



# Ch xx: Psycholinguistic studies of rendaku\*

## 1 Introduction

This chapter provides an overview of experimental studies of rendaku. The general spirit behind these studies is to test whether rendaku—and other factors that affect the applicability of rendaku—are psychologically real. Experiments using nonce words, or those that ask the participants to create new compounds, address the question of whether patterns of rendaku are internalized in native speakers' mind; i.e. grammaticalized. This spirit is clearly articulated in Vance (1979), which also offers the very first experimental study of rendaku.

This chapter is organized as follows. Section 2 introduces the experiments that address the question of whether rendaku is a grammatical process or a lexicalized pattern. Section 3 summarizes experiments on various specific aspects of rendaku. Section 4 discusses experimental approaches to Lyman's Law, as it relates to rendaku and beyond. Section 5 presents work on the acquisition of rendaku. The final section discusses remaining issues.

## 2 Grammatical vs. lexical?

One of the most important questions about rendaku is whether it is a productive, phonological process or a lexicalized, analogical pattern. The first position assumes/asserts that rendaku is a productive phonological process, governed by the phonological component of grammar—this is the position assumed by most generative studies on rendaku (Itô & Mester 1986, 1996, 2003a,b; Kurisu 2007; Kuroda 2002; McCawley 1968; Mester & Itô 1989; Otsu 1980). In this view, rendaku should be subject to phonological analyses, and can bear on phonological theorizing. The other view is that rendaku is lexical. It is not governed by a productive linguistic system; whether a particular compound shows rendaku or not is stored in memory for each compound. Whether rendaku applies

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or not to novel compounds is determined based on lexical analogy, either via phonological or semantic similarity. In this view, analyses of rendaku should not bear on phonological issues.

One experiment that addressed this question is Ohno (2000), arguing for the lexicalist view of rendaku. The experiment used two N2s: one item, *kami* ‘hair’, almost always undergoes rendaku ([+rendaku]), whereas the other item, *ti* ‘blood’, almost never undergoes rendaku ([-rendaku]). The test was a two-way forced choice wug test (Berko, 1958), in which the participants were given new words and asked to create new words based on them. This experiment used real words, whose combination does not exist in the contemporary Japanese. The result showed that even the [+rendaku] item did not undergo rendaku in some contexts (i.e. *shiro-kami* ‘white hair’), and that even the [-rendaku] item underwent rendaku in some contexts (i.e. *mimi-di* ‘ear bleeding’). Based on this observation, Ohno (2000) concludes that rendaku application is determined by lexical analogy to existing compounds (*shiro-kami*—*kuro-kami* ‘black hair’; *mimi-di*—*hana-di* ‘nose bleeding’), and that characterization of each lexical item based on grammatical features (i.e. [±rendaku]) does not capture the results very well.

Another experiment approached the same issue from a different perspective (Fukuda & Fukuda, 1994). Children with specific language impairment (SLI) are known to fail to learn linguistic processes, whereas lexical information can be learned without obvious difficulties (Paradis & Gopnik, 1997). Fukuda & Fukuda (1994) built on this observation and conducted a word formation experiment using children with SLI as a target group and children without SLI as a control group. Children with SLI indeed applied rendaku to non-frequent or novel compounds much less frequently than children without SLI.<sup>1</sup> The fact that SLI children failed to learn rendaku for non-familiar compounds supports the idea that rendaku is a productive phonological process. However, children with SLI generally showed rendaku for familiar compounds. This result indicates that some familiar compounds with rendaku are stored in memory. The overall results thus show that rendaku perhaps has a dual nature; it may be both lexical and productive (cf. Clahsen 1999; Pinker 1999; Pinker & Prince 1988).

Finally, Kobayashi et al. (2013) report a ERP-based neurolinguistic experiment that supports a rule-governed nature of rendaku. They found that Japanese speakers show LAN and P600 in response to those rendaku-undergoing items that do not usually show rendaku (e.g. *hime* ‘princess’). LAN is independently known to appear as a result of over-application of regular rules (Weyerts et al., 1997), and P600 is similar in this result (at least in some cases) (Morris & Holcomb, 2005). Therefore, their results support the rule-based nature of rendaku; when rendaku applies to otherwise non-undergoing items, rendaku behaves like regular rules in other languages.

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<sup>1</sup>There was no evident difference in the effect of Lyman’s Law (Chapter xx and Section 4 below) between the two groups of participants, however. Both groups of participants showed unexpectedly high rates of rendaku application despite the violation of Lyman’s Law—it seems as though they have not learned Lyman’s Law. See Kawahara (2008) for independent arguments that Lyman’s Law may not be a natural, innate, universal constraint, but instead a unnatural, learned, language-specific constraint.

### 3 Experiments on specific aspects of rendaku

There are many conditions that either increase or decrease the applicability of rendaku (see Chapter xx). This section discusses various experiments that examine these factors experimentally.

#### 3.1 Lexical stratification and rendaku

The application of rendaku is generally limited to Yamato(-like)—i.e., native—words (see Chapter 5 and also Itô & Mester 1986, 1995, 1999, 2008; Otsu 1980). Suzuki et al. (2000) addressed the question of whether this restriction is productive. A larger question they attempted to address is whether the lexical stratification of Japanese lexicon (Itô & Mester, 1995, 1999, 2008) is psychologically real.<sup>2</sup> One of their experiments compared nonce words that can be phonotactically Yamato words, and those that cannot be, where non-Yamato status was cued by voiceless stops after nasals (\*NT-violation) and singleton [p]s (\*[p]-violation) (Itô & Mester, 1995, 1999, 2008). The results showed that there were no differences between the two conditions. Based on these results, Suzuki et al. (2000) doubt the psychological reality of the effect of lexical stratification on rendaku.

One concern of this interpretation of the results is that nonce words that can be phonotactically Yamato words can be conceived of as belonging to any strata (Fukazawa et al., 2002; Ota, 2004): given a core-periphery structure of the Japanese lexicon (Itô & Mester, 1995, 1999, 2008), an element of a subset (Yamato) can also be a member of a superset (e.g. foreign words).<sup>3</sup> That is, there is no guarantee that “nonce Yamato words” were perceived as Yamato words. Nonce words may indeed tend to be perceived as foreign words anyway, because foreign words are those that speakers usually already do not know.<sup>4</sup>

#### 3.2 Effects of N1

It is generally assumed that N1’s effect on the applicability of rendaku is minimal or none (e.g. Itô & Mester 2003a) (Rosen’s Rule and the strong version of Lyman’s Law are exceptions; see below and Chapter xx). Tamaoka et al. (2009), extending on Murata (1984) and Ihara & Murata (2006),

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<sup>2</sup>See also Gelbart (2005), Gelbart & Kawahara (2007), Moreton & Amano (1999), and Tanaka & Yashima (2013) for other experiments addressing this question.

<sup>3</sup>Even if the core-periphery structure does not hold strictly (Kawahara et al., 2002), it is generally the case that a word that can phonotactically be a Yamato word can also be a foreign word, because foreign words are not subject to phonotactic constraints that are specific to them (as far as we know, the only possible exception is the rarity of palatalized [r] in foreign words: Moreton & Amano 1999).

<sup>4</sup>There are a few additional pieces of evidence that nonce words and foreign words are treated alike, at least in Japanese. First, nonce words tend to receive the same accentual patterns as loanwords (Katayama, 1998; Kawahara & Kao, 2012; Kawahara, to appear). Second, both nonce words and loanwords are written with the same type of orthography, i.e. *kata-kana* (Kawahara, 2012).

identified some effects of N1 on rendaku application via experimentation.

The first observation was that the shorter N1, the more likely N2 undergoes rendaku—the distinction between one mora words and longer words seems especially clear (cf. Rosen’s Rule, see below). They also found that the etymological status of N1 affects the applicability of rendaku with the following hierarchy: Yamato > Sino-Japanese > Foreign. It may be the case that the etymological status of N1 affected the interpretation of the etymological status of the whole compounds, resulting in the observed hierarchy. The experiment also found that N1 ending with a moraic nasal /N/ is more likely to cause rendaku than those ending with a vowel. This result replicates a lexical tendency concerning rendaku (Okumura, 1955; Vance, 1987, 2007).

In another study, Tamaoka & Ikeda (2010) compared effects of five kinds of N1 (*imo* ‘potato’, *kome* ‘rice’, *soba* ‘soba noodle’, *mugi* ‘wheat’, *kokutōo* ‘black sugar’) on rendaku with a fixed N2 (*syootyuu* ‘alcoholic beverage’). They tested speakers from six different dialects (Kagoshima, Oita, Fukuoka, Yamaguchi, Hiroshima and Shizuoka) which differ in familiarity with these different kinds of *syootyuu*. The purpose of this design was to test the hypothesis that familiar non-Yamato items can undergo rendaku (Itô & Mester, 2003a; Otsu, 1980; Takayama, 1999) (cf. Ohno 2000). Since *syootyuu* is a Sino-Japanese noun, if familiarity facilitates rendaku, the dialect should differ in which N1 induces rendaku the most—i.e., the most familiar type of *syootyuu* in each dialect is predicted to undergo rendaku most often.

However, the results were that there are no substantial differences among dialects. The overall order among the five different N1’s was: *imo* > *kome* > (=) *soba* > *mugi* > *kokutōo*. There was an effect of N1 length: the shorter the N1, the more likely it causes rendaku, which explains the lowest of applicability of rendaku to *kokutōo*. The presence of a voiced stop (in *soba* and *mugi*) may have blocked rendaku to some extent (although the authors doubt this possibility that a stronger version of Lyman’s Law is active; see below Section 4).

While the effects of N1 on rendaku were identified in these experiments, another specific effect of N1 length on rendaku application was discovered by Rosen (2003), which Vance (to appear) proposes to call “Rosen’s Rule”. According to Rosen’s Rule, rendaku is more likely to apply when N1 is longer than 2 moras than when N1 is shorter (Irwin, 2009; Rosen, 2003; Vance, to appear). Sano & Kawahara (2013) addressed whether this lexical pattern can be replicated using nonce words. The results of their experiment showed that there is a small trend in which rendaku is more likely when N1 is 3 mora long than when it is 2 mora long, but that the difference is very small and not statistically significant. They conclude that the lexical tendency represented by Rosen’s Rule may not be grammaticalized.<sup>5</sup>

Finally, Kawahara & Sano (2014) addressed a yet another factor that impacts the applicability

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<sup>5</sup>Null results in inferential statistical tests do not support the null hypothesis, and therefore their conclusion should be interpreted with a grain of salt. However, the fact that 35 native speakers of Japanese showed only very small, if any, effects undermines the hypothesis that Rosen’s Rule is synchronically active.

of rendaku, namely, avoidance of two adjacent identical CV moras (i.e. identity avoidance). The effect of identity avoidance is known to play a role in some domains of Japanese phonology (Sano, 2013). Its effect on rendaku was briefly noted by Sato (1988) but refuted by Irwin (2013) based on statistical evidence. Their experiment showed that rendaku is indeed more likely to apply when the two CV moras across a morpheme boundary are identical (e.g. [ika+**kaniro**]) than when they were not (e.g. [ika+**taniro**]); i.e., the identity avoidance constraint triggers rendaku. The experiment also showed that rendaku is less likely to apply when it would result in two adjacent identical consonants across a morpheme boundary (e.g. [iga+**ganiro**]) than when it would not (e.g. [iga+**daniro**]). The identity avoidance constraint blocks rendaku.

### 3.3 Right branching condition

One well-known—and also often debated—restriction on rendaku is right-branching condition, where rendaku applies only to an element that is on a right branch of a compound (see Chapter xx and Kubozono 2005; Otsu 1980; Vance 1980a, 1987). Kozman (1998) tested the psychological reality of this restriction. In this experiment, Japanese speakers were asked to guess the meanings of given novel compounds in a two-way forced choice format. For example, given [nuri+**bashi**+bako] and [nuri+**hashi**+bako] ‘lacquered chopstick box’, the participants were asked which one of [[nuri+hashi]+hako] or [[nuri+[hashi+hako]] better represents their meanings, the meanings being cued by full sentences. The right-branching condition predicts that the form with rendaku on the second element should be interpreted as being on the right branch (i.e. [[nuri+**bashi**]+hako]). However, the results were that the presence of rendaku did not disambiguate the element with rendaku as being on a right branch. See Kumagai (2009) for similar results showing no effects of the right branching condition.

### 3.4 Semantic relationships between N1 and N2

Kozman (1998) tested another morphological restriction on rendaku: rendaku applies if N1 is a modifier of N2, but does not apply if N1 is a (syntactic) direct object of N2 (Sugioka, 1984, 2002, 2005; Yamaguchi, 2011). In the experiment, Kozman (1998) presented two novel compounds using, for example, [eda] ‘branch’ and [haki] ‘sweeping’—[eda+**haki**] and [eda+**baki**]—and investigated whether the compounds with rendaku induce the modifier interpretation more than the direct object interpretation. However, the results showed that the presence of rendaku did not encourage the interpretation of N1 as a modifier.

### 3.5 Segmental effects on rendaku

Ihara et al. (2011) ran a wug-test to examine various segmental effects on rendaku, addressing which consonants are most likely to undergo rendaku. They found segmental effects of consonant with the following hierarchy: /h/ > /k/ = /t/ > /s/ where /h/ is most likely to undergo rendaku and /s/ is least likely to undergo rendaku. They argue that this hierarchy can be interpreted as reflecting the markedness hierarchy, \*[z] >> \*[g], \*[d] >> \*[b], and that this hierarchy is compatible with the cross-linguistic markedness patterns and phonetic challenges that voiced obstruents present. Voiced fricatives seem cross-linguistically more marked than voiced stops, because voiced fricatives require high intraoral air pressure to cause frication, but at the same time the high intraoral air pressure makes it difficult to maintain airflow across the glottis (Ladefoged & Maddieson, 1996; Lindblom & Maddieson, 1988; Ohala, 1983). The rendaku hierarchy within voiced stops found in this experiment is also compatible with the aerodynamic difficulty hierarchy among voiced stops with different place of articulation: the further back the oral occlusion is, the quicker the intraoral air pressure goes up, resulting in the cession of glottal airflow (Hayes & Steriade, 2004; Ohala, 1983; Ohala & Riordan, 1979).<sup>6</sup>

## 4 Experiments on Lyman's Law

There have been a number of experiments on Lyman's Law on rendaku and beyond. Lyman's Law (Lyman, 1894) is a restriction where rendaku is blocked when N2 already contains a voiced obstruent (see Chapter 22). Vance (1980b), based on Vance (1979), presented a wug experiment on the effect of Lyman's Law on rendaku. The results showed that there was generally a large inter-speaker variability. Nevertheless, all speakers applied rendaku less often if it resulted in a violation of Lyman's Law. A locality effect was also found such that the closer the blocker, the less likely rendaku occurred. This is an interesting result because, since Lyman's Law holds almost without exceptions in the Japanese lexicon, the observed locality may not be based on the lexical pattern.

Ihara et al. (2009) further investigated whether the locality of Lyman's Law violation affects the applicability of rendaku. Their results found that locality did matter—the closer the voiced obstruent to the potential undergoer, the less likely that it actually underwent rendaku. They conducted the same experiment twice, once in 1984 and once in 2005, and found that this locality effect became weaker from the first experiment in 1984 to the second experiment in 2005.

Kawahara (2012) conducted naturalness judgment experiments on the effect of Lyman's Law on rendaku. The participants were presented with N1 (*nise*-) and N2, together with N1+N2 with

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<sup>6</sup>This effect of place of articulation is also observed in the devoicing likelihood of geminates in loanwords (Kawahara & Sano, 2013b).

rendaku. They were asked to rate how natural the form with rendaku is for each form, using a Lickert 5-point scale. Japanese speakers judged rendaku that violates Lyman’s Law less natural than rendaku that does not. In this experiment, the locality of the violation of Lyman’s Law did not matter, and the conjecture was that the locality effect was increasingly diminishing so that it had no tangible effects by the time the experiment was run in 2011. In an experiment conducted in 2013, Kawahara & Sano (2013a) also failed to find the locality effect of Lyman’s Law, which may support this conjecture.<sup>7</sup>

Kawahara & Sano (2013a), building on Kawahara & Sano (2014), tested whether the simultaneous violation of an identity avoidance constraint and Lyman’s Law (e.g. [dadanu]) is considered to be worse than a mere violation of Lyman’s Law (e.g. [daguta]), using a wug-test. They found that as long as the violation occurs in adjacent syllables, Japanese speakers do avoid the simultaneous violation more than a mere violation of Lyman’s Law. Since there are only a handful of exceptions of Lyman’s Law in the Japanese lexicon, they argue that this finding cannot be reduced to an inference from the lexical pattern about rendaku in Japanese.

Sano & Kawahara (2013) tested another aspect of Lyman’s Law, namely, the strong version of Lyman’s Law. Sugito (1965) points out that the morpheme [+ta] fails to undergo rendaku in family name formation more often when N1 contains a voiced obstruent (e.g. *fuji-ta*) than when it does not (e.g. *ima-da*). The blockage of rendaku by a voiced obstruent in N1 is known as “strong version of Lyman’s Law” and is argued to hold in Old Japanese (Unger, 1975; Vance, 2005b), although the synchronic status of this constraint is much debated (Itô & Mester, 1996, 2003a; Sugito, 1965; Vance, to appear). Sano & Kawahara (2013), using a wug-test, did not find a substantial blockage effect due to the strong version of Lyman’s Law.

Finally, Lyman’s Law is generally known to affect rendaku, but Nishimura (2003) pointed out that Lyman’s Law can also cause devoicing of voiced obstruent geminates in loanwords. Kawahara (2011a,b, 2012, 2013) conducted a series of judgment experiments testing the productivity of this devoicing pattern triggered by Lyman’s Law. Kawahara (2011b) found that Lyman’s Law made devoicing of geminates more natural, and Kawahara (2011a, 2012, 2013) further found that Lyman’s Law made devoicing of singletons more natural as well. Lyman’s Law thus seems to be active not only in blocking rendaku, but also triggering devoicing.

## 5 Acquisition of rendaku

Sugimoto (2013) examines the acquisition of rendaku by pre-schoolers (*yootiendi*). The study tested, for children of each grade, (i) whether they show rendaku for compounds that actually ex-

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<sup>7</sup>However, the locality effect of Lyman’s Law is found in the devoicing likelihood of voiced geminates in loanwords (Kawahara & Sano, 2013b).

hibit rendaku, and (ii) whether they do not show rendaku for those words that should not (Lyman's Law-violating words, Sino-Japanese words, and foreign words). First, the study found that in the second conditions, pre-schoolers of all grades did not show rendaku. There are two possible interpretations of this result: (i) the children knew that they should not apply rendaku in these words or (ii) not applying rendaku is the default, and they do not apply rendaku unless they learn otherwise. Second, the experiment found that the rendaku application rate increased as the children's ages got older. Sugimoto (2013) concludes that rendaku is acquired gradually, rather than on an all-or-nothing basis, and that it may be learned word by word. This result is not too surprising, given the lexical nature of rendaku (Chapter xx). A longitudinal acquisition study is yet to be conducted.

[Note: This section is likely to be moved to another chapter and merged with studies on L2 acquisition of rendaku.]

## 6 Remaining questions

Although there have been a number of experimental studies on rendaku, there are some remaining issues that can and should be addressed in future research. The first issue concerns the experimental instructions. Rendaku generally applies only to native words, but nonce words are usually treated by native speakers as if they are loanwords. One question that arises is whether it would make sense at all to run experiments on rendaku using nonce words. To address this concern, Vance (1980b) instructed the participants to treat nonce word stimuli as Old Yamato words. Kawahara (2012) ran the same experiment with two different instructions: in Experiment I, the stimuli were presented as Old Yamato words, whereas in Experiment II, the stimuli were presented as nonce words. Kawahara (2012) found that there were no substantial differences between the two conditions. This question is important for us to continue to address, as it is related to a larger question of whether it makes sense to run nonce-word studies to probe aspects of rendaku at all, and if so, how.

Another limitation of the previous studies is that the methodology is limited to off-line judgment tasks: wug-test (many studies reviewed above), naturalness judgment task (Kawahara 2011b *et seq.*) or meaning probing task (Kozman, 1998). Experiments going beyond off-line judgments may reveal the psychological reality of rendaku from a perceptual point of view. For example, it would be interesting to create a voiceless-voiced continuum, and to investigate if Japanese speakers show a boundary shift toward voiced responses in an environment where rendaku is expected. It would also be interesting to see if Lyman's Law causes a similar boundary shift toward voicelessness. This sort of methodology may help to address the psychological reality of rendaku and Lyman's Law more directly than off-line judgment tasks (see Goldrick 2011 for critical discussion



on off-line judgment tasks).

Finally, there are also a few other aspects of rendaku that are yet to be tested. For example, in compounding, rendaku tends to be accompanied by deaccentuation of whole compounds; e.g. *ta'ba-ta* vs. *yosi-da* (both family names) (Sugito, 1965; Sugioka, 2002; Tanaka, 2005; Zamma, 2005). Dvandva compounds are known not to undergo rendaku (Itô & Mester, 1986; Sugioka, 1984). The applicability of rendaku also depends on parts of speech of N2 (Vance, 2005a; Yamaguchi, 2011). These aspects of rendaku have not been tested, and there are no reasons that they should not be.

## References

- Berko, Jean (1958) The child's learning of English morphology. *Word* **14**: 150–177.
- Clahsen, Harald (1999) Lexical entries and rules of language: A multidisciplinary study of German inflection. *Behavioral and Brain Sciences* **22**: 991–1013.
- Fukazawa, Haruka, Mafuyu Kitahara, & Mitsuhiro Ota (2002) Acquisition of phonological sublexica in Japanese: An OT account. In *Proceedings of the Third Tokyo Conference on Psycholinguistics*, Yukio Otsu, ed., Tokyo: Hitsuji Shobo, 97–114.
- Fukuda, Suzy & Shinji Fukuda (1994) To voice or not to voice: The operation of rendaku in the Japanese developmentally language-impaired. *McGill Working Papers in Linguistics* **10**: 178–193.
- Gelbart, Ben (2005) *Perception of Foreignness*. Doctoral dissertation, University of Massachusetts, Amherst.
- Gelbart, Ben & Shigeto Kawahara (2007) Lexical cues to foreignness in Japanese. In *Proceedings of Formal Approaches to Japanese Linguistics 4 [MIT Working Papers in Linguistics 55]*, Cambridge: MITWPL, 49–60.
- Goldrick, Matthew (2011) Utilizing psychological realism to advance phonological theory. In *The Handbook of Phonological Theory, 2nd Edition*, John A. Goldsmith, Jason Riggle, & Alan Yu, eds., Oxford: Blackwell-Wiley, 631–660.
- Hayes, Bruce & Donca Steriade (2004) Introduction: The phonetic bases of phonological markedness. In *Phonetically Based Phonology*, Bruce Hayes, Robert Kirchner, & Donca Steriade, eds., Cambridge: Cambridge University Press, 1–33.
- Ihara, Mutsuko & Tadao Murata (2006) Nihongo-no rendaku-ni kansuru ikutsuka-no jikken [Some experiments on sequential voicing]. *On-in Kenkyuu [Phonological Studies]* **9**: 17–24.
- Ihara, Mutsuko, Katsuo Tamaoka, & Hyunjung Lim (2011) Rendaku and markedness: Phonetic and phonological effects. Talk presented at Tokyo Circle of Phonologists (TCP), July 24th.
- Ihara, Mutsuko, Katsuo Tamaoka, & Tadao Murata (2009) Lyman's Law effect in Japanese se-

- quential voicing: Questionnaire-based nonword experiments. In *Current Issues in Unity and Diversity of Languages: Collection of the papers selected from the 18th International Congress of Linguists*, The Linguistic Society of Korea, ed., Dongam Publishing Co., Republic of Korea.
- Irwin, Mark (2009) Prosodic size and rendaku immunity. *Journal of East Asian Linguistics* **18**: 179–196.
- Irwin, Mark (2013) Rendaku and duplicate moras. Ms. Yamagata University.
- Itô, Junko & Armin Mester (1986) The phonology of voicing in Japanese: Theoretical consequences for morphological accessibility. *Linguistic Inquiry* **17**: 49–73.
- Itô, Junko & Armin Mester (1995) Japanese phonology. In *The Handbook of Phonological Theory*, John Goldsmith, ed., Oxford: Blackwell, 817–838.
- Itô, Junko & Armin Mester (1996) Rendaku I: Constraint conjunction and the OCP. Ms. University of California, Santa Cruz.
- Itô, Junko & Armin Mester (1999) The phonological lexicon. In *The Handbook of Japanese Linguistics*, Natsuko Tsujimura, ed., Oxford: Blackwell, 62–100.
- Itô, Junko & Armin Mester (2003a) *Japanese Morphophonemics*. Cambridge: MIT Press.
- Itô, Junko & Armin Mester (2003b) Lexical and postlexical phonology in Optimality Theory: Evidence from Japanese. *Linguistische Berichte* **11**: 183–207.
- Itô, Junko & Armin Mester (2008) Lexical classes in phonology. In *The Oxford Handbook of Japanese Linguistics*, Shigeru Miyagawa & Mamoru Saito, eds., Oxford: Oxford University Press, 84–106.
- Katayama, Motoko (1998) *Optimality Theory and Japanese Loanword Phonology*. Doctoral dissertation, University of California, Santa Cruz.
- Kawahara, Shigeto (2008) Phonetic naturalness and unnaturalness in Japanese loanword phonology. *Journal of East Asian Linguistics* **17**(4): 317–330.
- Kawahara, Shigeto (2011a) Aspects of Japanese loanword devoicing. *Journal of East Asian Linguistics* **20**(2): 169–194.
- Kawahara, Shigeto (2011b) Japanese loanword devoicing revisited: A rating study. *Natural Language and Linguistic Theory* **29**(3): 705–723.
- Kawahara, Shigeto (2012) Lyman’s Law is active in loanwords and nonce words: Evidence from naturalness judgment experiments. *Lingua* **122**(11): 1193–1206.
- Kawahara, Shigeto (2013) Testing Japanese loanword devoicing: Addressing task effects. *Linguistics* **51**(6): 1271 – 1299.
- Kawahara, Shigeto (to appear) The phonology of Japanese accent. In *The Handbook of Japanese Language and Linguistics: Phonetics and Phonology*, Haruo Kubozono, ed., Mouton.
- Kawahara, Shigeto & Sophia Kao (2012) The productivity of a root-initial accenting suffix, [-zu]: Judgment studies. *Natural Language and Linguistic Theory* **30**(3): 837–857.

- Kawahara, Shigeto, Kohei Nishimura, & Hajime Ono (2002) Unveiling the unmarkedness of Sino-Japanese. In *Japanese/Korean Linguistics 12*, W. McClure, ed., Stanford: CSLI, 140–151.
- Kawahara, Shigeto & Shin-ichiro Sano (2013a) Identity Avoidance and Lyman's Law. ms. Keio University and Okayama Prefectural University.
- Kawahara, Shigeto & Shin-ichiro Sano (2014) Identity avoidance and rendaku. *Proceedings of Phonology 2013*.
- Kawahara, Shigeto & Shinichiro Sano (2013b) A corpus-based study of geminate devoicing in Japanese: Linguistic factors. *Language Sciences* **40**: 300–307.
- Kobayashi, Yuki, Yoko Sugioka, & Takane Ito (2013) Kisokutekiyoo toshite-no rendaku: Jishoo kanren den-i keisokujikken-no kekka-kara [Rendaku as rules: Evidence from an ERP experiment]. Talk presented at the 147th meeting of Linguistic Society of Japan.
- Kozman, Tam (1998) The psychological status of syntactic constraints on *rendaku*. In *Japanese/Korean Linguistics 8*, David Silva, ed., Stanford: CSLI, 107–120.
- Kubozono, Haruo (2005) Rendaku: Its domain and linguistic conditions. In *Voicing in Japanese*, Jeroen van der Weijer, Kensuke Nanjo, & Tetsuo Nishihara, eds., Berlin & New York: Mouton de Gruyter, 5–24.
- Kumagai, Gakuji (2009) How do Japanese speakers produce rendaku? The psychological reality of the branching constraint regarding rendaku in Japanese Phonology. Ms. Dokkyo University.
- Kurusu, Kazutaka (2007) Asymmetric voicing and relativized markedness. *Proceedings of Formal Approaches to Japanese Linguistics* **4**: 161–172.
- Kuroda, S.-Y. (2002) Rendaku. In *Japanese/Korean Linguistics 10*, Noriko Akatsuka & Susan Strauss, eds., Stanford: CSLI, 337–350.
- Ladefoged, Peter & Ian Maddieson (1996) *The Sounds of the World's Languages: 2nd Edition*. Oxford: Blackwell Publishers.
- Lindblom, Björn & Ian Maddieson (1988) Phonetic universals in consonant systems. In *Language, speech and mind*, L. Hyman & C. Li, eds., London: Routledge, 62–80.
- Lyman, Benjamin S. (1894) Change from surd to sonant in Japanese compounds. *Oriental Studies of the Oriental Club of Philadelphia* : 1–17.
- McCawley, James D. (1968) *The Phonological Component of a Grammar of Japanese*. The Hague: Mouton.
- Mester, Armin & Junko Itô (1989) Feature predictability and underspecification: Palatal prosody in Japanese mimetics. *Language* **65**: 258–93.
- Moreton, Elliot & Shigeaki Amano (1999) Phonotactics in the perception of Japanese vowel length: Evidence for long distance dependencies. *Proceedings of the 6th European Conference on Speech Communication and Technology*.
- Morris, J & P. Holcomb (2005) Event-related potentials to violations of inflectional verbal mor-

- phonology in English. *Cognitive Brain Research* **25**: 963–981.
- Murata, Tadao (1984) Nihongo-no rendaku-ni tsuite [On rendaku in the Japanese language]. Hand-out of a talk presented at Fukuoka Linguistic Society.
- Nishimura, Kohei (2003) *Lyman's Law in loanwords*. MA thesis, Nagoya University.
- Ohala, John J. (1983) The origin of sound patterns in vocal tract constraints. In *The Production of Speech*, Peter MacNeilage, ed., New York: Springer-Verlag, 189–216.
- Ohala, John J. & C. J. Riordan (1979) Passive vocal tract enlargement during voiced stops. In *Speech Communication Papers*, J. J. Wolf & D. H. Klatt, eds., New York: Acoustical Society of America, 89–92.
- Ohno, Kazutoshi (2000) The lexical nature of rendaku in Japanese. In *Japanese/Korean Linguistics 9*, Mineharu Nakayama & Carles Quinn, eds., Stanford: CSLI Publications, 151–164.
- Okumura, Mitsuo (1955) Rendaku. In *Kokugogaku jiten*, Kokugogakkai, ed., Tokyo: TokyooDoo, 961–962.
- Ota, Mitsuhiro (2004) The learnability of the stratified phonological lexicon. *Journal of Japanese Linguistics* **20**: 19–40.
- Otsu, Yukio (1980) Some aspects of rendaku in Japanese and related problems. In *MIT Working Papers in Linguistics*, vol. 2, Ann Farmer & Yukio Otsu, eds., Cambridge, Mass.: Department of Linguistics and Philosophy, MIT, 207–228.
- Paradis, M. & M. Gopnik (1997) Compensatory strategies in genetic dysphasia: Declarative memory. *Journal of Neurolinguistics* **10**: 173–185.
- Pinker, Steven (1999) *Words and Rules*. New York: Basic Books.
- Pinker, Steven & Alan Prince (1988) On language and connectionism: Analysis of a parallel distributed processing model of language acquisition. *Cognition* **28**: 73–193.
- Rosen, Eric (2003) Systematic irregularity in Japanese *rendaku*: How the grammar mediates patterned lexical exceptions. *Canadian Journal of Linguistics* **48**: 1–37.
- Sano, Shin-ichiro (2013) Violable and inviolable OCP effects on linguistic changes: Evidence from verbal inflections in Japanese. *Proceedings of FAJL 6 [MIT Working Papers in Linguistics 66]*: 145–156.
- Sano, Shin-ichiro & Shigeto Kawahara (2013) Testing rendaku experimentally: Rosen's Rule, (Strong) Lyman's Law and Identity Avoidance. Talk presented at ICPP 3.
- Sato, H. (1988) Hukugougo-ni okeru akusento kisoku-to rendaku kisoku [Rules on compound accents and rendaku]. *Nihongo no Onsei to On'in* **2**: 233–265.
- Sugimoto, Takayo (2013) Yooji-no rendaku-no kakutoku-ni kansuru oudanteki kenkyuu-goshu-to raiman-no hoosoku-wo chuushin-ni. Talk delivered at Nihon Gengogakkai, 2013.
- Sugioka, Yoko (1984) *Interaction of Derivational Morphology and Syntax in Japanese and English*. Doctoral dissertation, University of Chicago, published 1986, Outstanding Dissertations

- in Linguistics series, Garland, New York.
- Sugioka, Yoko (2002) Incorporation vs. modification in deverbal compounds. In *Japanese/Korean Linguistics 10*, Noriko Akatsuka & Susan Strauss, eds., Stanford: CSLI Publications, 495–508.
- Sugioka, Yoko (2005) Multiple mechanisms underlying morphological productivity. In *Polymorphous Linguistics: Jim McCawley's Legacy*, Salikoko S. Mufwene, Elaine J. Francis, & Rebecca S. Wheeler, eds., Cambridge: MIT Press, 204–223.
- Sugito, Miyoko (1965) Shibata-san to Imada-san: Tango-no chookakuteki benbetsu-no ichi koosatsu [Mr. Satoo and Mr. Imada: An Analysis of Auditory Distinction of Words]. *Gengo Seikatsu* **165**.
- Suzuki, Keiichiro, Jessica Maye, & Kazutoshi Ohno (2000) On the productivity of lexical stratification in Japanese. A talk presented at LSA.
- Takayama, Tomoaki (1999) Syakuyoo-go-no rendaku/koo'onka-ni tsuite [Sequential voicing and fortition in loanwords]. *Report of the special research project for the typological investigation of languages and cultures of the East and West* **1**: 375–385.
- Tamaoka, Katsuo, Mutsuko Ihara, Tadao Murata, & Hyunjung Lim (2009) Effects of first-element phonological-length and etymological-type features on sequential voicing (rendaku) of second elements. *Journal of Japanese Linguistics* **25**: 17–38.
- Tamaoka, Katsuo & Fumiko Ikeda (2010) Whiskey or bhiskey? Influence of first element and dialect region on sequential voicing of *shoochuu*. *Gengo Kenkyu [Journal of the Linguistic Society of Japan]* **137**: 65–79.
- Tanaka, Shin-ichi (2005) Where voicing and accent meet: (In-)completeness in the harmonic scale of phonological prominence. In *Voicing in Japanese*, Jeroen Van de Weijer, Kensuke Nanjo, & Tetsuo Nishihara, eds., Berlin and New York: Mouton de Gruyter, 261–278.
- Tanaka, Yu & Jun Yashima (2013) Deliberate markedness in Japanese hypocoristics. *Proceedings of GLOW in Asia* **IX**: 283–297.
- Unger, Marshall (1975) *Studies in Early Japanese Morphophonemics*. Doctoral dissertation, Yale University.
- Vance, Timothy J. (1979) *Nonsense word experiments in phonology and their application to rendaku in Japanese*. Doctoral dissertation, University of Chicago.
- Vance, Timothy J. (1980a) Comments on Otsu (1980). In *MIT Working Papers in Linguistics*, vol. 2, Ann Farmer & Yukio Otsu, eds., Cambridge, Mass.: Department of Linguistics and Philosophy, MIT, 229–236.
- Vance, Timothy J. (1980b) The psychological status of a constraint on Japanese consonant alternation. *Linguistics* **18**: 245–267.
- Vance, Timothy J. (1987) *An Introduction to Japanese Phonology*. New York: SUNY Press.
- Vance, Timothy J. (2005a) Rendaku in inflected words. In *Voicing in Japanese*, Jeroen van de

- Weijer, Kensuke Nanjo, & Tetsuo Nishihara, eds., Berlin & New York: Mouton de Gruyter, 89–104.
- Vance, Timothy J. (2005b) Sequential voicing and Lyman’s Law in Old Japanese. In *Polymorphous Linguistics: Jim McCawley’s Legacy.*, Salikoko S. Mufwene, Elaine J. Francis, & Rebecca S. Wheeler, eds., Cambridge: MIT Press, 27–43.
- Vance, Timothy J. (2007) Have we learned anything about *rendaku* that Lyman didn’t already know? In *Current issues in the history and structure of Japanese*, Bjarke Frellesvig, Masayoshi Shibatani, & John Carles Smith, eds., Tokyo: Kurosio, 153–170.
- Vance, Timothy J. (to appear) Rendaku. In *The Handbook of Japanese Language and Linguistics: Phonetics and Phonology*, Haruo Kubozono, ed., Gruyter: Mouton.
- Weyerts, H., M. Penke, U. Dohrn, H. Clahsen, & T.F. M/’unte (1997) Brain potentials indicate differences between regular and irregular German plurals. *NeuroReport* **8**: 957–962.
- Yamaguchi, Kyoko (2011) Accentedness and *rendaku* in Japanese deverbal compounds. *Gengo Kenkyu [Journal of the Linguistic Society of Japan]* **140**: 117–134.
- Zamma, Hideki (2005) Correlation between accentuation and *rendaku* in Japanese surnames: with particular attention to morphemes. In *Voicing in Japanese.*, Jeroen van der Weijer, Kensuke Nanjoo, & Tetsuo Nishihara, eds., Berlin & New York: Mouton de Gruyter, 157–176.