The Afterlife of Morphemes:

Rendaku and the Search for Ghosts in Japanese Morphophonology

Thomas J. Magnuson

University of Victoria
thomasm@uvic.ca

ABSTRACT

Rendaku, or sequential voicing in Japanese compounds, has been characterized in terms of autosegmental phonology as being the product of a floating morpheme whose only content is the feature [+voice]. This 'ghost' either appears or does not (i.e., voicing occurs or does not) depending on a number of phonological and lexical circumstances. This report is a preliminary exploration of potential alternatives to the autosegmental account. Borrowing from Rosen (2003), Gordon (2005), and Martel (2009), the potential for prosodic boundaries and compound length as explaining *rendaku* is explored with a view toward incorporating the idea of perceptual salience into the dynamics of sequential voicing. While the present investigation falls short of complete exorcism of *rendaku*'s ghostly morpheme, directions for future research are suggested whereby such may eventually be possible.

Keywords: Japanese; *rendaku*; sequential voicing; compound words; prosodic boundaries.

1 Introduction

Compound words in Japanese display a systematic pattern whereby the first obstruent of the second member of the compound becomes voiced. Known as *rendaku*, or sequential voicing, this process is subject to a number of restrictions which make reference to various aspects of the words involved. Lexically, *rendaku* is associated mainly with native Japanese words as opposed to Chinese or other foreign loanwords. Phonologically, its application or non-application depends on whether or not there is already a voiced obstruent in the second conjunct: if there is, *rendaku* is blocked. In terms of phonological domains, then, we have a process which occurs at the edges of two entities which bring with them their own particular lexical and morphological baggage. Current approaches to rendaku (Ito & Mester (I&M), 2003; Fukazawa & Kitahara (F&K), 2001; Rosen, 2003) make reference to an invisible linking morpheme, or 'ghost' of sorts, which alights onto obstruents making them [+voice]. In this paper I argue that the ghost may be a remnant of post-nasal voicing assimilation

(Unger, 1975; 1993). I also take the position that while autosegmental approaches to *rendaku* account for many idiosyncrasies, these accounts lack explanatory appeal. In light of this, I borrow the concepts of *striping* and *counter-striping* (Martel, 2009) and suggest that the prosodic length of compounds manipulates perceptual salience so as to heighten or decrease the psychological distance between the compounded elements. Insofar as this structural investigation is not enough to account for key idiosyncrasies, I also argue that Exemplar-dynamically motivated effects of word frequency can account for structural exceptions.

This exploration of sequential voicing first reviews in more detail what exactly *rendaku* is (§2), and the types of compound words and environments it is associated with (§2.1 ~ §2.3). Section 3 delves into possible explanations and accounts of *rendaku*, and §3.1 ~ §3.2 brings our search for morphological ghosts to its fruition. Then, in §3.3, a functional alternative to autosegmental approaches is explored with reference to the Exemplar Dynamics model proposed by Pierrehumbert (2001) and the concept of varying degrees of perceptual salience at prosodic boundaries (Gordon 2005, Martel 2009).

2 Preliminaries: What is *rendaku*?

The term *rendaku* literally means 'sequential (*ren*) warping (*daku*),' and is used to describe the phenomenon in Japanese compound word formation whereby the first obstruent of the second member of the compound becomes voiced, as in (1) and (2):

(1) ***kuti*** 'mouth' + ***kuse*** 'habit' → ***kuti+guse*** 'trademark phrase'

(2) ***hi*** 'day' + ***hi*** 'day' → ***hi+bi*** 'days'

In (1) the initial obstruent [k] in the second component of the compound, ***kuse*** ('habit') voices to [g]. With (2), ***hi*** ('day') reduplicates to form the plural, and the initial obstruent [h] undergoes voicing to become [b][1]. It is important to note, however, that there are many exceptions to the process based on a variety of factors including (among others): compound type (sub- versus coordinate), lexical stratum (native versus non-native words), and phonological environment. The sections that follow provide a more detailed account of the conditions where rendaku does and does not occur.

2.1 Compound types: roots vs. words

It is worthwhile here to distinguish between what I refer to as native Japanese *words* Chinese *roots*, which rarely stand on their own as independent words. Chinese roots are symbolized in orthography by individual *kanji* characters and are typically bound to other Chinese roots. Combined into multiple-root compounds, their phonological form is a concatenation of Japanisized renditions of the original Chinese sounds associated with the

[1] It bears mention that, in Japanese, [h] behaves such that its voiced counterpart is [b].

given characters. Orthographically speaking, where *kanji* characters occur on their own, their 'Yamato' (native) readings are typically used. Throughout this paper I will use the term *root* to mean the bound, morphological roots (separated by hyphens '-') associated with the Chinese loanwords described above. Although unsatisfactory in its vagueness, the term *word* will refer to any morphological element that can grammatically 'stand on its own.'

Rendaku is generally thought of as a non-productive process which applies only to the native, or 'Yamato' stratum[2] of the lexicon, but there are in fact examples that go against this presumption (Rosen, 2003):

(3) ***yu*** 'hot water' + ***to-hu*** 'tofu' → ***yu+do-fu*** 'hot tofu'
****yu+to-fu***

(4) ***hi-koo-ki*** 'airplane' + ***kumo*** 'cloud' → ***hi-koo-ki+gumo*** 'vapour trail'
****hi-koo-ki+kumo***

(5) ***kami*** 'paper' + ***hi-koo-ki*** 'airplane' → ***kami+hi-koo-ki*** 'paper airplane'
****kami+bi-koo-ki***

In (3), ***yu*** ('hot water') is a native Japanese word whereas ***to-hu*** ('tofu') is an established Chinese loanword. Nonetheless, the initial [t] in ***to-hu*** voices to [d], exhibiting sequential voicing contrary to the idea that rendaku is limited to only native words. Example (4) also illustrates that *rendaku*-eligible compounds are not necessarily those whose members are both native to Japanese. The word for 'airplane' is a combination of three Chinese bound roots: ***hi*** ('fly'), ***koo*** ('go'), ***ki*** ('machine'). When the native word ***kumo*** ('cloud') is combined its initial [k] undergoes voicing. If, as in (5), the non-native ***hi-koo-ki*** is the second element in the compound, rendaku does not occur. The behaviour of (4) and (5) is predictable in the sense that voicing does or does not occur depending on whether the second element is a native Japanese word or another type of word formed from Chinese roots. If the second element is a native word, rendaku happens but if it is a non-native word it doesn't. As to why ***to-hu*** ('tofu,' a Chinese loan) does voice in (3) will be pondered further in later sections. For now, let us consider more environments where rendaku occurs regularly.

2.2 More compound types: rendaku *environments*

This section provides a summary of environments where rendaku is observed. These include subordinating compounds, including those whose second members contain up to three syllables, and intensifying/pluralizing reduplicants. Examples of each type are given in Table 1.

In (6~9) the words for 'lost,' 'young,' 'ash,' and 'burn/fry' all respectively modify their second components which in turn make up the lexical head of the compound. Example (10) is

[2] For a detailed discussion of lexical strata in Japanese, see Ito & Mester (hereafter I&M) (1999).

the same compound as (4) discussed earlier, and the last example (11) is a particular kind of reduplication in Japanese whose function is to either a) express plurality or b) intensify the meaning of the original form.

Table 1

A summary of environments where *rendaku* occurs

Subordinating compounds (I&M, 2003: 86)			
(6)	***mai*** 'lost'	+ ***ko*** 'child'	→ ***mai+go*** 'lost child'
(7)	***waka*** 'young'	+ ***ha*** 'leaves'	→ ***waka+ba*** 'young leaves'
Compounds with mono- to tri-syllabic 2nd members (I&M, 2003:74, 75):			
(8)	***hai*** 'ash'	+ ***sara*** 'dish'	→ ***hai+zara*** 'ashtray'
(9)	***yaki*** 'burn/fry'	+ ***sakana*** 'fish'	→ ***yaki+zakana*** 'broiled fish'
Root+Word compounds (Rosen, 2003:13)			
(10)	***hi-koo-ki*** 'airplane'	+ ***kumo*** 'cloud'	→ ***hi-koo-ki+gumo*** 'vapour trail'
Intensive/pluralizing reduplicants (I&M: 76, 77):			
(11)	***kata*** 'person (hon.)' x2		→ ***kata+gata*** 'people (hon.)'

Table 2.

A summary of environments where rendaku does not occur

Coordinating compounds (I&M, 2003: 86):			
(12)	***oya*** 'parent'	+ ***ko*** 'child'	→***oya+ko*** 'parent & child'
(13)	***eda*** 'branches'	+ ***ha*** 'leaves'	→***eda+ha*** 'branches & leaves'
OV (object-verb) compounds (I&M: 86):			
(14)	***sakana*** 'fish'	+ ***turi*** 'catching'	→***sakana+turi*** 'catching fish'
(15)	***kami*** 'hair'	+ ***sori*** 'shaver'	→***kami+sori*** 'razor'
Compounds with non-native 2nd members:			
(16)	***kami*** 'paper'	+ ***hi-koo-ki*** 'airplane	→***kami+hi-koo-ki*** 'paper airplane'
(17)	***mee*** 'famous'	+ ***kom-bi*** 'duo'	→***mee+kom-bi*** 'famous duo'
'Mimetic' (sound-symbolic) reduplicants (I&M: 77 (adapted)):			
(18)	[3]****sara*** '?swishy'	+ ****sara*** '?swishy'	→***sara+sara*** 'smooth & silky'
(19)	****kata*** '?clack'	+ ****kata*** '?clack'	→***kata+kata*** 'clackety-clack'

*2.3 Non-*rendaku *environments*

Table 2 summarizes the types of compounds where we do not see sequential voicing. In contrast to subordinate compounds, coordinate compounds (12, 13) where neither component modifies the other see no voicing. Thus while the subordinately modified 'child' in (4) undergoes voicing to go, it does not voice in (12) when paired with the word for 'parent' in oya+ko ('parent and child'). As well, compounds formed from words in an object-verb relationship (14, 15) are not subject to rendaku. As seen in Section 2.1, compounds where the second element is a non-native word (16, 17) are (generally) immune. The other similar-yet-different case of non-occurrence is in mimetic reduplicants (18, 19) whose meanings are

[3] Similar to Chinese roots, mimetic roots do not grammatically occur on their own.

neither intensified nor pluralized as in (11) but rather are symbolically related to the sounds of the compounded forms themselves.

The other and perhaps best recognized condition in which *rendaku* fails to apply is where the second component of a compound already contains a voiced obstruent within it. Otherwise known as Lyman's Law, this condition trumps sequential voicing even in cases that would otherwise fall into those described in Table 2. Interestingly, Lyman's Law applies even where the voiced obstruent in the second component of the compound is relatively far away from what would have been the target for *rendaku* to apply, as in (21) given in Table 3.

Table 3.
Non-application of rendaku due to Lyman's Law (I&M, 2003: 89-90)

Coordinating compounds (I&M, 2003: 86):			
(20)	***nama*** 'raw'	+ ***kubi*** 'head'	→***nama+kubi*** 'freshly severed head
(21)	***kaki*** 'write'	+ ***kotoba*** 'word'	→***kaki+kotoba*** 'written language'
(22)	***tugi*** 'next'	+ ***tugi*** 'next'	→***tugi+tugi*** 'in succession; one by one'

2.3.1 Lexical immunity, resistance, & prosodic length

Rosen (2003) elaborates on the environments mentioned above by focussing on a number of seemingly inexplicable exceptions to *rendaku* which, he argues, have a great deal of systematicity. From a corpus of roughly 1,500 native Japanese compounds he identifies a small number (*T*= < 70) 'immune' nouns which never undergo voicing (see Table 4). As well, he finds slightly more 'resistant' nouns which voice in only a small number of short (single prosodic word) compounds and regularly in long ones (see below for a discussion of prosody and word size). The majority of *rendaku*-eligible nouns in his corpus, moreover, are words that 'robustly' voice.

Table 4.
Rendaku-immune & -resistant nouns

(Immune)		(Resistant)	
kita	'north'	***kuse***	'habit'
kasu	'dregs'	***kusa***	'grass'
hama	'beach'	***saki***	'tip'
sita	'below'	***hara***	'field'
tuti	'earth'	***te***	'hand'
…		…	

Rosen (2003:7-9)

In terms of prosodic size, he observes that it plays a critical role in determining whether or not 'resisters' voice. Specifically, he argues that long compounds are too big prosodically to be contained in a single prosodic word, which means that within the compound there is a prosodic word boundary: a special position where markedness (i.e. *rendaku*) can be licensed (Rosen, 2003: 20-21). In discussing prosodic units, I adopt the structure (see Fig. 1) assumed

by Rosen (2003) wherein a prosodic word (PWD) dominates maximally two prosodic feet (φ), which in turn dominate from one to two moras (▬). This view of prosodic structure for Japanese diverges from that of Kubozono (1999) in that the syllable is essentially left out. I do, however, go along with Kubozono's observation that, based on evidence from loanword phonotactics and clippings, the PWD in Japanese prefers to be two bi-moraic feet in length.

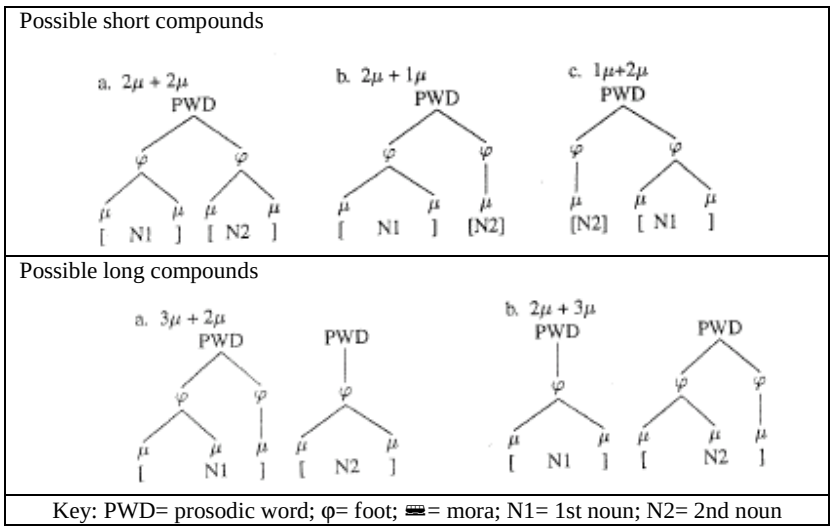

Figure 1.
Structures for 'short' and 'long' compounds (Rosen, 2003:20). While both conjuncts in a short compound are contained by a common PWD, long compounds involve two PWDs. *Rendaku* occurs at the left edge of the rightmost conjunct in the compound.

One structural observation that can be made from the schemata in Figure 1 is that there are at least two prosodic domain boundaries which demarkate where *rendaku* happens. Again, the target for voicing is the initial obstruent of the second, or rightmost element of the compound. In short (one PWD) compounds, this means that the left edge of a foot is involved. Moreover in long (two or more PWD) compounds, the left edge of two domains is involved: the foot, as in short compounds, as well as the larger PWD itself. This observation is intriguing in light of the dual behaviour of 'resistant' nouns which resist voicing in short compounds but yield to it in long compounds. They question raised, then, is whether this duality is rooted in some sort of double-domain edge effect. This as well as other potential explanations are explored from Section 3 below.

3 Possible Explanations

As we have seen in the previous sections, *rendaku* is a voicing phenomenon whereby the first obstruent in the second element of a compound word becomes voiced, barring a number of restrictions discussed above. The first of these limitations has to do with the type of compound: *rendaku* does not occur in bound root compounds, object-verb, or coordinate compounds. Moreover, sound-symbolic mimetic reduplicants do not undergo voicing whereas pluralizing or intensifying reduplicants do. Above and beyond these conditions, the presence of a voiced obstruent in the second component of a compound, even at some distance, trumps *rendaku* irrespective of the type of compound in question. In this way, *rendaku* gives us a puzzle whose solution necessarily makes reference to more than just how sounds arrange themselves in a given string: 1) Morphology delimits what type of words *rendaku* applies to, 2) Phonology plays a role insofar as the process is sensitive to the presence or absence of voiced obstruents in the second component, and 3) Prosodic domains are involved insofar as voicing targets a particular *edge* within a compound.

3.1 Autosegments & ghost morphemes

One solution to the messy problem of accounting for sequential voicing in terms of phonological rules is offered by Ito & Mester (1986, 2003) who avoid this by positing that *rendaku* is itself not a process so much as an actual [+voice] morpheme linking the two elements in a compound (I&M, 2003:83). This ghostly linking morpheme (ℜ) is realized on the initial obstruent of the sencond noun (23) or, if there is already a voiced obstruent in the second component, it surfaces through that segment's [+voice] feature (24). These approaches recast Lyman's Law as a manifestation of the Obligatory Contour Principle (OCP) which operates to heighten perceptual salience by banning sequences of the same feature.

(23) ***mai*** 'lost' + ℜ + ***ko*** 'child' → ***mai+go*** (ℜ) 'lost child'

(24) ***kaki*** 'write' + ℜ + ***kotoba*** 'word' → ***kaki+kotoba*** (ℜ) 'written language'

There are crucial difficulties with this and similar analyses offered by Fukazawa & Kitahara (F&K) (2001) and Rosen (2003). Both I&M and F&K do not account for a large number of idiosyncratic exceptions to sequential voicing such as the immune and resistant nouns discussed earlier. Although Rosen (2003) does account for such exceptions, the complexity of his analysis and its dependence upon adjusting floating versus linked feature values in the input to suit the output leaves much to be desired. The question follows, however, as to whether there are any better explanations for the phenomenon.

3.2 Whence the ghost may have come: a diachronic view

Unger (1993; 1975, in I&M, 2003) offers a historical analysis which both explains possibly why *rendaku* does not apply to object-verb or coordinating compounds, as well as provides circumstantial evidence for the existence of a phonetically empty [+voice] linking morpheme. It happens that two grammatical particles, the genitive ***-no*** and the oblique ***-ni***, may have left ghosts of themselves in the form of post-nasal voicing. That is, many present-day subordinate compounds can be traced to phrasal antecedents involving either particle.

Table 5 depicts the development of one such compound, 'a woman's heart.' Insofar as grammatical particles used in the phrasal counterparts of coordinate and object-verb compounds have no nasal, it stands to reason that there would be not ghost of post-nasal voicing in them. Although Unger's account is intriguing on an explanatory level, it still does not tell us why *rendaku* typically fails to occur in Sino-Japanese root compounds which, after all, are used in analogous phrasal environments.

Table 5.
Diachronic change with the genitive particle ***-no*** (Adapted from I&M 2003:86)

	(Genitive Phrase)	(Process)
↓	*onna+* ***no#*** ***k****okoro* woman+ GEN# heart 'the heart of a woman'	Loss of vowel from *-no* leaves a bare nasal.
	-no → -n, k → g	
Passage of Time	*onna-* ***n#*** ***g****okoro* woman- GEN# heart 'the heart of a woman'	Post-nasal voicing targets [k] in *kokoro*.
	-n → ∅	
↓	*onna+* ***g****okoro* woman+ heart 'a woman's heart' (Subordinate Compound)	Loss of remaining nasal, but voicing effect sticks.

3.3 Functional possibilities

From Gordon's (2005) work on perceptual salience in syllable onsets, Martel (2009) proposes the terms striping and counter-striping to characterise the increasing (striping) or decreasing (counter-striping) of perceptual salience at the edge of a given phonological domain (p. 3). Given that compound words inherently involve the bringing together of two or more psychologically meaningful units, it is reasonable to imagine that a language would employ strategies such that the relatedness of the compounded elements were easily recognizeable. That is, insofar as the voicing of an onset obstruent decreases perceptual salience (Gordon, 2005), rendaku may be a means of counter-striping one component so as to more easily allow for the entire compound to be perceived as a single unit.

The question remains, though, as to why would Rosen's immune nouns never voice and the resistant ones voice only in long compounds. If we hold to the premise that a PWD containing two bimoraic feet is the favoured shape of a word in Japanese, we can designate

the single PWD span as the 'default' psychologically meaningful unit. That is to say, when speakers of the language hear a chunk of four moras, they would expect it to be a single word (both prosodically and morphologically). Assuming this perceptual bias toward parsing 4-mora spans as single words, we can make the functional argument that, in order to preserve some sign that the span is in fact made up of two parts, increased perceptual salience is needed. In other words, then, short compounds use striping to maintain the perceptual integrity of either component by retaining a maximally salient (i.e. voiceless) sound at the left edge of the second prosodic foot.

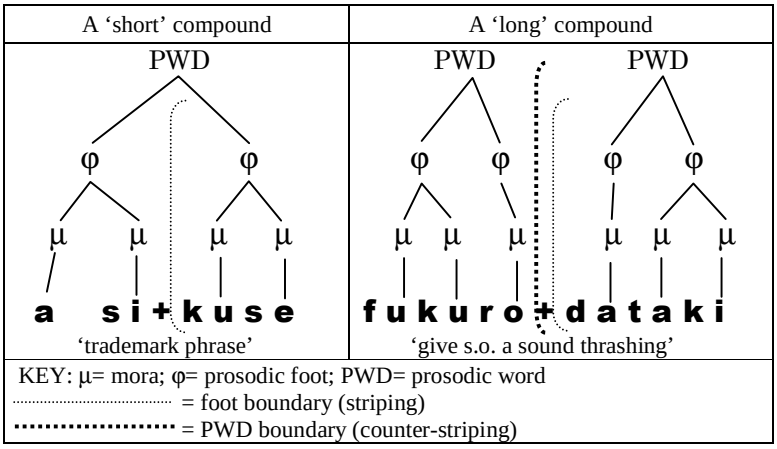

Figure 2.
Prosodic structure & boundary effects. Foot boundaries serve as loci for striping while PWD boundaries are loci for counter-striping.

Conversely with long compounds which are inherently more than one PWD, there is no need to remind speakers that the chunk that they are dealing with is more than 4-moras in length. In fact, the opposite may be argued: that, in order to signal the psychological unity of a long compound, perceptual salience is reduced at the PWD boundary. In other words, long compounds use counter-striping to heighten the relatedness of its conjuncts while short ones employ striping to achieve the opposite. Both of these conditions are illustrated in Figure 2.

3.3.1 Hot tofu & other unpalatables

The preceding line of reasoning with regard to the role of perceptual salience at different prosodic boundaries is well worth pursuing in future studies of *rendaku*, but there are nonetheless some facts that are still mysterious. Recall the case of (3) ***yu+do-hu*** ('hot tofu'), where ***do-hu*** is a Chinese root compound which we would not expect to undergo voicing. That is, in spite of its not being a native Japanese word it nonetheless behaves as though it were. In a similar pot but with slightly different broth is (1) ***kuchi+guse*** ('trademark phrase'). Prosodically speaking this is the ideal shape we would expect for a word in Japanese: a single

PWD formed from two bimoraic feet. However, sequential voicing occurs counter to the argument in Section 3.3 which predicted that the prosodic foot boundary in a short compound would be a locus for striping so as to bolster the integrity of the second component.

Although autosegmentalists such as Rosen (2003) successfully account for these idiosyncrasies through deft manipulation of featural specifications in the lexicon, a more explanatorily satisfying possibility is offered by Pierrehumbert (2001). Here she proposes a model, Exemplar Dynamics, in which phonological processes such as lenition become more pervasive in forms which are used more frequently. Considering that tofu has been very much apart of Japanese language and culture for centuries, this is a tantalizing explanation for why ***to-hu*** might voice in ***yu+<u>d</u>o-hu***. Also, a similar argument can be made for the voicing of kuse in ***kuchi+guse*** ('trademark phrase'). Compared with its cousin compound ***asi+<u>k</u>use*** ('way of walking'), ***kuchi+guse*** certainly has a more abstracted meaning which may be indicative of a higher rate of occurrence. That said, however, these observations serve only to highlight issues and areas where further research is needed.

4 Discussion & conclusions

Unger's diachronic explanation of the possible origins of *rendaku* as being a remnant of phrasal truncation and post-nasal voicing assimilation is an intriguing one. This suggests the possibility that historical processes in a language cast ghostly shadows onto the present, and that those shadows (as linking morphemes, floating features, or any other similarly abstract creature) surface in the grammar in predictable ways. That said, however, we have seen that predictability in *rendaku* is largely a conglomeration of tendencies. Lyman's Law/OCP exceptions to voicing are highly predictable, but the situation becomes less sure as we attempt generalizations based on lexical strata (native vs. loanwords), or prosodic structure (foot vs. PWD boundary effects). Nonetheless, the argument that sequential voicing (or non-voicing) may be conditioned by the need to augment or decrease perceptual salience is more explanatorily satisfying than any appeal to linked versus unlinked floating features swimming in the turbid pool that is the lexicon. However, just as the autosegmental accounts require us to stretch our imaginations to accept abstract invisible elements as real, the perceptual salience account in §3.3 does not explain idiosyncratic exceptions well. As such, we are left to ascribing any idiosyncratic phenomena to Exemplar Dynamics and the effects of frequency. In other words, we still are required to take a leap of faith.

So where does this leave us? Having begun to investigate how the edges of prosodic feet and prosodic words may potentially influence if and when voicing occurs, the next step is to quantitatively analyze this process in greater detail. As well, diachronic studies of frequency, and 'age' of loanwords where we do see *rendaku* occur are needed to verify the predictions of Exemplar Dynamics. Until such work progresses, though, we are left with an understanding of compound voicing which is invariably haunted by conjecture.

References

Fukazawa, H., & Kitahara, M. (2001). Domain-relative faithfulness and the OCP: Rendaku revisited. In Van de Weijer, J. Maarten, & T. Nishihara (Eds.), *Issues in Japanese Phonology and Morphology*. New York: Mouton de Gruyter, 85-109.

Gordon, M. (2005). A perceptually-driven account of onset-sensitive stress. *Natural Language & Linguistice Theory* 23, 595-653.

Ito, J. & Mester, A. (1986). The phonology of voiceing in Japanese. *Linguistic Inquiry* 17, 49-73.

Ito, J. & Mester, A. (1999). The Phonological Lexicon. In John McCarthy (ed.), *Optimality Theory in Phonology: A Reader*. Cambridge: Blackwell. [Excerpt from: Natsuko Tsujimura (ed.), *The Handbook of Japanese Linguistics*. Oxford: Blackwell, 62-100.]

Ito, J. & Mester, A. (2003). *Japanese Morphophonemics: Markedness and Word Structure.* Cambridge, MA: MIT Press, 71-99.

Kubozono, H. (1999). Mora and syllable. In: Natsuko Tsujimura (ed.), *The Handbook of Japanese Linguistics*. Oxford: Blackwell, 31-61.

Martel, J. (2009). A Functional Account of Phonological Processes at the Edges of Phonological Domains. *Working Papers of the Linguistics Circle* 19.

Pierrehumbert, J. (2001). Exemplar dynamics: Word frequency, lenition, and contrast. In J. Bybee & P. Hopper (Eds.), *Frequency and the Emergence of Linguistic Structure*. Amsterdam: Benjamins, 137−157.

Rosen, E. (2003). Systematic irregularity in Japanese rendaku: How the grammar mediates patterned lexical exceptions. *Canadian Journal of Linguistics/Revue canadienne de linguistique* 48 (1/2), 1-37.

Unger, J.M. (1975). *Studies in Early Japanese Morphophonemics.* Doctoral dissertation. Yale University. In: Ito, J. & Mester, A. (2003). *Japanese Morphophonemics: Markedness and Word Structure.* Cambridge, MA: MIT Press.

Unger, J.M. (1993). *Studies in Early Japanese Morphophonemic*s. (Second Edition). Bloomington, IN: Indiana University Linguistics Club Publications.