for its lexical variation and unpredictability (McCawley 1968:87, note 18; Otsu 1980:1; Vance 1987), recent accounts of *rendaku* voicing have tended to abstract away from its irregularity in order to deal with phonologically regular processes such as Lyman's Law, which blocks *rendaku* in a 99.9% predictable fashion (see, e.g., Itô and Mester 1986, 1998). *Rendaku* occurs in about 75% of *Yamato* noun-noun compounds that have the right phonological conditions to trigger it, namely, the presence of an initial voiceless obstruent (that is not followed by a voiced obstruent) in the simplex form of the second member.

The irregularity of *rendaku* is illustrated by pairs such as the following, in which *rendaku* mysteriously fails to occur in one compound but not the other, in spite of apparent phonological, morphological, and semantic similarity between the two compounds:

- (1) a. kuti 'mouth' kuse 'habit' kuti guse 'way of speaking'
 b. asi 'foot, leg' kuse 'habit' asi kuse 'way of walking'

Rendaku voicing occurs in *kuse* 'habit' in (1a) but not in (1b). Both compounds in (1a, b) are unaccented. Both *kuti* and *asi* are bimoraic, end in a high front vowel, and contain voiceless obstruents. There is thus no obvious phonological, morphological, or semantic difference between the two compounds that could account for the lack of voicing in (1b). Moreover, the meanings of the two compounds are parallel, where both compounds have a first member that refers to a body part that is the focus of the particular habit that the compound refers to. Such a semantic near-minimal pair rules out the possibility that morpho-semantic factors could determine whether voicing occurs or not in noun-noun compounds such as these.

Further examples of irregularity in *rendaku* voicing are the compounds in (2) with second member *hara* 'field', which has a pitch accent on the initial mora as a simplex noun. The noun *hara* fails to voice in compounds with the initially accented bimoraic noun *sino* 'bamboo' in (2a) but voices in compounds formed with the initially accented bimoraic nouns *tono* 'nobility' and *matu* 'pine' in (2b, c). All three compounds in (2) have a pitch accent on the second mora.

- (2) a. sino 'bamboo' hara 'field' sino hara 'bamboo field'
 b. tono 'nobility' hara 'field' tono hara 'the nobility'
 c. matu 'pine' hara 'field' matu hara 'pine grove'

In example (3), the noun *kawa* 'skin, hide', which has a pitch accent on the second mora as a simplex noun, resists voicing when it combines with the unaccented bimoraic noun *himo* 'cord' but voices when it combines with the unaccented bimoraic noun *momi* 'unhulled rice'. Both compounds in (3) are unaccented.

- (3) a. himo 'cord' kawa 'skin, hide' himo kawa 'strap'
 b. momi 'unhulled rice' kawa 'skin, hide' momi kawa 'unhulled rice skin'

Seen from the perspective of an individual noun, *rendaku* voicing indeed appears completely unpredictable. But on a global scale, as shall be elaborated on in section 2, *rendaku* voicing will be seen to exhibit a strong degree of patterning.

1.2. Theoretical framework and assumptions

The analysis presented here adopts the constraint-based framework of Optimality Theory (Prince and Smolensky 1993), which derives output forms through a ranked set of violable constraints. Within this framework, I adopt the following assumptions:

Rendaku voicing occurs because of a junctural morpheme whose underlying form is a floating [+voice] feature (Itô and Mester 1986:57, 1998:26).

"Combinatorial Underspecification" (Archangeli and Pulleyblank 1994). Under this proposal, more than one possible input form may occur for one particular combination of features in the output. For a binary feature *F*, any of three possible

input values may occur: (a) +F, (b) –F, or (c) 0F, where both 0F and one of +F or –F will surface with the same value. This hypothesis reflects the principle of “Richness of the Base” in Optimality Theory.

“Lexical prespecification” (Kiparsky 1993; Inkelas 1995; Inkelas, Orgun, and Zoll 1996). This proposal argues that exceptions to phonological processes should be accounted for through prespecification of a feature that blocks the process, rather than by partitioning the grammar into separate cophonologies (Inkelas and Orgun 1995; Itô and Mester 1995) where cophonology A accounts for the regular process and cophonology B for exceptions to the process.

2. Systematicity of exceptions to *rendaku* in noun-noun compounds

We now examine evidence that *rendaku* voicing is not only irregular, but that its irregularity exhibits clear systematicity. Section 2.1 sketches out the nature of *rendaku* voicing. Section 2.2 discusses the corpus of data that was used to identify patterns of *rendaku* voicing and blocking. In sections 2.3 to 2.5, we identify three ways in which *rendaku* blocking is not completely random: (a) the existence of nouns that are immune to *rendaku*, (b) the effects of prosodic size on *rendaku* blocking, and (c) lexical clustering of blocking cases.

2.1. Compounds that are eligible for *rendaku* voicing

Excluded from the process of *rendaku* voicing are (a) *dvandva* or headless compounds which predictably block *rendaku* voicing (see Sakurai 1966:41; Okumura 1980; Otsu 1980; Nishikawa 1987; Vance 1987) and (b) compounds whose second member contains a non-initial voiced obstruent, which predictably blocks voicing through Lyman’s Law (Itô and Mester 1986, 1998). The present analysis considers only compounds that are *eligible* for *rendaku* voicing, that is, non-*dvandva* compounds that have an initial voiceless obstruent and no voiced obstruent in the second conjunct in its surface simplex form.

2.2. Corpus of data

The relevant data, a corpus of 1004 headed *Yamato* noun-noun compounds, was gathered from a list of about 1200 *Yamato* monomorphemic nouns in Martin’s (1987) inventory of *Yamato* nouns, by excluding all nouns that are transparently polymorphemic. Using this database, a list of *rendaku*-eligible noun-noun compounds was developed from entries in the *NHK*² *Japanese Accent and Pronunciation Dictionary* (1999) and the *Shogakukan Progressive Japanese-English Dictionary* (1993). A few further compounds were added from entries in Breen (2003). This corpus reveals two significant patterns in the blocking of *rendaku* voicing, elaborated in sections 2.3 to 2.5. One is a clustering of *rendaku* blocking around groups of nouns that either frequently resist *rendaku* or show complete

²Japanese Broadcasting Corporation

immunity to *rendaku* voicing. The second is a prosodic size threshold which, when exceeded by a compound, disables blocking of *rendaku* by *rendaku* resisters. We begin by examining, in section 2.3, nouns that are immune to *rendaku*.

2.3. Immunity to *rendaku*

As pointed out by Martin (1987) and Vance (1987), a small number of *Yamato* nouns, such as the following, never undergo *rendaku* voicing:

(4)	kita	‘north’	hasi	‘edge’	sita	‘below’
	kasu	‘dregs’	hima	‘leisure’	kemuri	‘smoke’
	kase	‘shackles’	himo	‘string’	katati	‘shape’
	tuti	‘earth’	hime	‘princess’	kamati	‘framework’
	hama	‘beach’	tuya	‘gloss’		

For example, *hime* ‘princess’ only occurs in compounds as *hime*, not **bime* (e.g., *uta hime* (song-princess) ‘songstress’, *oto hime* ‘youngest princess’, *ori hime* ‘woman textile worker’).³

Another *rendaku*-immune noun in (4) is *kasu* ‘dregs’, which, like other *rendaku*-immune nouns, fails to voice in compounds even when the compound is long (i.e., has at least one member that exceeds two moras). In such long compounds, *rendaku* voicing is never blocked, *except* in the case of *rendaku*-immune nouns (see section 2.4). In the compound *abura kasu* ‘oil dregs’, for example, voicing fails to occur, even though its first conjunct *abura* ‘oil’ exceeds two moras. Its lack of voicing cannot be due to any property of the noun *abura*, because all other *rendaku*-eligible compounds of which it is the first member will undergo voicing:

(5)	Second conjunct	Compound		
	sumi	‘ink’	abura zumi	‘marking ink’
	semi	‘locust’	abura zemi	‘a large brown cicada’
	kami	‘paper’	abura gami	‘oilpaper’
	kiri	‘paulownia’	abura giri	‘a type of paulownia’
	kusuri	‘medicine’	abura gusuri	‘ointment’

Other *rendaku*-immune nouns also fail to voice in long compounds:

(6)	First conjunct	Second conjunct	Compound			
	mado	‘window’	kamati	‘framework’	mado kamati	‘window framework’
	kami	‘hair’	katati	‘shape’	kami katati	‘hairdo’
	kao	‘face’	katati	‘shape’	kao katati	‘features, looks’
	sina	‘goods’	katati	‘shape’	sina katati	‘quality and shape’

³In *rendaku* voicing, /h/ voices to /b/. The phoneme /h/ behaves in Japanese like an obstruent whose voiced counterpart is /b/.

mizu	'water'	kemuri	'smoke'	mizu kemuri	'mist over water'
sio	'salt; tide'	kemuri	'smoke'	sio kemuri	'spray of seawater'
sunā	'sand'	kemuri	'smoke'	sunā kemuri	'cloud of sand dust'
yuki	'snow'	kemuri	'smoke'	yuki kemuri	'spray of snow'
yu	'hot water'	kemuri	'smoke'	yu kemuri	'steam'
tuti	'earth'	kemuri	'smoke'	tuti kemuri	'cloud of dust'
ti	'blood'	kemuri	'smoke'	ti kemuri	'spurt of blood'
sira-yuki	'white snow'	hime	'princess'	sira-yuki hime	'Snow White'
tatu-ta	'standing field'	hime	'princess'	tatu-ta hime	'goddess of autumn'

These facts distinguish nouns like *kasu* 'dregs' from "*rendaku* resisters", discussed below, which, even if they resist voicing in short compounds, always voice in long compounds (see section 2.4.2).

2.4. *Rendaku* resisters and prosodic size effect

A second class of nouns also resists *rendaku* voicing, but unlike *rendaku*-immune nouns, these nouns (a) do undergo voicing in a minority of "short-short" compounds (see section 2.4.1) and (b) always voice in long compounds. Excluding the cases of *rendaku*-immune nouns (above), exceptions to *rendaku* voicing occur solely in compounds in which neither member exceeds two moras. Following Kubozono (1995, 1996), I adopt the label "short-short" to refer to this type of compound. We first examine the behaviour of some *rendaku* resisters in short-short compounds.

2.4.1. *Blocking of rendaku by resisters in short-short compounds*

In (7) and (8) are examples of short-short compounds with the second member *kusa* 'grass'. We find 16 such compounds that do not voice (7), and only three that do (8). We can thus label *kusa* a "*rendaku* resister" because it resists voicing in most but not all short-short compounds in which it occurs.

(7) Short-short compounds with *kusa* that do not voice:

First conjunct	Compound
aki 'autumn'	aki kusa 'autumn plants'
ao 'green'	ao kusa 'green grass'
buta 'pig'	buta kusa 'pig grass'
haru 'spring'	haru kusa 'spring grass'
huyu 'winter'	huyu kusa 'winter grass'

ira	'thorn'	ira kusa	'nettle'
kara	'Chinese'	kara kusa	'arabesque'
miti	'path'	miti kusa	'tarrying'
mizu	'water'	mizu kusa	'water grass'
nana	'seven'	nana kusa	'grasses'
natu	'summer'	natu kusa	'summer grass'
siba	'brushwood'	siba kusa	'lawn'
sita	'under'	sita kusa	'undergrowth'
tami	'people'	tami kusa	'the populace'
туру	'vine'	туру kusa	'creeper, vine'
tuyu	'dew'	tuyu kusa	'spiderwort'

- (8) Short-short compounds with *kusa* that voice:

First conjunct	Compound
no 'field'	no gusa 'wild grasses'
mo 'duckweed'	mo gusa 'water plants'
ti 'thousand'	ti gusa 'great variety of flowering plants'

The noun *kuse* 'habit' occurs in fewer compounds than *kusa* 'grass' but also robustly resists *rendaku*, failing to voice in six out of eight short-short compounds.

- (9) Short-short compounds with *kuse* that do not voice:

First conjunct	Compound
kami 'hair'	kami kuse 'hairstyle'
asi 'foot'	asi kuse 'way of walking'
nana 'seven'	nana kuse 'seven grasses'
te 'hand'	te kuse 'sticky fingered'
siri 'buttocks'	siri kuse 'promiscuity'
hito 'one'	hito kuse 'trait'

- (10) Short-short compounds with *kuse* that voice:

First conjunct	Compound
kuti 'mouth'	kuti guse 'way of speaking'
sake 'sake'	sake guse 'drinking habit'

The noun *saki* 'tip'⁴ looks almost like a *rendaku*-immune noun, blocking voicing in all known noun-noun compounds except for the reduplicated form *saki zaki* 'distant future':

- (11) All non-reduplicated forms with second conjunct *saki* block voicing:

First conjunct	Compound
asi 'foot, leg'	asi saki 'foot tip'
ha 'edge'	ha saki 'blade edge'
hake 'brush'	hake saki 'brush tip'
hana 'nose'	hana saki 'tip of nose'

⁴Excluded from this list are place names and personal names derived from the noun *saki* in which it means 'peninsula'. Examples are the town *Miyazaki* and the surname *Tanizaki*.

haru	'spring'	haru saki	'early spring'
he	'prow, bow'	he saki	'prow'
hi	'fire'	hi saki	'flame tips'
ho	'cheek, ear'	ho saki	'ear tip'
kado	'gate'	kado saki	'entrance door'
kata	'shoulder'	kata saki	'shoulder'
kuti	'mouth'	kuti saki	'lips'
mise	'shop'	mise saki	'shop front'
niwa	'garden'	niwa saki	'in the garden'
noki	'eaves'	noki saki	'under eaves'
sio	'tide'	sio saki	'rising of tide'
sita	'tongue'	sita saki	'tongue tip'
tabi	'trip'	tabi saki	'while travelling'
te	'hand'	te saki	'fingertips; minion (in gang)'
tume	'claw'	tuma saki	'tiptoe'
tutu	'pipe'	tutu saki	'nozzle'
ya	'arrow'	ya saki	'arrowhead'
yubi	'finger'	yubi saki	'fingertip'

The nouns *hara* 'field' (12)–(13), *ki* 'tree' (14)–(15), and *te* 'hand' (16)–(17) block *rendaku* in more than half of the short-short compounds in which they occur.

- (12) Short-short compounds with *hara* 'field' that block voicing:

First conjunct	Short-short compound
siba 'brushwood'	siba hara 'brushwood field'
suna 'sand'	suna hara 'desert'
sino 'bamboo'	sino hara 'bamboo field'
no 'field'	no hara 'field'
sasa 'bamboo grass'	sasa hara 'bamboo.grass field'
hagi 'clover'	hagi hara 'reedy field'
kawa 'river'	kawa hara 'dry river bed'
kusa 'grass'	kusa hara 'grass-covered plain'

- (13) Short-short compounds with *hara* 'field' that voice:

First conjunct	Compound
una 'ocean'	una bara 'ocean'
tono 'nobility'	tono bara 'the nobility'
matu 'pine'	matu bara 'pine grove'
kuwa 'mulberry'	kuwa bara 'mulberry field'
kuni 'country'	kuni bara 'spacious country'
yatu 'guy'	yatu bara 'guys'

- (14) Short-short compounds with *ki* 'tree, wood' that block voicing:

First conjunct	Compound
kazi 'oar'	kazi ki 'paper mulberry'
maru ki 'circle'	maru ki 'log'
kubi 'neck'	kubi ki 'yoke'
hizi 'elbow'	hizi ki 'bracket'

oya	'parent'	oya ki	'stock'
moto	'original'	moto ki	'original tree-trunk'
nama	'live'	nama ki	'live tree'
nami	'average'	nami ki	'row of trees'

- (15) Short-short compounds with *ki* 'tree, wood' that voice:

First conjunct	Compound
yoko 'side'	yoko gi 'wooden bar of a gate'
yana 'fish weir'	yana gi 'willow'
ude 'arm'	ude gi 'bracket'
ti 'thousand'	ti gi 'ornamental crossed rafter ends on shrine gables'
yama 'mountain'	yama gi 'mountain trees'

- (16) Compounds with *te* 'hand' that block voicing:

First conjunct		Compound	
oku	‘interior’	oku te	‘a child slow to grow up’
ura	‘rear’	ura te	‘rear’
yoko	‘side’	yoko te	‘side’ (also <i>yoko de</i>)
iwa	‘rock’	iwa te	(placename)
yama	‘mountain’	yama te	‘sickle’
sita	‘below’	sita te	‘lower position’
uwa	‘upper’	uwa te	‘more qualified person’
kara	‘empty’	kara te	‘karate’
simo	‘lower’	simo te	‘lower part’
migi	‘right’	migi te	‘right hand’
hira	‘flat; palm’	hira te	‘palm’
sake	‘sake’	saka te	‘money for drinking’

- (17) Compounds with *te* 'hand' that voice:

First conjunct		Compound
hito	'person'	hito de 'help; starfish'
kumo	'spider'	kumo de 'crossing of many streets; confusion'
moto	'origin'	moto de '(financial) capital'
kuma	'bear'	kuma de 'gardening tool'

2.4.2. Failure of blocking by resisters in long compounds

We have just observed that *rendaku*-resisting nouns robustly resist *rendaku* in short-short compounds; however, they differ from *rendaku*-immune nouns in two ways: (a) they do not block voicing in 100% of cases; (b) they never block *rendaku* when they occur in long compounds. Not all *rendaku* resisters actually occur in long compounds but those that do never fail to voice. Note that the important long compounds for us to examine here are those with a long first member and a short second member that resists *rendaku* in short-short compounds. Compounds with a long second member always undergo voicing unless they are *rendaku*-immune. The following data show long compounds whose second conjunct is one of the

rendaku-resisting nouns examined in section 2.4.1. In these data, all first conjuncts exceed two moras:

(18)	First conjunct	Second conjunct	Compound
	onna 'woman'	kuse 'habit'	onna guse 'philandering'
	hituzi 'sheep'	kusa 'grass'	hituzi gusa 'sheep grass'
	hotaru 'firefly'	kusa 'grass'	hotaru gusa 'firefly grass'
	enokoro 'foxtail' (bound morpheme)	kusa 'grass'	enokoro gusa 'foxtail grass'
	haha-ko 'mother and child'	kusa 'grass'	haha-ko gusa 'cottonweed'
	matu 'wait' + yoi 'evening'	kusa 'grass'	matu-yoi gusa 'evening primrose'
	mo 'duckweed' + sio 'salt'	kusa 'grass'	mo-sio gusa 'seaweed for salt'
	ne 'root' + nasi 'without'	kusa 'grass'	ne-nasi gusa 'duckweed; transient person'
	ao-una 'blue ocean'	hara 'field'	ao-una bara 'the blue sea'
	tokiwa 'eternity'	ki 'tree'	tokiwa gi 'evergreen'

To add to the data above, we can also examine long compounds whose second conjunct is a noun that blocks voicing in at least some short-short compounds. The examples below illustrate the voicing behaviour of the following nouns in short-short compounds: *tori* 'bird' (19), *siru* 'soup' (20), *kumo* 'cloud' (21), *kawa* 'hide' (22), and *tama* 'ball, jewel' (23). A few compounds with Sino-Japanese first members are also included for comparison (marked "SJ"⁵). Henceforth the notation "N2" is used to denote the second conjunct of a noun-noun compound.

(19) Compounds with N2 *tori* 'bird':

a. Voicing in eight compounds:

natu 'summer'	natu dori 'summer bird'
koma 'shoogi piece'	koma dori 'robin'
huyu 'winter'	huyu dori 'winter bird'
umi 'sea'	umi dori 'sea bird'
yama 'mountain'	yama dori 'mountain bird'
oya 'parent'	oya dori 'parent bird'
osi 'mandarin duck'	osi dori 'mandarin duck'
tutu 'pipe'	tutu dori 'oriental cuckoo'

b. Blocking in two compounds:

mizu 'water'	mizu tori 'water bird'
niwa 'garden'	niwa tori 'chicken'

⁵Compounds with Sino-Japanese members constitute data that is considered supplemental to the main body of data used here. This is because *rendaku* occurs much more frequently in native than in non-native vocabulary (see Martin 1952, Okumura 1980, Vance 1996, Ohno 2000).

(20) Compounds with N2 *siru* 'soup':

a. Voicing in three compounds:

buta	'pig'	buta ziru	'pork soup'
imo	'potato'	imo ziru	'potato soup'
hana	'nose'	hana ziru	'nasal mucus'

b. Blocking in one compound:

miso	'beanpaste'	miso siru	'miso soup'
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(21) Compounds with N2 *kumo* 'cloud':

a. Voicing in eight compounds:

natu	'summer'	natu gumo	'summer cloud'
kaze	'wind'	kaza gumo	'elements'
hata	'flag'	hata gumo	'flag-shaped cloud'
asa	'morning'	asa gumo	'morning cloud'
yoko	'side'	yoko gumo	'cloudbank'
yuki	'snow'	yuki gumo	'snow cloud'
wata	'cotton'	wata gumo	'cotton cloud'
ame	'rain'	ama gumo	'rain clouds'

b. Blocking in two compounds:

mura	'clump'	mura kumo	'gathering clouds'
yami	'darkness'	yami kumo	'at random'

(22) Compounds with N2 *kawa* 'skin, hide, leather':

a. Voicing in eight compounds:

momi	'unhulled rice'	momi gawa	'rice skin'
hana	'nose'	hana gawa	'toe cover for clogs'
ke	'hair'	ke gawa	'pelt'
same	'shark'	same gawa	'sharkskin'
se	'back'	se gawa	'leather bound'
sika	'deer'	sika gawa	'deerskin'
soko	'bottom'	soko gawa	'sole leather'
wani	'alligator'	wani gawa	'alligator skin'

b. Blocking in five compounds:

ara	'chaff'	ara kawa	'husk, bark, et al'
sugi	'cedar'	sugi kawa	'cedar bark'
ue	'upper'	uwa kawa	'scum'
himo	'cord'	himo kawa	'strap, flat thong'
tume	'claw'	tuma kawa	'toe cover for clogs'

(23) Compounds with *tama* 'ball, jewel':

a. Voicing in 12 compounds:

mayu	'cocoon'	mayu dama	'New Year's decoration'
oya	'parent'	oya dama	'boss'
hune	'boat'	huna dama	'boat ball'
yuki	'snow'	yuki dama	'snow ball'
kimo	'liver; courage'	kimo dama	'spirit'

ame ‘candy’	ame dama ‘candy ball’
hi ‘fire’	hi dama ‘falling star’
me ‘eye’	me dama ‘eyeball’
tosi ‘year’	o-tosi dama ‘New Year’s present’
te ‘hand’	te dama ‘beanbag’
ya ‘arrow’	ya dama ‘arrows and bullets’
yu ‘hot water’	yu dama ‘bubbles in boiling water’

b. Blocking in three compounds:

mizu ‘water’	mizu tama ‘water ball’
kani ‘crab’	kani tama ‘Chinese-style omelette with crabmeat.’
nori ‘dried seaweed’	nori tama ‘seaweed seasoning’

Out of the 52 short-short compounds listed above, blocking occurs in 13 cases, or about 25% of the time. We now examine compounds in which the same nouns occur as N2, but this time, with long first members.

(24) Long compounds with N2 *tori* ‘bird’:

First Conjunct	Compound
momo-ti ‘hundred thousand’	momo-ti dori ‘all sorts of birds’
naga-o ‘long tail’	naga-o dori ‘fowl’
o-naga ‘long tail’	o-naga dori ‘cock’
hi-kui ‘fire-eating’	hi-kui dori ‘cassowary’
iso ‘seashore’ + hiyo (bound morpheme)	iso-hiyo dori ‘blue rockthrush’
ahoo ‘fool’ (SJ)	ahoo dori ‘albatross’
itiban ‘first’ (SJ)	itiban dori ‘cockcrow’
kan ‘leisure’ + ko ‘old’ (SJ)	kan-ko dori ‘bird announcing lack of customers’

(25) Long compounds with N2 *tama* ‘ball, jewel’:

kusuri ‘medicine’	kusu dama ‘ornamental scent bag’
hyooroku (bound morpheme) (SJ)	hyooroku dama ‘simpleton’
iti-en ‘one yen’ (SJ)	iti-en dama ‘one-yen coin’
teppoo ‘gun’ (SJ)	teppoo dama ‘gunshot’
nankin ‘Nanjing’ (SJ)	nankin dama ‘glass beads’
zyuu-en ‘ten yen’ (SJ)	zyuu-en dama ‘ten-yen coin’
kansyaku ‘passion’ (SJ)	kansyaku dama ‘fit of anger’

(26) Long compounds with N2 *siru* ‘broth’:

sizimi ‘corbicula’	sizimi ziru ‘corbicula broth’
inaka ‘countryside’	inaka ziru ‘country broth’
tanuki ‘raccoon’	tanuki ziru ‘raccoon broth’
usio ‘saltwater’	usio ziru ‘saltwater broth’

(27) Long compounds with N2 *kumo* ‘cloud’:

uroko ‘fishscale’	uroko gumo ‘cirrocumulus’
kinoko ‘mushroom’	kinoko gumo ‘mushroom cloud’
madara ‘spots’	madara gumo ‘spotted cloud’

iwasi ‘sardine’	iwasi gumo ‘cirrocumulus’
hituzi ‘sheep’	hituzi gumo ‘sheep cloud’
nyuudoo ‘monk’ (SJ)	nyuudoo gumo ‘cumulonimbus’
hoosyanoo ‘radioactivity’ (SJ)	hoosyanoo gumo ‘radioactive cloud’
hikooki ‘airplane’ (SJ)	hikooki gumo ‘vapour trail’

(28) Long compounds with N2 *kawa* ‘hide’:

omote ‘front; outside’	omote gawa ‘epidermis’
tikara ‘strength’	tikara gawa ‘stirrup’
huton ‘futon’ (SJ)	huton gawa ‘quilting’

(29) Long compound with N2 *tori* ‘bird’:

miyako ‘shrine’	miyako dori ‘oystercatcher’
-----------------	-----------------------------

Out of the 31 long compounds listed in (24)–(29), blocking never occurs. This is in contrast to the measurable rate of blocking (25%) among the 52 short-short compounds with the same second conjuncts in the previous set of data (19)–(23). These results suggest that when we factor out compounds with *rendaku*-immune nouns, blocking is disabled in long compounds.

2.5. Clustering of blocking around *rendaku* resisters

We saw from the data in (7) through (13) that certain nouns such as *kusa* ‘grass’, *hara* ‘field’, *kuse* ‘habit’, *te* ‘hand’, *ki* ‘tree’, and *saki* ‘tip’ block voicing in compounds more frequently than not. On a global scale, cases of *rendaku* blocking do in fact cluster around particular lexical items rather than being randomly dispersed.

Factoring out compounds with *rendaku*-immune nouns, most cases of *rendaku* blocking in short-short noun-noun compounds occur among compounds headed by a small number of *rendaku* resisters: nouns that voice in only a small minority of compounds. From the 781 short-short compounds in our corpus, subtracting 49 that are *rendaku*-immune leaves 732. Of these, 167 block *rendaku*. Eighty-three, or 50%, of these cases occur among just eight nouns, as shown in Table 1.

Table 1: Blocking cases among eight *rendaku*-resisting nouns

Noun	Blocking cases	Total short-short compounds
kusa ‘grass’	16	19
hara ‘field’	8	14
kuse ‘habit’	6	8
kawa ‘skin’	6	14
saki ‘tip’	22	22
ki ‘tree, wood’	8	13
ko ‘child’	5	13
te ‘hand’	12	16
Total	83	119

In addition to these particular nouns, there are other *Yamato* nouns that occur in fewer compounds, and which also resist voicing. For example, the nouns given in Table 2 never voice in known compounds. (The number of compounds in which the noun occurs as a second conjunct is given following each noun.)

Table 2: Further nouns that resist *rendaku* voicing

Nouns		Number of Compounds
kami	'temple of head'	1
kami	'above'	2
kasa	'shade'	1
kata	'shoulder'	1
kera	'cricket'	1
kuso	'dung'	3
simo	'frost'	1
sio	'tide'	2
siro	'materials'	2
suso	'cliff'	1
take	'measure'	2
tami	'people'	1
tami	'people'	1
tuyu	'dew'	2

Because each of these nouns (Table 2) occurs in only a few compounds, all of them short-short, it is difficult to tell if it is behaving as a *rendaku* resister or as a *rendaku*-immune noun. The actual number of nouns we can call *rendaku* resisters is therefore difficult to determine, since many compounds have second conjuncts that only occur in one or two compounds. The nouns in Table 2 could be either *rendaku*-immune or *rendaku*-resistant. I suggest that there is a class of nouns of indeterminate number that resist voicing of which the eight nouns listed in Table 1 are those that occur in enough compounds to determine whether they are *rendaku*-immune or *rendaku*-resistant. Whether or not these nouns have any other common characteristics has yet to be determined.

The eight *rendaku*-resisting nouns listed in Table 1 each occur in at least eight noun-noun compounds. If we look for other *rendaku*-eligible nouns that occur as a second conjunct in at least as many short-short compounds, we find 17 others, listed below. Thirteen of these, shown in Table 3, voice in every compound in which they occur. The remaining four, shown in Table 4, voice in 36 out of 48 compounds.

The set of nouns in Table 1 (83 cases of blocking in 119 compounds) added to the set in Table 3 (zero cases of blocking in 140 compounds) and Table 4 (12 cases of blocking in 48 compounds) form a set of 25 *rendaku*-eligible nouns that account for a total of 307 compounds. Of these, 119, or 39%, occur with the eight *rendaku*-resisting nouns in Table 1. These eight nouns account for 83 out

Table 3: Nouns that voice in every compound

Nouns	Number of Compounds
huro ‘bath’	9
hara ‘belly’	8
hune ‘boat’	9
hone ‘bone’	7
hana ‘flower’	8
hue ‘flute’	12
kane ‘metal’	9
kuti ‘mouth’	15
soko ‘bottom’	10
hako ‘box’	16
kami ‘paper’	16
hito ‘person’	9
kata ‘shape’	12
Total	140

Table 4: Nouns that voice in most compounds in which they occur

Noun	Voicing cases/ Total compounds
tori	8/10
kumo	8/10
kawa	8/13
tama	12/15

of 95 cases of blocking among the 307 compounds in Tables 1, 3, and 4. The resistant nouns in Table 1 have no obvious phonological or semantic feature that distinguishes them from the non-resistant nouns in Tables 3 or 4. For example, both *kuse* ‘habit’, a resister, and *kami* ‘paper’, which always voices, have final pitch accent. Both *kusa*, which resists *rendaku*, and *kuti* ‘mouth’, which robustly voices, have two voiceless obstruents. Examples of compounds formed with *kami* ‘paper’, one of the nouns listed in Table 3 that does not block voicing, are given in (30).

(30)	First conjunct	Compound
	kasa ‘umbrella’	kasa gami ‘oiled umbrella paper’
	iro ‘colour’	iro gami ‘coloured paper’
	hari ‘needle’	hari gami ‘label’
	tane ‘seed’	tane gami ‘silkworm egg card’
	tiri ‘dust’	tiri gami ‘kleenex’
	yoko ‘side’	yoko gami(-yaburi) ‘wayward’

wara	‘straw’	wara gami	‘rice paper’
ita	‘board’	ita gami	‘cardboard’
ao	‘green, blue’	ao gami	‘green paper’
ue	‘above’	uwa gami	‘wrapper’
kata	‘type’	kata gami	‘paper dress pattern’
hasi	‘chopsticks’	hasi gami	‘chopstick paper’
nosi	‘dried sea-ear’	nosi gami	‘gift wrapping paper’
kabe	‘wall’	kabe gami	‘wallpaper’
obi	‘belt’	obi gami	‘wrapper’
hana	‘nose’	hana gami	‘tissue’

A summary of the lexical clustering of *rendaku* blocking among short-short noun-noun compounds is given in Table 5. Exceptions to *rendaku* voicing are not randomly dispersed, but cluster around particular nouns. In section 3, we examine how this kind of lexically based systematicity of exceptions can be accounted for through the appropriate choice of input representation for nouns that resist or are immune to *rendaku* voicing.

Table 5: Summary of blocking patterns among *Yamato* noun-noun compounds

Classification of second conjunct	Total no. of short compounds	No. of cases of voicing in short compounds	Total no. of long compounds	No. of cases of voicing in long compounds
– <i>rendaku</i> -immune (never undergoes <i>rendaku</i> voicing)	49	0 (0%)	14	0 (0%)
– <i>rendaku</i> -resistant (usually blocks voicing in short compounds but never in long compounds)	119	36 (30%)	13	13 (100%)
–unknown type (see Table 2) (never undergoes <i>rendaku</i> voicing but occurs in few compounds; likely either <i>rendaku</i> -resistant or <i>rendaku</i> -immune)	21	0 (0%)	0	0 (0%)
–non-resistant (usually voices in compounds)	580	522 (90%)	196	196 (100%)

3.1. Exceptionless blocking by *rendaku*-immune nouns

⁶I adopt here a version of Optimality Theory in which featural identity is determined by the faithfulness constraints MAX and DEP (see McCarthy and Prince 1998, Lombardi 1995b, 1998, Myers 1998, Pulleyblank 1996). DEP constraints require that some feature F' in the output have a corresponding feature F in the input or base form. MAX constraints require that some feature F in the input or base form have a corresponding feature F' in the

Under the present proposal, the initial obstruent of a *rendaku*-immune noun has a path of association to a [–voice] feature in the input; the initial obstruent of any other noun eligible for *rendaku* has no path of association to any voicing feature in the input. Thus, any output candidate derived from a non-immune noun will equally violate DEP-PATH-FEATURE whether it has voicing or not, since neither [+voice] nor [–voice] is linked in the input (see (43)–(44)). However, DEP-PATH-FEATURE will rule out a candidate with initial voicing for a *rendaku*-immune noun, since only a candidate with initial [–voice] will satisfy this constraint. Since *rendaku*-immune nouns block voicing without exception, I take DEP-PATH-FEATURE to be undominated.

We can account for the surfacing of the [+voice] feature of the junctural morpheme in non-blocking cases through a MAX faithfulness constraint for the feature [+voice], MAX[+VOICE] in (34a), where MAX[+VOICE] outranks MAX[–VOICE].

- (34) a. MAX[+VOICE]: For every [+voice] feature in the input, there is a corresponding [+voice] feature in the output.
 b. MAX[–VOICE]: For every [–voice] feature in the input, there is a corresponding [–voice] feature in the output.

- (35) MAX[+VOICE] >> MAX[–VOICE]

The tableau in (36) shows how blocking occurs to satisfy the constraint DEP-PATH-FEATURE in compounds such as *abura kasu* ‘oil dregs’.

- (36)

		DEP-PATH-FEATURE	MAX[+VOICE]	MAX[–VOICE]
	<div style="text-align: center;">[–voi]</div> <div style="text-align: center;"> </div> <div style="text-align: center;">abura + [+voi] + kasu</div>			
✖ a.	<div style="text-align: center;">[–voi]</div> <div style="text-align: center;"> </div> <div style="text-align: center;">abura-kasu</div>		*	
b.	<div style="text-align: center;">[+voi]</div> <div style="text-align: center;"> </div> <div style="text-align: center;">abura-gasu</div>	*!		*

As shown, the *rendaku*-immune noun blocks voicing because the velar consonant has a specified, linked [–voice] feature in the input. Candidate (a) satisfies DEP-PATH-FEATURE since a linked [–voice] feature occurs in the input. Candidate (b) violates DEP-PATH-FEATURE since no linked [+voice] feature occurs in the input. The [+voice] feature of the junctural morpheme is not linked to any root node

output. By the term ‘feature’ I include here not just phonological features but also nodes on a feature tree, paths between features and nodes (as defined in Archangeli and Pulleyblank 1994), and nodes of prosodic structure. I do not posit faithfulness constraints of the IDENT type, which compare a whole segment-sized output with a whole segment-sized input (see Pater 1998).

in the input. This kind of account of lexical exceptions to *rendaku* follows the proposal of Inkelas, Orgun, and Zoll (1996), who account for exceptions to regular phonological processes through prespecification of features. I shall delay until section 3.2.2 an illustration of how the constraint MAX[+VOICE] becomes relevant in choosing the optimal candidate.

3.2. Blocking by *rendaku* resisters

Because the nouns that we are calling *rendaku* resisters block voicing only in short-short compounds, such blocking must be due to a phonological difference between long and short compounds in addition to any lexical feature that distinguishes *rendaku* resisters from non-resisters. Accordingly, an analysis of these cases must take account of the differing prosodic structures of long and short compounds.

3.2.1. Prosodic differences between long and short compounds and Positional Markedness

In short-short compounds, neither conjunct exceeds a bimoraic Foot. The primacy of the bimoraic Foot in Japanese phonology is well known (see, for example, Poser 1990). Itô (1991) and Hewitt (1994) show that truncations to a bimoraic Foot occur in several situations in the language. One is in foreign borrowings, where words are often truncated to one bimoraic Foot per morpheme when imported into the language. For example ‘word processor’ becomes *waa-puro*, ‘remote control’ becomes *rimo-kon*, and ‘pocket monster’ becomes *poke-mon*. In addition, personal names are often truncated to fit a bimoraic template before the hypocoristic suffix *-tyan*, or after the hypocoristic prefix *o-*. For example, *Keiko* can become *Kei-tyan* or *O-kei* and *Hiroko* can become *Hiro-tyan*, or *O-hiro*. Itô, Kitagawa, and Mester’s (1992) examination of “*Zyuuzya-go*”, the Japanese secret language used by jazz musicians, gives further support for the bimoraic Foot as the canonical prosodic unit in Japanese. They argue convincingly that the bimoraic Foot is the template into which an original word is mapped to derive the corresponding word in the secret language.

An important part of the analysis is Kubozono’s (1999) proposal that in Japanese, every Foot is entirely contained within the same morpheme. In his analysis of compound accent, two adjacent monomoraic morphemes will not form a single bimoraic Foot. Instead, each will be parsed as a separate degenerate Foot. Following analyses of Japanese prosody in Poser (1984, 1990), Tateishi (1989), Itô (1991), Mester (1990), Itô and Mester (1992), Itô, Kitagawa, and Mester (1992) and Kubozono (1995), let us further adopt the position that a Prosodic Word must maximally consist of two Feet (37a). Where binary Feet cannot be achieved, degenerate, monomoraic Feet are formed, as in (37b–c).

(37) Licit Prosodic Words for short-short compounds:

Short-short compounds will then be dominated by a single Prosodic Word, as in (37). Compounds in which both members are monomoraic will consist of two degenerate Feet dominated by a Prosodic Word.

Long compounds, on the other hand, are prosodically too large to be dominated by a single Prosodic Word, given our hypothesis that a Prosodic Word can contain at most two bimoraic Feet. Long compounds of the form $3\mu + 2\mu$ and $2\mu + 3\mu$ are shown in (38). The crucial assumption is that all prosodic material is dominated by a Prosodic Word. In (38), a single Prosodic Word could not dominate both conjuncts because it would consist of three Feet: two bimoraic Feet plus a degenerate monomoraic Foot.

(38) Licit Prosodic Words for long compounds:

Our hypothesis that long compounds differ prosodically from short compounds is supported by independent evidence from the pitch-accent behaviour of Japanese compounds. Kubozono (1995, 1996) and Alderete (1999) show that the pitch accent pattern of a long compound is completely predictable. On the other hand, the pitch accent pattern of a short-short compound cannot be predicted from the input forms of its constituents. According to Haruo Kubozono (personal communication), a random 70% of $2\mu + 2\mu$ compounds are unaccented; most of the remaining 30% have antepenultimate accent, and the rest have unpredictable accent. As for $2\mu + 1\mu$ compounds, a random 50% are unaccented; the other 50% are initially accented.

The following example illustrates the unpredictability of pitch accent in short-short compounds. When the accented noun *te* 'hand' combines in a compound with each of the following final-accented bimoraic nouns, the accent patterns of the resulting compounds will vary in spite of the fact that the inputs have identical accent patterns in all cases (pitch-accent indicated by acute accent):

(39) Second conjunct Compound

kusé	‘habit’	te kúse (penult accent)	‘light-fingeredness, thieving’
hatá	‘loom’	té bata (initial accent)	‘hand loom’
kiwá	‘brink’	te giwa (unaccented)	‘skill’
hatá	‘flag’	te bata (unaccented)	‘hand flag, semaphore flag’

The predictability of accent in long noun-noun compounds is accounted for by Alderete (1999:85ff), following analyses by Poser (1990) and Kubozono (1995). Predictable default accent in a long compound obeys a prosodic requirement of three or more moras on the noun that receives accent. Default accent does not occur in short-short compounds, which have no member that is three moras or longer. Alderete proposes that default accent in a Japanese long compound occurs on a constituent that forms a prosodic head, which he analyses as a Prosodic Word. In his analysis, a prosodic head must dominate at least a bimoraic Foot plus further prosodic material. An implication of his analysis is that short-short compounds never receive default accent because neither constituent qualifies as a prosodic head, being less than a Prosodic Word. This kind of analysis of Japanese compound accentuation is consistent with the present proposal that long compounds consist of a separate Prosodic Word for each constituent but short-short compounds do not.

Adopting such a proposal enables us to explain why *rendaku* blocking (other than by *rendaku*-immune nouns) occurs only in short compounds. The relevant generalization is that *rendaku* voicing is freely permitted to occur in a syllable that is at the left edge of a Prosodic Word. In short compounds, as shown in (37), the initial obstruent of the second conjunct is not at the left edge of a Prosodic Word; in long compounds, shown in (38), it is. In other words, the [+voice] feature of the junctural morpheme is permitted more freely in what we could call a “prominent” position. Beckman (1998:vii), in her examination of phonological effects that she explains through “Positional Faithfulness”, identifies “psycholinguistically prominent positions such as roots, root-initial syllables, stressed syllables, and syllable onsets”. Her claim is that these kinds of positions differ from non-prominent positions with respect to faithfulness to an underlying form.

The generalization that *rendaku* surfaces more readily at the edge of a Prosodic Word could be captured either as Positional Faithfulness (Alderete 1995; Jun 1995; Lombardi 1995a; Steriade 1995; Beckman 1995; Casali 1996; Beckman 1998) or as Positional Markedness (Zoll 1998; Kager 2001; Smith 2002). In the former view, “Head-Dependence” (Alderete 1995) requires that the voicing feature that occurs on an obstruent at the left edge of the second conjunct have some correspondent in the input, when that edge is a prosodically strong position (i.e., the edge of a Prosodic Word in a long compound). In the latter view, the marked [+voice] feature is permitted more freely in the prosodically strong position that occurs at the left edge of the second conjunct of a long compound.

Although either of the two approaches is possible for the case at hand, I will adopt Positional Markedness here for the following reasons. Given our

hypothesis that the morpheme boundary in a long compound is in a prosodically stronger position than in a short-short compound, a Positional Faithfulness account would need to view long compounds as being more faithful to the input than short compounds. Yet the fact that blocking in short compounds clusters around particular lexical items suggests that it is some lexically specified feature such as [–voice] that effects blocking. Under Positional Faithfulness, we ought to expect faithfulness to such a feature to occur more readily in long compounds than in short compounds. What appears to be happening, however, is the opposite, since it is short compounds rather than long ones that are showing lexical idiosyncrasy.

It is also to be noted that in the prosodic structure of Japanese compounds that we have proposed, the left edge of the whole compound is also at the left edge of a Prosodic Word; however, *rendaku* voicing never occurs in that position. If we consider the junctural morpheme as an affix, we can account for its linear surface position through De Lacy's (1999) Correspondence Theory of Morpheme Order, where the direction of attachment of an affix to a morpheme is determined by an empty position in the input form of a morpheme. Under De Lacy's proposal, N2 of a Japanese compound would have an empty position at the left edge of its input form. The junctural morpheme will prefer to surface at that position because of constraints that refer to relations between positions in the input and output, as proposed by McCarthy and Prince (1995).

I will pursue here an account of the effects of prosodic size on *rendaku* voicing that is based on Positional Markedness, using a type of constraint proposed by Zoll (1998). She proposes a constraint "COINCIDE", which effectively allows marked features to be licensed when they coincide with a strong position. Zoll formulates this kind of constraint through Local Conjunction (see below) of the markedness constraint in question with what she calls a "positional" constraint which requires the coincidence of category *x* with category *y*. She argues that local conjunction is necessary for formulating a Positional Markedness constraint.

The principle of "Local Conjunction" of two constraints that form a natural class has been proposed in order to account for a number of cross-linguistic phenomena, including derived environment effects (Smolensky 1995; Lubowicz 1998; Itô and Mester 1998; Alderete 1999). When two constraints are conjoined, they act together as a single constraint, which is violated if and only if both conjuncts are violated in the same domain *D*. The term "local" refers to the fact that there is some local domain *D* in which violations of the two sub-constraints are calculated.⁷

⁷An alternative way of conjoining constraints, put forth by Hewitt and Crowhurst (1996), is that a conjoined constraint is violated if and only if either one of its two conjuncts is violated. Under this proposal, a conjoined constraint *C* with conjuncts *C*₁ and *C*₂ will be satisfied only if both *C*₁ and *C*₂ are satisfied. This type of conjunction will yield different results than the type of conjunction originally proposed by Smolensky (1995).

In the case we are examining, the markedness constraint IF [–SON] THEN [–VOICE] in (32) is conjoined with the alignment constraint in (40) that in effect identifies the strong position as the left edge of a Prosodic Word.

- (40) ALIGN(σ , LEFT, PWD, LEFT): The left edge of every syllable in the output is aligned with the left edge of a Prosodic Word.

The conjoined constraint is violated when both conjuncts are violated in the same syllable. This effectively discourages a [+voice] feature in an obstruent from occurring in a syllable other than the leftmost syllable of a Prosodic Word.

For simplicity, I shall refer to the conjoined constraint IF [–SON] THEN [–VOICE] & ALIGN(σ , LEFT, PWD, LEFT) as COINCIDE([–SON, +VOI], LEFTMOST IN PWD) using Zoll’s terminology. This constraint will be violated when a voiced obstruent occurs at a position other than the left edge of a Prosodic Word — most relevantly, here, at the left edge of N2 in a short-short compound but not at the left edge of N2 in a long compound. In section 3.2.2 we examine how this positional markedness constraint derives *rendaku* blocking in short-short compounds.

3.2.2. Applying Positional Markedness to *rendaku* blocking

Blocking of *rendaku*, as we saw in section 2, does not occur in *all* short compounds. In section 3.1, we distinguished *rendaku* resisters by positing a lexically prespecified [–voice] feature in nouns resistant to voicing. Since blocking among resisters occurs only in short-short compounds, it must be *both* a lexical feature *and* the violation of positional markedness that blocks voicing. That is, the proposed positional markedness constraint COINCIDE must only be allowed to block voicing when there is a lexical [–voice] feature in the input. When there is no such feature in the input, no blocking occurs; that is, no [–voice] feature surfaces in the output. This requirement can be expressed through the following faithfulness constraint:

- (41) DEP-FEATURE: For every feature F’ in the output there is a corresponding feature F in the input where F’ corresponds to F.

DEP-FEATURE must be ranked above the positional markedness constraint COINCIDE, lest voicing be blocked in *all* short-short compounds. Because the constraint COINCIDE blocks voicing, it must be ranked above the constraint MAX[+VOICE] that was proposed in section 3.1. Including the undominated constraint DEPATH-FEATURE that was also proposed in section 3.1, we arrive at the following constraint ranking:

- (42) DEP-PATH-FEATURE, DEP-FEATURE > > COINCIDE > > MAX[+VOICE]
> > MAX[–VOICE]

To see how this ranking will determine relevant output forms, consider, for example, the *rendaku* resister *kusa* ‘grass’, which voices in only three out of 19 short-short compounds in the corpus. It has the proposed lexical entry /Kusa/, with

the floating feature [–voice]. Henceforth, capitalized letters “K”, “T”, “S”, and “H” are used to represent input forms of obstruents that have no specified voicing feature. Relevant instances of the features [+voice] and [–voice] are shown with no association lines when they are floating features and with association lines when they have a path to a root node. In the tableaux that follow, only violations that pertain to the voicing feature on the initial obstruent of N2 are shown.

Both candidates in tableau (43) violate DEP-PATH-FEATURE since there is no path from a voicing feature to the relevant root node in the input. On the other hand, neither candidate violates DEP-FEATURE, which does not refer to paths, since both [+voice] (the junctural morpheme) and [–voice] (part of the input form of *kusa*) occur in the input. If the [+voice] feature of the junctural morpheme occurs in the output as in candidate (b), the constraint COINCIDE is violated, since the [+voice] feature is not at the left edge of a Prosodic Word, which here dominates the whole compound, as proposed in (37). Candidate (a), however, in which no voicing occurs, will not violate COINCIDE, and therefore, is optimal. Prosodic Word boundaries are shown henceforth with curly brackets.

(43)

[–voi]		DEP-PATH-FEATURE	DEP-FEATURE	COINCIDE	MAX[+VOI]	MAX[–VOI]
ao + [+voi] + Kusa 'green' 'grass'						
a.	[–voi]	*			*	
	 {ao-kusa}					
b.	[+voi]	*		*!		*
	 {ao-gusa}					

If the input has both a floating [+voice] (the junctural morpheme) and a [–voice] feature (present in some morphemes, as proposed), it does not matter whether more than one instance of each feature occurs in the entire input: an output with no voicing will be optimal for a short compound. For example, a noun with both floating [–voice] and [+voice] will block voicing as well, since either relevant candidate will satisfy the constraint DEP-FEATURE.

Consider now, in (44), a compound in which N2 is not a *rendaku* resister, and, as we have proposed here, has no underlying [–voice] feature. Both candidates violate DEP-PATH-FEATURE, because there is no path from the initial consonant to any voicing feature in the input. Candidate (a), with no voicing on the initial obstruent, will violate DEP-FEATURE, since the [–voice] feature in that candidate has no correspondent in the input. Candidate (b), which voices the obstruent, satisfies DEP-FEATURE because there is a [+voice] feature (the junctural morpheme) in the input. Because the faithfulness constraint is ranked above the positional markedness constraint, positional markedness cannot block voicing in this case.

(44)

ao + [+voi] + Take 'green' 'bamboo'		DEP-PATH- FEATURE	DEP- FEATURE	COINCIDE	MAX[+voi]	MAX[−voi]
a.	[−voi] {ao-take}	*	*!		*
b.	[+voi] {ao-dake}	*		*		

Consider now a long compound. Even if N2 were to have the kind of floating [−voice] feature that we have proposed blocks voicing in short compounds, voicing will not be blocked by the constraint COINCIDE, as it was in (20), since the left edge of N2 is, in our analysis, at the left edge of a Prosodic Word. This is where the proposed constraint MAX[+VOICE] (34) becomes relevant. Candidate (a), in which the [+voice] feature of the junctural morpheme does not surface, will violate this constraint, making the candidate with voicing optimal:

(45)

[−voi] hituza + [+voi] + Kusa 'sheep' 'grass'		DEP- PATH- FEATURE	DEP- FEATURE	COINCIDE	MAX[+voi]	MAX[−voi]
a.	[−voi] {hituzi}−{kusa}	*			*!
b.	[+voi] {hituzi}−{gusa}	*				*

In summary, lexical prespecification of a [−voice] feature in *rendaku*-resisting nouns interacts with prosodic length to cause blocking of *rendaku* voicing specifically in short-short compounds but not in long compounds.

3.3. Exceptions to robust patterns: blocking by non-resisters and voicing by resisters

The previous subsection proposed a set of representations and a constraint ranking that is intended to account for a strong degree of patterning among *Yamato* nouns: a set of *rendaku*-resisting nouns robustly blocks voicing in short-short compounds and non-resisting nouns robustly undergo voicing. However, as we observed in section 2.5, there are also exceptions to this general pattern: (a) some nouns that usually voice fail to voice in a few compounds (see, e.g., (19)); and (b), *rendaku*-resisting nouns do voice in a few compounds (see, e.g., (8)).

A few examples of the first kind of exception are given in (46), with the nouns *kumo* 'cloud', *tama* 'ball', and *tori* 'bird', all of which usually voice in compounds.

The constraint will be violated once by an output candidate that is derived from a single-listeme input and more than once by an output candidate that is derived from more than one listeme. With respect to *rendaku* voicing, high ranking of this constraint will allow exceptional voicing to occur when a compound is listed as one listeme with a [–voice] feature that does not occur in the listing of the simplex morpheme N2. This is because this constraint will eliminate candidates that are derived from separate listemes when they compete with candidates that are derived from a single-listeme input. This will be illustrated in tableau (50).

DEP-PATH-FEATURE must be ranked above USE-LISTED, for reasons that will be discussed in section 3.4. However, because we still want single-listeme inputs to permit exceptional blocking by non-resisters, USE-LISTED must be ranked above DEP-FEATURE and COINCIDE, which cause blocking of *rendaku*. Accordingly, the constraint ranking we shall posit is as follows:

- (49) DEP-PATH-FEATURE >> USE-LISTED >> DEP-FEATURE >> COINCIDE >> MAX[+VOICE] >> MAX[–VOICE]

3.3.1. Deriving exceptional blocking in short-short compounds

Given the proposed constraint ranking in (49), consider the compound *yami kumo* ‘recklessly’, where the noun *kumo* ‘cloud’ is not a *rendaku* resister. The proposed single-listeme input, shown in (50), contains a floating [–voice] feature that does not occur in the listing of the simplex noun *kumo*. The input form of the latter is /Kumo/ with no specification of voicing on the obstruent.

The tableau in (50) illustrates how a single-listeme input can derive exceptional blocking in *yami kumo*. I follow Zuraw (2000) in distinguishing between candidates in the tableau according to the input form they are derived from.

(50)

	[–voi] yami + [+voi] + kumo ‘darkness’ ‘cloud’ simplex noun ‘cloud’: Kumo	DEP- PATH-F	USE- LISTED	DEP- FEATURE	COINCIDE	MAX [+VOI]	MAX [–VOI]
a.	[–voi] {yami-kumo} 1L	*	*			*	
b.	[+voi] {yami-gumo} 1L	*	*		*!		*
c.	[–voi] {yami-kumo} C	*	***!	*		*	
d.	[+voi] {yami-gumo} C	*	***!		*		

Candidate (a) differs from candidate (c) in that (a) is derived from a single listeme whereas (c) is derived from three listemes (if we include the junctural morpheme as a listeme). The notation “1L” refers to a candidate that is derived from a single listeme and “C” to a candidate that is derived from the concatenation of separately listed morphemes. In this tableau, all candidates violate DEP-PATH-FEATURE because whatever voicing feature surfaces on the initial obstruent of *kumo*, it has no linked voicing feature in the input. High ranking of USE-LISTED eliminates candidates (c) and (d), each of whose inputs consists of more than one listeme.

Candidates (a) and (b) are derived from a single listeme that has a [–voice] feature in the input. Thus the presence of the added [–voice] feature in the single-listeme input blocks *rendaku* in the same way as it does in *rendaku* resisters. The competition among candidates (a) and (b) is analogous to the determination of the winning candidate for a compound with a *rendaku* resister such as *ao-kusa* in (43).

3.3.2. The absence of exceptional blocking in long compounds

Recall that exceptional blocking never occurs in long compounds, which always undergo *rendaku* voicing, the only exceptions being a lexically identified set of uniformly *rendaku*-immune nouns. In the above tableaux, blocking of *rendaku* in non-immune nouns occurs because of the positional markedness constraint COINCIDE, which is only violated in short-short compounds. This means that a single-listeme input with an included [–voice] feature cannot cause exceptional blocking in long compounds, since it does not interact with the constraint COINCIDE, which only pays attention to prosodic size. Consider, for example, a hypothetical single-listeme input with an added [–voice] feature for the long compound *hituzi gumo* ‘sheep cloud’. As we see in tableau (51), because the compound is long, and each constituent thus constitutes its own Prosodic Word, the positional markedness constraint is satisfied by a candidate with voicing.

(51)

hituzi + [+voi] + kumo ‘sheep’ ‘cloud’ simplex noun ‘cloud’: Kumo		DEP- PATH-F	USE- LISTED	DEP- FEATURE	COINCIDE	MAX [+VOI]	MAX [–VOI]
a.	[–voi] {hituzi}--{kumo} 1L	*	*			*!	
b.	[+voi] {hituzi}--{gumo} 1L	*	*				*
c.	[–voi] {hituzi}--{kumo} C	*	***!	*		*	
d.	[+voi] {hituzi}--{gumo} C	*	***!				

A single-listeme input has no effect on blocking here, since violation of the positional markedness constraint is necessary to derive blocking.

3.3.3. Deriving exceptional voicing among resisters

We turn now to the second type of exception to the regular pattern: exceptional voicing in compounds where we expect blocking. An example is *hito de* ‘starfish’ (lit. ‘person-hand’), which voices despite the fact that the noun *te* ‘hand’ robustly resists voicing in short-short compounds (see (16)–(17)).

A possible listing for such a compound is one in which the floating [–voice] feature associated with the *rendaku*-resisting noun is absent from the single-listeme input, as shown in tableau (52). With such an input form, all candidates will equally violate DEP-PATH-FEATURE since there are no linked voicing features in the input form of either the simplex morphemes or the single-listeme input. USE-LISTED eliminates candidates derived from two listings in (c) and (d). Of the two remaining candidates, which are derived from the single-listeme input with no [–voice] feature, candidate (b) with voicing becomes optimal, because it satisfies DEP-FEATURE, unlike the voiceless candidate (a). Here, the single-listeme input can override the effects of the floating [–voice] feature in the simplex input form of N2, because USE-LISTED forces the choice of the single-listeme input form.

(52)

hito + [+voi] + te ‘person’ ‘hand’ simplex noun ‘hand’: [–voi] Te	DEP- PATH-F	USE- LISTED	DEP- FEATURE	COINCIDE	MAX [+voi]	MAX [–voi]
a. [–voi] {hito-te} 1L	*	*	*!		*
b. [+voi] {hito-de} 1L	*	*		*		
c. [–voi] {hito-te} C	*	***!			*	
d. [+voi] {hito-de} C	*	***!		*		*

3.4. Constraining the effects of single-listeme inputs

We have proposed that exceptions to robust blocking of voicing patterns of resisters and non-resisters can be explained through a single-listeme input for the whole compound whose voicing features differ from those of the input form of N2 alone.

These features differ either by the presence of a floating [–voice] feature that is not present in the simplex listing of N2, or by the absence of a floating [–voice] feature that is present in the simplex listing of N2. However, if compound words can have single-listeme inputs whose features can depart from those of the simplex-morpheme listings of the corresponding constituents of the compound, we must explain why we do not find a compound whose special listing departs even more widely than observed from the input forms of the constituent morphemes. A few compounds exhibit morpheme-final vowel alternations. For example, *hune* ‘ship’ surfaces as *huna* in compounds like *huna-ita* ‘ship-plank’ (see Vance 1987:149); however, these kinds of alternations are much less radical than what should be hypothetically possible if we allow single-listeme inputs for compounds.

In the OT framework, Correspondence Theory (McCarthy and Prince 1995) was developed to capture the requirement that two morphologically related structures show correspondence to each other. Even if a morphologically complex word is derived through a single-listeme input, we generally find, except, for example, in cases of suppletion, that its output form will show phonological correspondence to the shape of morphologically related simplex forms.

With respect to Japanese compound words, we find that the possibility of obtaining surface forms that depart from robust patterns is highly constrained. For example, long compounds never block voicing unless the second constituent is itself lexically specified as *rendaku*-immune. If a single-listeme input of a compound word were allowed to derive outputs in an unconstrained fashion, nothing should prevent the possibility of a compound like *hotaru gusa* ‘firefly grass’ being given a single-listeme input with a [–voice] feature linked to the velar consonant in the input, just as we proposed is the case for the simplex listing of a *rendaku*-immune noun. Recall that we proposed that the simplex noun *kusa* ‘grass’, which resists *rendaku* in short-short compounds, has a floating [–voice] feature in its input form that does not have a path to a root node. The proposal here is that compounds with *rendaku* resisters like *hotaru gusa* never show exceptional blocking in long compounds because of correspondence between the output form of *hotaru gusa* and the input form of the simplex noun *kusa* ‘grass’, which, unlike a *rendaku*-immune noun, has no linked voicing feature on the initial obstruent. To account for this kind of correspondence, I propose a faithfulness constraint that is based on correspondence of a single morpheme to its simplex input form. This constraint follows the general framework of Correspondence Theory. In this case, we require correspondence between a morphologically complex output form and the input forms of its constituent morphemes:

- (53) DEP-PATH-FEATURE(MORPHEME-CORRESPONDENCE): If P' is a path to F' , where F' is a feature in morphological domain M_i' in the output, and M_i is a morphological domain in the input, where M_i' corresponds to M_i , then there must exist path P to feature F in the (simplex) input form of M_i , such that P' corresponds to P and F' corresponds to F .

This constraint requires correspondence to the input form of a particular morpheme, rather than to any single-listeme input for a morphologically complex word. It replaces the constraint DEP-PATH-FEATURE in our earlier tableaux. In those tableaux, making the constraint DEP-PATH-FEATURE require morpheme correspondence would have had no added effect, since we were not positing any single-listeme input for a whole compound that differed from the input form of a constituent morpheme with respect to paths from features to root nodes.

3.4.1. Single-listeme inputs cannot force blocking in long compounds

Let us now examine how the faithfulness constraint proposed in (53) will prevent exceptional blocking in a long compound like *hotaru-gusa*, even if it were given a single-listeme input with a linked [–voice] feature. Since, by hypothesis, *kusa* has no path to a [–voice] feature in its simplex listing, the output **hotaru kusa*, with no voicing, violates faithfulness that is based on correspondence to the input form of the constituent morpheme *kusa*, even if it were to satisfy faithfulness to some spurious [–voice] feature in a single-listeme input. This is because the relevant faithfulness constraint DEP-PATH-F(MORPHEME-CORRESPONDENCE) refers to correspondence between the output and input forms of the simplex morpheme, not the form of the single-listeme entry for the whole compound.

The tableau in (54) illustrates how the output form of the compound *hotaru gusa* is determined when it has a linked [–voice] feature in a single-listeme input. DEP-PATH-FEATURE(MORPHEME-CORRESPONDENCE) replaces the previous constraint DEP-PATH-FEATURE in the proposed hierarchy.

(54)

	<div style="text-align: center;">[–voi] hotaru + [+voi] + kusa 'firefly' 'grass' simplex noun 'grass': Kusa</div>	DEP- PATH-F (M-C)	USE- LISTED	DEP- FEATURE	COINCIDE	MAX [+VOI]	MAX [–VOI]
a.	<div style="text-align: center;">[–voi] {hotaru}–{kusa} 1L</div>	*	*			*!
b.	<div style="text-align: center;">[+voi] {hotaru}–{gusa} 1L</div>	*	*				*
c.	<div style="text-align: center;">[–voi] {hotaru}–{kusa} C</div>	*	***!			*	
d.	<div style="text-align: center;">[+voi] {hotaru}–{gusa} C</div>	*	***!				*

Because the DEP-PATH-F(MORPHEME-CORRESPONDENCE) constraint is based on correspondence to the input form of the morpheme *kusa*, and not to the single-listeme input for the whole compound, this constraint will not eliminate candidates with voicing, the way it does for a *rendaku*-immune noun, as in (36). The rest of the tableau is the same as that of any other long compound, as in (45).

3.4.2. *Single-listeme inputs cannot force voicing among rendaku-immune nouns*

To further show that a single-listeme input cannot create “unexpected” exceptions to systematic patterns of blocking and voicing, consider the fact that compounds with immune nouns can never be forced to voice by a single-listeme input that has built-in voicing. Suppose, for example, that there were a single-listeme input with an immune noun in which its linked [–voice] feature is not present or linked to the obstruent, as shown in (55).

(55)

uta + [+voi] + hime ‘song’ ‘princess’ simplex noun ‘princess’: [–voi] hime		DEP- PATH-F (M-C)	USE- LISTED	DEP- FEATURE	COINCIDE	MAX [+VOI]	MAX [–VOI]
a. [–voi] {uta-hime} 1L			*	*		*	
b. [+voi] {uta-bime} 1L		*!	*		*		
c. [–voi] {uta-hime} C			***!			*	
d. [+voi] {uta-bime} C		*!	***		*		*

Because of the high ranking of DEP-PATH-F(MORPHEME-CORRESPONDENCE), all candidates that voice are out of contention, since they have no path to a [+voice] feature in the input of any simplex morpheme. By contrast, candidates with no voicing satisfy this constraint, owing to the presence of a linked [–voice] feature in the input form of the simplex noun. Crucially, because the highest ranked faithfulness constraint is based on correspondence to a simplex morpheme, a single-listeme input cannot force this kind of unexpected output.

4. CONCLUSION

This article has argued that exceptions to *rendaku* voicing in noun-noun compounds, while not always fully predictable on an individual basis, show strong lexical and phonological patterning. More specifically, *rendaku* blocking occurs robustly in two situations: (a) among *rendaku*-immune nouns that never voice in any compound; (b) among *rendaku*-resistant nouns when these nouns occur in short-short compounds. These tendencies have been represented in a speaker's knowledge in two ways. One is through identification of *rendaku*-immune nouns and *rendaku* resisters in a speaker's lexicon. Formally, this kind of lexical marking occurs, in our analysis, through combinatorial specification of features (Archangeli and Pulleyblank 1994). Specifically, the initial voiceless obstruent of a *rendaku*-immune noun is fully specified in the input with a [–voice] feature that has a path to a root node. The initial voiceless obstruent of a *rendaku* resister is specified as [–voice] but this feature does not have a path to a root node in the input. Nouns that are neither resisters nor immune do not have an initial obstruent specified for a voicing feature. The second is through a grammar that calculates possible outputs with respect to Positional Markedness (Zoll 1998). Specifically, outputs are disfavoured when they have a marked voiced obstruent in a prosodically weak position; in this case, away from the edge of a Prosodic Word. Such a grammar accounts for why blocking among *rendaku* resisters occurs only in short compounds, where the initial obstruent eligible for voicing occurs in a prosodically weak position.

In the light of recent work on systematic irregularity by Zuraw (2000) and Albright and Hayes (2002), the empirical evidence that *rendaku* blocking follows systematic patterns further illuminates the question of how systematic irregularity in language might be encoded in a speaker's knowledge of language. Further, the question of why short-short compounds can block voicing in situations where long compounds cannot is relevant to the question of how faithfulness and markedness interact.

Finally, we observed a parallel between the predictability of pitch accent and the predictability of *rendaku* voicing with respect to the effects of prosodic size on a compound word. When a compound has at least one constituent that exceeds two moras, both its pitch accent and the voicing of the *rendaku*-targeted obstruent are predictable from the input forms. When neither constituent attains this size, neither the pitch accent nor the voicing behaviour are completely predictable. In both cases, there is a correlation between prosodic size and irregularity. Further investigation of pitch accent in short-short compounds is needed in order to determine if what we are seeing here is an interaction between size and faithfulness or size and markedness.

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