# Testing Rosen’s Rule Yet Again: An Experimental Study

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## 1 Introduction

Compound formation in Japanese may involve a voicing alternation known as “rendaku.” When rendaku applies, the initial consonant of the second element becomes voiced, as shown in (1).[1]

(1) Compounds undergoing rendaku

| | | | | | |
|---|---|---|---|---|---|
| maki | + | susi | → | maki-**z**usi | ‘rolled-sushi’ |
| ori | + | kami | → | ori-**g**ami | ‘folding-paper’ |

Rendaku is quite irregular and does not apply in every compound. A number of studies have proposed phonological and non-phonological factors affecting the occurrence of this compound voicing alternation (see Vance 2015a; Kawahara 2016; Kawahara and Zamma 2016; Irwin 2016a among others for recent overviews of research on rendaku). One of such factors is the prosodic size of word elements. Rosen (2001, 2003) proposes that a non-coordinate compound composed of native nouns always undergoes rendaku if “one of its elements is three moras or longer” (unless the second element is

[1] The transcriptions of words in this paper are largely based on the kunrei romanization system. The glosses for compounds are mostly verbatim translations of their elements.

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somehow idiosyncratically immune to voicing).[2] This condition is known as "Rosen's Rule." Illustrative examples are given in (2).

(2) Compounds showing Rosen's Rule effects

| | | | | | | |
|---|---|---|---|---|---|---|
| a. | hotaru | + | k̲usa | → | hotaru-**g**usa | 'firefly-grass' |
| b. | haru | + | k̲usa | → | haru-kusa | 'spring-grass' |

Both compounds have /kusa/ 'grass' as their second element (henceforth "E2"). As can be seen, (2a) with a three-mora first element (henceforth "E1") shows voicing, while (2b) with a two-mora E1 does not.

Later studies confirm the validity of Rosen's Rule. Irwin (2009, 2016b) and Vance (2015a,b) conduct dictionary studies, and show that, although the rule is not actually as ironclad as Rosen (2001, 2003) has originally claimed, it does capture statistical tendencies of rendaku application. That is, generally speaking, compounds are more likely to undergo voicing when one of their elements exceeds two moras.

On the other hand, the rule's psychological reality has been called into question. Kawahara and Sano (2014) conduct a nonword experiment where Japanese speakers judge rendaku applicability in compounds with various lengths of E1. The results show that speakers do not particularly prefer voicing change when E1 is three moras compared to when it is two moras. Kawahara and Sano conclude that E1's length does not affect rendaku, further suggesting that Rosen's Rule may not be active in Japanese speakers' minds.[3]

What caused the difference between the actual data patterns reported in Irwin (2009, 2016b) and Vance (2015a,b) on one hand and the participants' behaviors in Kawahara and Sano (2014) on the other? It is possible that the tendencies seen in real words are not internalized as real phonological patterns in Japanese speakers' mental grammars, as is implied by Kawahara and Sano. Another possibility is that their null experimental results have been caused by some confounding factors, such as the length and nonword status of E2.

It should first be noted that the stimuli in Kawahara and Sano's (2014) experiment are not perfectly suited for testing Rosen's Rule from the point of view of their prosodic size. Kawahara and Sano used two-element compounds composed of two- or three-mora existing words as E1 (e.g. two-mora *mori* 'forest', three-mora *kumori* 'cloudy, cloudiness') and three-mora nonsense words as E2 (e.g. *semaro*). They predicted that rendaku application in

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[2] See Rosen (2001, 2003) for its detailed definition. Also see Irwin (2009, 2016b) for a proposal to modify the original definition.

[3] Tamaoka et al. (2009) and Tamaoka and Ikeda (2010) conduct similar studies. Although their research is not particularly intended to test Rosen's Rule, they also conclude that there is no effect of E1's length on rendaku application.

the three-mora-E1 condition, as shown in (3b) below, would have a higher acceptance rate than that in the two-mora-E1 condition, or (3a). As stated above, the prediction was not borne out.

(3) Kawahara and Sano's (2014) experimental task
  a. mori + semaro → mori-**s**emaro or mori-**z**emaro?
  b. kumori + semaro → kumori-**s**emaro or kumori-**z**emaro?

However, Rosen's Rule, in its original definition, states that rendaku must apply if "one of the elements is three moras or longer" (see above). Notice that every stimulus word in Kawahara and Sano (2014) is already eligible for rendaku by this criterion, since E2 is trimoraic. Thus, this may have promoted their participants' rendaku responses in general, and have dampened potential effects of E1's length differences.

Meanwhile, their participants may also have been reluctant to accept rendaku application in general due to the fact that nonce words always appeared as E2. The literature shows that language speakers have a non-alternation bias (see e.g. Albright and Do 2013; Coetzee 2009): participants in an artificial language learning task tend to assume that they should not change word forms (unless they are given ample evidence telling them otherwise). It is possible that Kawahara and Sano's (2014) participants disfavored voicing change in nonce E2 items (e.g. *semaro* → *zemaro*), which they had never seen before, due to this non-alternation bias. That is, it may have played a role as a rendaku-inhibiting factor in their judgment.

It is unclear whether or how E2's length and non-word status have actually affected Kawahara and Sano's (2014) experimental results. Nevertheless, it is conceivable that these factors, which could drive rendaku application rates to the two opposite directions, have masked subtle acceptability differences among the different conditions, or in other words, potential effects of Rosen's Rule. Given these possible confounds in the previous research, a new experiment with a more controlled design is called for. This study fills the gap. I conduct a nonword rendaku judgment experiment along the lines of Kawahara and Sano (2014) while controlling for the factors discussed above. The goal of the study is thus to reexamine the psychological reality of Rosen's Rule.

## 2 Method

### 2.1 Participants

Forty-one native speakers of Japanese participated in the experiment. Most of them were college students in their late teens or early twenties who were recruited in classrooms in Doshisha University, Japan. Others were recruited through e-mails or on social media. They all took part on a voluntary basis.

| | Nonce E1 + Real E2 | Real E1 + Nonce E2 |
|---|---|---|
| 2-mora Nonce | /kema-tori/ 'NONCE-bird' | /kawa-hesa/ 'river-NONCE' |
| 3-mora Nonce | /somoka-tori/ 'NONCE-bird' | /kawa-sekora/ 'river-NONCE' |

Table 1 Stimulus types and examples

### 2.2 Stimuli

Compounds composed of nonce and real elements were used as stimuli. For nonce elements, I created two-mora and three-mora words, randomly combining phonotactically-legal open syllables in Japanese. It was ensured that the sound sequences were not listed as lexical items on a large dictionary of Japanese (Shinmura 2008), and that, other than the length differences, they did not contain any features that could affect rendaku application (e.g. voiced obstruents, segments that are typical of Sino-Japanese words or recent loans, etc.) when appearing as E1 or E2 of a compound. Those containing features that could sound unnatural (e.g. sequences of idential moras) were also excluded. As a result, 48 two-mora words (one half for E1 and the other half for E2) and 48 three-mora words (one half each for E1 and E2) were obtained. Those to be used as E2 all had a voiceless obstruent in word-initial position, so that they would potentially undergo voicing. Examples include /heka/ and /kemosa/. (A full list of the nonce words is given in Table 3 in Appendix.)

As for existing words, I referred to the Rendaku Database compiled by Irwin et al. (2017), and adopted the 45 most frequent two-mora E1 nouns (e.g. /kusa/ 'grass') and the 49 most frequent two-mora E2 nouns (e.g. /sima/ 'island') that were not "rendaku-lovers," "rendaku-haters," or "rendaku-immune" in Rosen's (2001) terms. That is, these E2 morphemes undergo rendaku moderately, or about 33% to 66% of the time in the entire database. (Irwin 2014 call such morphemes "rendaku-waverers.")[4]

These elements were then randomly combined to create non-existing compounds. By the length and position of the nonce elements, the words are categorized into four types: compounds composed of two- or three-mora nonce E1 and two-mora real E2 (e.g. /kema+tori/, /somoka+tori/ 'NONCE-bird'), and compounds composed of two-mora real E1 and two- or three-mora nonce E2 (e.g. /kawa+hesa/, /kawa+sekora/ 'river-NONCE'). (Recall that the real elements are all bimoraic.) The all four types are shown in Table 1 with representative examples.

[4] The reason for using the relatively large number of items, rather than selecting a smaller set, was to minimize potential effects of idiosyncratic behaviors of compound elements (see Rosen 2001; Irwin 2014; Vance 2015a,b for discussion on lexical idiosyncrasy and rendaku).

"**kema**"
is a word in Japanese.

Please read the word out loud.

[Proceed]

How would you pronounce a word
composed of "**kema**" and "鳥 (**tori**)"?

1. **kematori** 2. **kemadori**

Please pick the one that sounds more natural
after reading them out loud.

[1] [2]

Figure 1 An image of the judgment task

### 2.3 Procedure

The experiment was run on-line on Experigen (Becker and Levine 2013). After reading a consent form and agreeing to take the experiment, participants were given general instructions. They were told that they would see some Japanese words that were obsolete or used only in some regional dialects, and that they would be answering questions about them.

Participants first completed a practice session with basic instructions, which consisted of two trials, and moved on to a main session which had 32 trials. In each trial, they were orthographically presented with a nonce word written in hiragana (phonographic letters) and were asked to read it out loud. They then clicked on a proceed button, and were asked how they would pronounce a compound composed of the word just presented to them and a real word written in kanji (Chinese characters; logograms) with hiragana in parentheses. They were given the rendaku and non-rendaku forms of the compound, and were asked to pick the one that would sound more natural after reading them aloud. To answer the question, they clicked on a button with a number corresponding to their selection. An image of the task (stylized for presentation) is shown in Figure 1. The text is translated from Japanese into English. The parts shown in boldface were presented in hiragana.

The stimuli used in the 32 trials in the main session were balanced for the length and position of the nonce elements; that is, eight items were randomly selected from each of the four stimulus types in Table 1. The order of presentation was randomized for each participant.

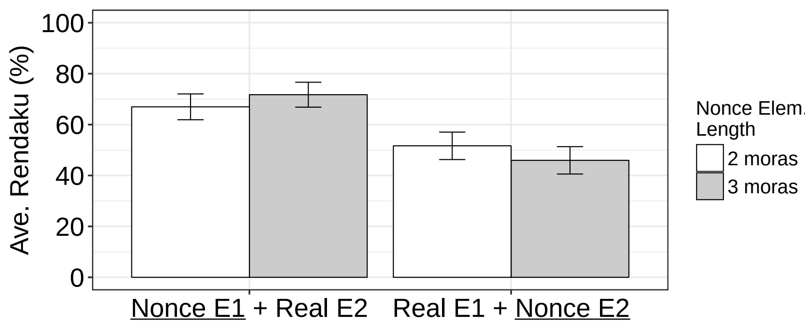


Figure 2 Rendaku response rates by condition (Error bars: 95%CI)

| | Estimate | Std. Error | $z$-value | Pr(> \|z\|) | |
|---|---|---|---|---|---|
| Intercept: (Nonce=E1, Nonce=2μ) | 0.8064 | 0.2240 | 3.600 | 0.0003 | *** |
| Nonce=E2 | –0.7507 | 0.2734 | –2.745 | 0.006 | ** |
| Nonce=3μ | 0.3336 | 0.2374 | 1.405 | 0.160 | |
| Nonce=E2 * Nonce=3μ | –0.6290 | 0.3556 | –1.769 | 0.077 | . |

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1

Table 2 Logistic regression model coefficients

## 3 Results

Figure 1 plots the average rates of rendaku responses by condition. The error bars represent 95% confidence intervals. For statistical analysis, a mixed-effects logistic regression model was constructed with Rendaku Response (rendaku or no rendaku) as the response variable, Nonce Element Length (two moras or three moras), Nonce Element Position (E1 or E2) and their interaction term as explanatory variables, Participant, E1 Item and E2 Item as random effects (intercepts).[5] The coefficients of the factors predicted by the model are shown in Table 2. The intercept here can be seen as corresponding to the “Nonce E1 + Real E2” condition where the nonce element is two moras.

In the “Nonce E1 + Real E2” condition (the two bars on the left), the rendaku rate is slightly higher when E1 is 3 moras (gray) than when it is 2 moras (white); however, the effect of nonce E1’s length turns out be not statistically significant ($p$=0.160; $z$=1.405). In the “Real E1 + Nonce E2” condition (the

[5] Putting random slopes for participants into the model did not improve its fit to the data according to the Akaike information criterion (AIC), and thus were removed from the final model presented here.

two bars on the right), the rendaku rate looks rather lower when E2 is 3 moras (gray) than when it is 2 moras (white); yet, here too, the effect of nonce E2’s length is not significant ($p$=0.264; $z$=–1.117).[6] In other words, the main effect of Rosen’s Rule is not attested regardless of the position of the nonce element.

The analysis also reveals that, overall, the likelihood of rendaku application is lower when the nonce element appears as E2 (the right two bars) than as E1 (the left two bars) with the main effect of Nonce Element Position being significant ($p$=0.006; $z$=–2.745). This indicates that speakers generally disfavor the occurrence of rendaku voicing in a nonce element that they have just encountered, as opposed to a real element that they already know, suggesting the existence of a non-alternation bias.[7]

The interaction term is not significant ($p$=0.077, $z$=–6.290). That is, the (non-)effects of the main predictors reported above do not change significantly when they are combined together.

## 4 Discussion and Conclusion

This study has conducted a nonce word experiment and has addressed the issue of whether Rosen’s Rule (Rosen 2001, 2003) is psychologically real. The results do not strongly support the hypothesis that the rule is real and active in the minds of Japanese speakers. We need to be careful in interpreting these null experimental results, as they do not refute the hypothesis, either. It is possible, for example, that the rule’s effects simply did not show up in the study’s experimental settings due to some factors of which the author is not aware. We should also note, however, that some other experiments with similar designs (Kawahara and Sano 2014; Tamaoka et al. 2009) have equally failed to obtain robust evidence. Taken together, the current and previous studies suggest that Rosen’s Rule has at best minimal effects in speakers’ mental grammars.

Formalization of Rosen’s Rule has been thorny (see Rosen 2003 for an attempt; Vance 2015a,b for criticism). One answer to the issue is that we may not need any theoretical treatment for it, on the assumption that theory and analysis in Generative Linguistics must be constructed based on productive phenomena. There has been much debate on whether some processes involving rendaku, or rendaku itself, should be considered to be problems in

[6] This is not directly shown in Table 2. The values were obtained from another logistic regression analysis with the intercept being the “Real E1 + Nonce E2 (two moras)” condition.

[7] This may also be interpreted as a “rendaku promotion” effect by real E2. Not only did the participants know the real words presented to them (e.g. /tori/ ‘bird’), they had most probably seen the rendaku forms (voiced forms) of those items in actual compounds (e.g. watari-**d**ori ‘migrating-bird’). This may have facilitated accepting rendaku application in non-existing compounds with such E2 items (e.g. somoka-**d**ori ‘NONCE-bird’). Also note, however, that the E2 items used in the experiment were all “rendaku waverers” (see §2.2), and thus the participants must have also seen them not undergoing rendaku in actual compounds (e.g. niwa-tori ‘yard-bird; chicken’).

phonology due to their irregular and seemingly non-productive behaviors (see Kawahara 2015, 2016; Vance 2014 among others for discussion). With this background in mind, the non-significant results reported in this study can still be seen as "significant" in that they further our understanding of rendaku as well as Rosen's Rule, and may contribute to answering the question of what aspects of the phenomenon should be accounted for by phonological theory.

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## References

Albright, A. and Y. Do. 2013. Three biases in learning phonological alternations. Paper presented at the 21th Manchester Phonology Meeting (MFM).

Becker, M. and J. Levine. 2013. Experigen — An Online Experiment Platform. Available at: http://becker.phonologist.org/experigen.

Coetzee, A. W. 2009. Learning lexical indexation. *Phonology* 26(1):109–145.

Irwin, M. 2009. Prosodic size and rendaku immunity. *Journal of East Asian Linguistics* 18:179–196.

Irwin, M. 2014. Rendaku lovers, rendaku haters and the logistic curve. *Japanese/Korean Linguistics*, eds. M. Giriko, N. Nagaya, A. Takemura, and J. T. Vance, vol. 22, 37–51. Stanford: CSLI Publications.

Irwin, M. 2016a. The rendaku database. *Sequential Voicing in Japanese: Papers from the NINJAL Rendaku Project*, eds. T. J. Vance and M. Irwin, no. 176 Studies in Language Companion, chap. 6, 79–106. Amsterdam and Philadelphia: John Benjamins.

Irwin, M. 2016b. Rosen's Rule. *Sequential Voicing in Japanese: Papers from the NINJAL Rendaku Project*, eds. T. J. Vance and M. Irwin, no. 176 Studies in Language Companion, chap. 7, 107–117. Amsterdam and Philadelphia: John Benjamins.

Irwin, M., M. Miyashita, and K. Russell. 2017. The rendaku database version 3.1. Available online at:
http://www-h.yamagata-u.ac.jp/˜irwin/site/Rendaku_Database.html.

Kawahara, S. 2015. Can we use rendaku for phonological argumentation? Linguistics Vanguard, doi:10.1515/lingvan-2015-0001.

Kawahara, S. 2016. Psycholinguistic studies of rendaku. *Sequential Voicing in Japanese: Papers from the NINJAL Rendaku Project*, eds. T. J. Vance and M. Irwin, no. 176 Studies in Language Companion, chap. 3, 35–45. Amsterdam and Philadelphia: John Benjamins.

Kawahara, S. and S. Sano. 2014. Testing Rosen's Rule and Strong Lyman's Law. *NINJAL Research Papers* 7:111–120.

Kawahara, S. and H. Zamma. 2016. Generative treatments of rendaku and related issues. *Sequential Voicing in Japanese: Papers from the NINJAL Rendaku Project*, eds. T. J. Vance and M. Irwin, no. 176 Studies in Language Companion, chap. 2, 13–34. Amsterdam and Philadelphia: John Benjamins.

Rosen, E. 2001. *Phonological processes interacting with the lexicon: Variable and non-regular effects in Japanese phonology*. Ph.D. dissertation, University of British Columbia.

Rosen, E. 2003. Systematic irregularity in Japanese rendaku: How the grammar mediates patterned lexical exceptions. *Canadian Journal of Linguistics* 48:1–37.

Shinmura, I., ed. 2008. *Kōjien*. Japanese dictionary. Tokyo: Iwanami Shoten, 6th edn.

Tamaoka, K., M. Ihara, T. Murata, and H. 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, K. and F. Ikeda. 2010. Whiskey or bhiskey?: Influence of first element and dialect region on sequential voicing of shoochuu. *Gengo Kenkyū [Journal of the Linguistic Society of Japan]* 137:65–79.

Vance, T. J. 2014. If rendaku isn't a rule, what in the world is it? *Usage-based approaches to Japanese grammar: Towards the understanding of human language*, eds. K. Kabata and T. Ono, 137–152. Amsterdam: John Benjamins.

Vance, T. J. 2015a. Rendaku. *The Handbook of Japanese Phonetics and Phonology*, ed. H. Kubozono, Handbooks of Japanese Language and Linguistics 2, 397–441. Berlin and New York: Mouton de Gruyter.

Vance, T. J. 2015b. Rendaku no fukisokusei to Rosen no hōsoku [Rendaku's irregularities and Rosen's Rule]. *NINJAL Research Papers* 9:207–214.

## Appendix

| E1 | | E2 | |
|---|---|---|---|
| 2 moras | 3 moras | 2 moras | 3 moras |
| heka | hamoro | hano | hasoki |
| heni | hasowa | hesa | hayora |
| hite | herate | hise | hekona |
| howa | hetuna | homa | hinose |
| kema | hisemo | honi | hosari |
| keso | kamasa | huno | hutune |
| kuya | kasoni | karo | kamore |
| meto | konati | kewa | kemosa |
| miri | kosewa | kima | kisana |
| moni | mekiwa | kino | kiwase |
| mose | misare | koni | korake |
| neku | mokise | kuna | kusuna |
| nemi | nakota | saro | samori |
| nesa | nesami | semo | sekora |
| newa | nimaya | siyu | siwato |
| notu | nisano | soke | sokume |
| nuwa | nisoke | suko | soneti |
| seyu | sayoki | suyo | sumoke |
| suno | semuri | tano | takune |
| taro | somasi | temi | tenika |
| tayo | somoka | teno | tewana |
| yuko | tanume | tike | timise |
| yumo | toneyo | tona | tonima |
| yuro | wasoya | tuni | tukoso |

Table 3 Nonce words