

Argument Structure and Rendaku: An Experimental Study

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1 Introduction

In Japanese, when a compound is formed with one preceding element 1 (E1) and one following element 2 (E2), if the initial sound of E2 is a voiceless obstruent, it may change into a voiced obstruent, as in (1).

- (1) a. *sita* ‘under’ + *kaki* ‘writing/drawing’ = *sita-gaki* ‘draft’
- b. *oo* ‘big’ + *huri* ‘falling’ = *oo-buri* ‘raining hardly’

This phenomenon is called *rendaku*, also known as *sequential voicing*. It has been argued that *rendaku* tends to occur when E1 and E2 have an adjunct relationship as in (1), while it tends not to occur when E1 and E2 have an argument relationship as in (2) (e.g. Okumura 1984, Sato 1989).

- (2) a. *e* ‘paint’ + *kaki* ‘writing/drawing’ = *e-kaki* ‘painter’
- b. *yuki* ‘snow’ + *huri* ‘falling’ = *yuki-huri* ‘snowing’

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In (2a) and (2b), the E1s are arguments of the E2s. *Painter* is a person who *draws a paint* (2a) and *snowing* is the state where *snow falls* (2b). In the former case E1 represents the direct object (henceforth, DO), and in the latter case E1 represents the subject. In contrast, the E1s do not look like an argument in (1a) and (1b). Rather, they modify E2 as an adjunct.

This study examines how the different grammatical relations of E1 and E2 affect the occurrence of *rendaku* in deverbal noun (DN) compounds, in which E2 is a nominalized verb. The findings of this study suggests that *rendaku* is influenced by the syntactically and semantically defined “distance” (to be qualified in Section 5) between E1 and E2. Furthermore, not only argument-adjunct distinction, but more specific subcategorization of grammatical relation between E1 and E2 is one of the key factors that determines whether *rendaku* occurs or not.

2 Previous Studies

This section reviews two previous studies on *rendaku* that are directly relevant to the present study: Nakamura & Vance (2002) and Fukasawa (2021).

2.1 Nakamura & Vance (2002)

Nakamura & Vance (2002) investigated the claim that the occurrence of *rendaku* depends on whether E1 is a DO or a non-DO of E2. In their experiment, twenty-one participants were first provided with a spoken prompt, in which (i) E1 is a DO of E2, or (ii) E1 is a non-DO of E2, and then they were asked to pronounce a DN compound that appropriately described the context of the sentence. For example, either *kutu-o hosu* ‘hang shoes to dry’ or *yoru-ni hosu* ‘hang (something) to dry at night’ were provided. Then participants were asked to produce a compound based on *kutu* ‘shoe’ and *hosu* ‘dry’ or on *yoru* ‘night’ and *hosu*. If *rendaku* tends to occur with non-DO E1s, participants should more often produce *kutu-hosi* for *kutu-o hosu* and *yoru-bosi* for *yoru-ni hosu* than *kutu-bosi* and *yoru-hosi*, respectively. The prediction was borne out. Participants gave more *rendaku* responses to non-DO compounds (61%) than DO compounds (28%), and the difference was statistically significant. This study provided experimental evidence that *rendaku* is less likely to occur when the E1 is the DO of E2, compared to cases where E1 is not a DO of E2.

Although Nakamura & Vance (2002) provides the first experimental evidence for the relevance of E1-E2 relation on *rendaku*, this study did not examine any other kinds of grammatical relations than DO and non-DO. As is discussed in the next subsection, other categories, such as subject-DN and

locative argument-DN compounds should also be investigated, since they show clear tendencies to trigger rendaku.

2.2 Fukasawa (2021)

In Fukasawa (2021), I collected DN compounds whose E2 had a voiceless obstruent as the initial sound (i.e. a potential rendaku segment) from *Kojien* (2011), one of the most popular monolingual Japanese dictionaries. 2,440 possible rendaku candidates were coded for the presence or absence of rendaku and for the E1-E2 relationship.

The study found that rendaku was observed in 54.37% of compounds when E1 is an argument of E2 (i.e., E1 is subject, DO or locative argument; N = 1166), and 97.68% of compounds when the E1-E2 relation is not an argument relation (N = 1371). Looking in more details, rendaku was observed in 69.47% of subject-DN compounds (N = 190), 50.22% of DO-DN compounds (N = 922), 72.22% of locative argument-DN compounds (N = 64),¹ 100% of locative adjunct-DN compounds (N = 196), and 97.87% of instrument-DN compounds. Importantly, percentages of rendaku vary between different subcategories of arguments and adjuncts. Significant differences were observed not only between argument-DN and adjunct-DN compounds, but also between subject-DN and DO-DN compounds. In other words, DO and non-DO classification might be too coarse to capture the tendencies to rendaku. This issue motivated a new experimental study with subcategories of arguments and adjuncts, which is discussed in the next section.

3 Current Experimental Study

This section introduces how the current experimental study was designed and conducted.

3.1 Design of the Experiment

The goal of this study is to investigate whether subcategories of argument-DN compounds and adjunct-DN compounds behave differently in terms of the occurrence of rendaku in the production of new compound words. The current study examined three types of argument-E2 relations, subject-DN, DO-DN and locative argument-DN compounds, and two types of adjunct-

¹ Locative argument-DN compounds are compounds in which E1 denotes a place but an argument (i.e. required by the verb) in the corresponding sentence. For example, the corresponding sentence for *hada-kake* 'skin-putting; blanket' is *hada-ni kake-ru* 'skin-DAT put-PRES; put something onto the skin'. Without 'skin', the meaning of the verb 'put' sounds incomplete.

E2 relations, locative adjunct-DN and instrument-DN compounds. Since many studies have pointed out that rendaku seldom occurs in non-Chinese loanwords in Japanese (e.g. Takayama 2005, Vance et al. 2017), the experiment was also designed to compare compound formation with nonce words and with existing words, which is referred to as “E2 reality”. All conditions are summarized in Table 1.

Condition #	Argument-adjunct combination	E2 Reality
1	Subject vs. Loc adjunct	Existing
2	Subject vs. Loc adjunct	Nonce
3	Subject vs. Instrument	Existing
4	Subject vs. Instrument	Nonce
5	DO vs. Loc adjunct	Existing
6	DO vs. Loc adjunct	Nonce
7	DO vs. Instrument	Existing
8	DO vs. Instrument	Nonce
9	Loc argument vs. Loc adjunct	Existing
10	Loc argument vs. Loc adjunct	Nonce
11	Loc argument vs. Instrument	Existing
12	Loc argument vs. Instrument	Nonce

Table 1: Relation comparison for each condition

Each compound was combined with two different contexts, an argument context (Subject, DO, or Loc argument in Table 1) and an adjunct context (Loc argument or Instrument). The compounds are further combined with either existing or nonce E2. Hence, twelve conditions were prepared. Participants were shown two pronunciations for each compound, one with rendaku and the other without, and were asked to choose the one that they thought was natural. The total number of the items was 24, as two items were prepared per condition.

3.2 Materials

Table 2 shows all existing E1 + existing E2 items, and Table 3 shows all existing E1 + nonce E2 items used in this experiment. As described above, each of the E1-E2 combination was presented with either an argument context or an adjunct context.

Item #	Condition #	E1	E2
01	1	<i>umi</i> 'ocean'	<i>sini</i> 'dying'
02	1	<i>yama</i> 'mountain'	<i>hare</i> 'shining'
03	3	<i>huti</i> 'edge'	<i>kire</i> 'cutting (intr)'
04	3	<i>tue</i> 'cane'	<i>tati</i> 'standing'
05	5	<i>sima</i> 'island'	<i>kai</i> 'buying'
06	5	<i>niwa</i> 'garden'	<i>kari</i> 'borrowing'
07	7	<i>hera</i> 'spatula'	<i>kiri</i> 'cutting (tr)'
08	7	<i>ito</i> 'thread'	<i>kui</i> 'eating'
09	9	<i>kame</i> 'jar'	<i>tame</i> 'storing'
10	9	<i>koya</i> 'shed'	<i>tuke</i> 'attaching'
11	11	<i>hasi</i> 'chopsticks'	<i>kake</i> 'hooking'
12	11	<i>ita</i> 'board'	<i>sasi</i> 'stabbing'

Table 2: List of existing E1 + existing E2

Item #	Condition #	E1	E2 (intended meanings)
13	2	<i>kura</i> 'warehouse'	<i>here</i> 'breaking'
14	2	<i>gake</i> 'cliff'	<i>temai</i> 'becoming'
15	4	<i>kome</i> 'rice'	<i>tami</i> 'growing up'
16	4	<i>iwa</i> 'rock'	<i>soruki</i> 'sinking'
17	6	<i>yume</i> 'dream'	<i>seke</i> 'fortune-telling'
18	6	<i>tera</i> 'temple'	<i>hinai</i> 'reparing'
19	8	<i>kami</i> 'paper'	<i>kute</i> 'rolling'
20	8	<i>nuno</i> 'cloth'	<i>setasi</i> 'washing'
21	10	<i>taru</i> 'barrel'	<i>sate</i> 'marinating'
22	10	<i>soto</i> 'outside'	<i>suse</i> 'hiding'
23	12	<i>tume</i> 'nail'	<i>sati</i> 'stabbing'
24	12	<i>kasa</i> 'umbrella'	<i>hotasi</i> 'hooking'

Table 3: List of existing E1 + nonce E2

The examples in (3) and (4) show English translations of Item #01 with an existing E2.

(3) Existing subject-DN compound

Your neighbor said, "this beach (umi) was beautiful for several decades, but recently, there was an oil spill. If we don't do anything, the beach will die (si-nu)." To wrap-up what the neighbor said, which expression do you use?

You: "So, if we don't do anything, ____ will happen."

- a) *umi-sini* ('beach' + 'dying') b) *umi-zini*

(4) Existing locative adjunct-DN compound

Your neighbor said, “this beach (umi) was beautiful for several decades, but recently, there was an oil spill. If we don’t do anything, many seabirds will die (si-nu) on the beach.” To wrap-up what the neighbor said, which expression do you use?

You: “So, if we don’t do anything, ____ of many seabirds will happen.”

- a) *umi-sini* b) *umi-zini*

In order to encourage participants to regard nonce E2s as native Japanese words, verbs were presented in different inflectional forms in the contexts. No participant judged both argument and adjunct contexts for the same items. For example, if one participant judged (3), the same person did not judge (4).

3.3 Procedures

The experiment was conducted online, using Google Forms. Sixty-four students at the University of Tokyo participated and received a ¥500 Amazon Gift Card as compensation. Data from two participants were removed due to their responses to screening items. Hence data from 62 participants were analyzed. Differences in rendaku rates among different conditions were examined by a logistic regression and chi-square test, using the lmerTest package (Kuznetsova et al. 2017) in R (Version 1.2.1578).

4 Results of the Experiment

This section presents the results of the experiment. Due to the limited space, this paper reports a subpart of the experiment that focuses on a comparison between the findings from the corpus study and the experiment, and therefore discusses the results that concern the items with existing E2. As was mentioned in Table 1, however, the full experiment involved an additional factor, whether E2 was an existing or nonce item.

Figure 1 compares the results of existing compounds in the corpus study (Fukasawa 2021) with the results of the experiment with compounds with an existing E2.

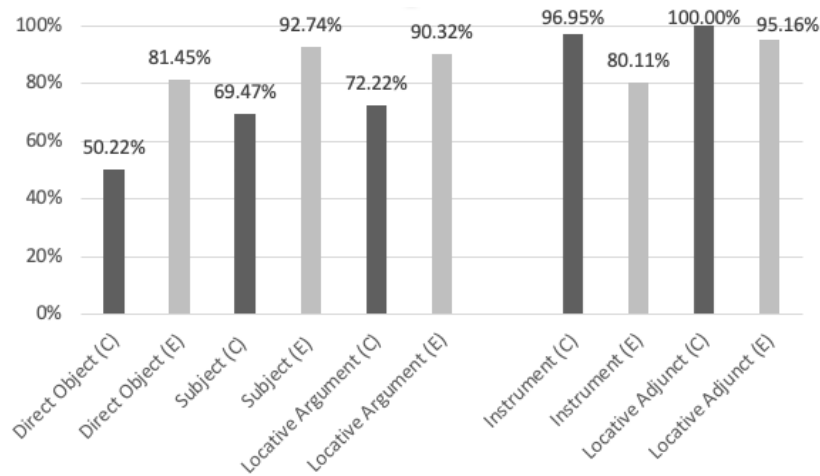


Figure 1: Rendaku rates of compounds with existing E2s

The bars with (C) represent the means from the corpus data, while the bars with (E) represent the means from the experimental data. There are three major findings that are consistent between the corpus and in the experiment. First, subject-DN compounds consistently showed a numerically higher rendaku rate than DO-DN compounds. Second, locative argument-DN compounds showed a numerically higher rendaku rate than DO-DN compounds. Lastly, locative adjunct-DN compounds showed a numerically higher percentage of rendaku than instrument-DN compounds. Although the tendency that locative adjunct-DN compounds show higher rendaku rates than locative argument-DN compounds was consistent between the two studies, the difference between the two kinds of locative-DN in the experiment was small compared to what was observed in the corpus.

5 Discussion

This section discusses what the findings from the two studies suggest. The adjunct compounds consistently showed a higher rendaku rate compared to the argument compounds. Although the results with locative argument compounds are different between the two studies, the findings from the other subcategories still argue for the necessity of examining subcategories of arguments and adjuncts in order to syntactically explain rendaku tendencies, as the results show that the rate of rendaku was consistently lower in DO-DN compounds than subject-DN compounds.

Now a new question arises: Why is the rendaku rate of DO-DN compounds lower than subject compounds, and that of instrument compounds is lower than locative compounds?

Satō & Yokosawa (2018) hypothesize that one of the key factors that determines the occurrence of rendaku is how speakers recognize the compound. That is, rendaku is likely to apply when speakers when speakers subconsciously want to morphologically mark the compound formation in order for it to be clearly recognized as one word, whereas it is not likely to occur when speakers are certain that the compound can be recognized as one word without a morphological marker. For example, ‘appear and disappear’ has two forms, *mie-gakure* and *mie-kakure* ‘seeing-hiding’ with and without rendaku. Satō & Yokosawa assume that the word occurs without rendaku when the speaker wants to emphasize the independent meanings of each element, ‘appear’ and ‘disappear’.

Although Satō & Yokosawa only offer this generalization as a speculation, it seems reasonable to expand it and propose that speakers always have two opposite subconscious motivations regarding rendaku: one is to apply rendaku in order to show that the produced compound is one word, and the other is not to apply rendaku in order to keep the second element unchanged and make semantic processing easier for hearers. Under this assumption, rendaku is relatively less motivated when the relationship of E1 and E2 is strong and there is more reason to retain E2’s original pronunciation form, while rendaku is relatively more motivated when the relationship between E1 and E2 is weak and there is more need to mark the connection of the two elements.

This assumption explains why DO-DN compounds occur with rendaku less often than subject-DN compounds. A DO or an internal argument is syntactically closer to the verb than a subject or an external argument. In terms of semantics, internal arguments are under idiosyncratic selectional requirement (e.g., the DO of *eat* must be edible), while external argument are subject to a broader selection (the subject of *eat* must be an agent). Either way, it is reasonable to assume that E1 and E2 hold a stronger relationship in DO-DN compounds than subject-DN compounds. The different rendaku rates of instrument-DN compounds and locative-DN compounds can be explained in a similar way. Takamine (2017) proposes a structural hierarchy of Japanese PPs, as in (5).

- (5) Structural hierarchy of Japanese PPs
Temporal/Locative > Comitative > Reason >
Instrumental/Means > Goal/Material > Manner

Based on (5), locative adjuncts always take higher position than instrumental adjuncts. Hence, instrumental adjuncts are syntactically closer to the

verb than locative adjuncts. Semantically, locative adjuncts are generally compatible with any eventive predicates (e.g., the subject may *eat* anywhere), while instruments are specific to the type of events that the verb denotes (only utensils can occur with *eat*). Therefore, we can argue that the relationship of E1 and E2 is stronger in instrument-DN compounds than locative adjunct-DN compounds. With a relatively stronger relationship, E2s in DO-DN compounds and instrument-DN compounds tend not to occur with *rendaku*.

In conclusion, the findings reported in this study confirm that the frequency of *rendaku* is affected by the specific types of argument/adjunct relations between E1 and E2. It provides novel experimental support for the claim that *rendaku* is more motivated when the E1-E2 relation is relatively more distant while it is less motivated when the relation is relatively closer.

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