Journal of Psycholinguistic Research, Vol. 34, No.3, May 2005 (© 2005)
DOI: 10.1007/s10936-005-3641-6

Priority Information Used for the Processing of Japanese Sentences: Thematic Roles, Case Particles or Grammatical Functions?

Katsuo Tamaoka,[1,6] Hiromu Sakai,[2] Jun-ichiro Kawahara,[2] Yayoi Miyaoka,[3] Hyunjung Lim,[4] and Masatoshi Koizumi[5]

The present study investigated scrambling effects on the processing of Japanese sentences and priority information used among thematic roles, case particles and grammatical functions. Reaction times for correct sentence decisions were significantly prolonged for scrambled active sentences with transitive verbs in the first experiment and with ditransitive verbs in the second experiment. Errors were made with scrambled sentences more than canonical sentences in both experiments, which suggested that scrambling effects were apparent in active sentences. Passive sentences in the third experiment indicated that canonical order defined based on case particles, not thematic roles, was more quickly and accurately identified than scrambled order. Potential sentences in the fourth experiment and causative sentences in the fifth experiment indicated that the processing of scrambled sentences based on grammatical functions, but not on case particles, required longer reaction times and resulted in higher error rates than canonical sentences. Consequently, scrambling effects in the present study indicated that neither thematic roles nor case particles can provide fully-satisfactory information for canonical phrase order, and that only grammatical functions offer satisfactory information in all types of sentences.

KEY WORDS: Japanese sentence processing; priority information; thematic roles; case particles; grammatical functions.

[1]International Student Center, Hiroshima University, Hiroshima, Japan.
[2]Graduate School of Education, Hiroshima University, Hiroshima, Japan.
[3]Hiroshima University of Economics, Hiroshima, Japan.
[4]Graduate School for International Development and Cooperation, Hiroshima University, Hiroshima, Japan.
[5]Graduate School of Arts and Letters, Tohoku University, Sendai, Japan.
[6]To whom all correspondence should be addressed. International Student Center, Hiroshima University, 1-1, 1-chome, Kagamiyama, Higashi-Hiroshima, 739-8524 Japan, email: ktamaoka@hiroshima-u.ac.jp

INTRODUCTION

Save for the rule that verbs must come at the end of sentences, word order in Japanese sentences is flexible. Studies in theoretical linguistics (e.g., Saito, 1985) present ample syntactic evidence for transformational accounts of free word order in Japanese. According to these accounts, canonical word order is reordered by a transformation called 'scrambling' (originally proposed by Ross, 1967; see general information about scrambling in Nakayama, 1999; Nemoto, 1999). Research in sentence processing, however, presents a conflicting picture on scrambling effects (see Miyamoto, 2004 for overview). Chujo (1983) reported that reaction times to make correct sentence decisions are lengthened by reordering phrases by scrambling. Likewise, Mazuka *et al.* (2002) found scrambling effects on Japanese sentence processing by way of an eye-movement experiment. Conversely, Nakayama (1995) and Yamashita (1997) found no significant scrambling effects using self-paced reading methods. To clarify these conflicting findings, the present study examined the effects of scrambling on the processing of Japanese sentences, using active sentences with transitive verbs in the first experiment and ditransitive verbs in the second experiment. Once the scrambling effects on active sentences could be established, passive sentences in the third experiment, potential sentences in the fourth experiment, and causative sentences in the fifth experiment were examined by comparing canonical and scrambled word orders with the aim of revealing priority of information used by native Japanese speakers for the processing of Japanese sentences.

'Gap-Filling Parsing' Hypothesis for Explaining Scrambling Effects

A 'gap-filling parsing' hypothesis was first proposed for English (Frazier & Clifton, 1989), Dutch (Frazier & Flores d'Arcais, 1989) and later also by some studies of Japanese *Wh*-scrambling constructions (Aoshima *et al.*, 2002; Sakamoto, 2002). For example, a scrambled word order in an active sentence with a transitive verb (V) is created by rearranging a subject (S) and an object (O): 'Tadao deceived Yukiko' is written in a canonical SOV sentence such as *Tadao-ga Yukiko-o damashita* and a scrambled OSV sentence such as *Yukiko-o Tadao-ga damasita*. Chujo (1983) asked native Japanese speakers to judge whether sentences made sense semantically by pressing a 'Yes' or 'No' button. Chujo found that scrambled sentences took longer to produce a correctness decision than canonical sentences, which he explained as follows. If the nominative noun phrase (NP-ga) *Tadao-ga* is placed in its canonical position before the accusative NP-o *Yukiko-o*, speakers can comprehend the

sentence without any extra effort. However, when the accusative NP-o is placed in the frontal position and NP-ga follows it (i.e., scrambled order), speakers must know whether or not the frontal accusative NP-o is appropriate for the object which typically appears just before the verb *damashit-a* to construct a verb phrase (VP) *Yukiko-o damashita*. The reversed order of NP-o and NP-ga initiates a search for 'gap' which is originally placed just before the transitive verb in canonical order. Due to this 'gap-filling parsing', speakers need extra time to process scrambled sentences.

On the other hand, Nakayama (1995) and Yamashita (1997) conducted on-line sentence processing experiments using self-paced reading methods, which did not find differences in reading times between canonical and scrambled sentences. According to these findings, both the nominative NP-ga and the accusative NP-o are located parallel to one another under the single flat level (i.e., flat structure). Since there is no specific canonical order in the flat structure, any word order can be generated to construct a sentence. Sakamoto (2001) further elaborated on the results of Yamashita, noting that since case particles are attached to all nouns in Japanese, clear identifications are given to functions of nouns. Consequently, scrambled word order does not require an extra cognitive load for sentence parsing. Given this argument, the assumption of flat structure does not initiate the gap-filling parsing. Since scrambling effects showed mixed results in previous studies, the present study first examines scrambling effects using active sentences with transitive and ditransitive verbs.

Three Information Cues for Predicting Canonical Noun Phrase Order

There are three possible information cues for canonical noun phrase order used by native Japanese speakers. First, canonical order is predicted by 'thematic roles' in such a way that an agent precedes a theme. For example, an agent *Hanako-ga* precedes a theme *Taro-o* in active sentences with canonical order *Hanako-ga Taro-o nagutta*. Second, 'case particles' in a noun phrase provide relations between a predicate and noun phrases: The particle *–ga* assigns a noun phrase nominative while *–o* assigns an accusative. In this case, *Hanako* is marked as a nominative noun phrase by *–ga* and *Taro* as an accusative noun phrase by *–o*. As a result, the sentence interprets that *Hanako* made an action of hitting *Taro*. Third, canonical order is established by grammatical functions in such a way that the subject precedes the object. For the purpose of this paper, we assume that grammatical functions are not primitive notions, rather they are defined in terms of syntactic configurations (see Chomsky, 1981). From a more abstract perspective, in the syntactic structure of a simplex clause without involving any transformation such as scrambling, subject (S) is

the argument in the syntactically highest position; direct object (DO) is the argument in the lowest position; indirect object (IO) is the argument in the position hierarchically between subject and object. When it is not necessary to distinguish between direct and indirect objects, we refer to non-subject arguments simply as objects. Since a verb (V) appears at the end of a sentence in Japanese (i.e., a head-final language), the syntactically canonical order is as follows: [S [IO [DO V]]]. In the sentence *Hanako-ga Taro-o nagutta*, the noun phrase *Hanako-ga* is the subject and *Taro-o* is the object. Syntactically non-canonical orders (e.g., *Taro-o Hanako-ga nagutta*) require gap-filling parsing, as mentioned above.

If results from the first and second experiments demonstrate extra cognitive loading for scrambled in comparison to canonical noun phrase order in sentence processing (i.e., scrambling effects), all three information cues can be applied to predict the canonical noun phrase order of active sentences. The third experiment used passive sentences such as *Taro-ga Hanako-ni nagurareta* ('Taro was hit by Hanako'). In this type of sentence, scrambled order is created by swapping two noun phrases as *Hanako-ni Taro-ga nagurareta*. The same meaning is kept in both sentences. Interestingly, according to thematic roles, canonical order is predicted as *Hanako-ni Taro-ga nagurareta* because an agent *Hanako-ni* precedes a theme *Taro-ga*. In contrast, as a noun phrase with the nominative case particle *–ga* precedes a noun phrase with the accusative case particle *–o*, case particles provide the canonical noun phase order of the passive sentence as *Taro-ga Hanako-ni nagurareta*. Grammatical functions also provide information cues for canonical order in the same way as case particles. Thus, canonical noun phrase order is different between thematic roles and case particles, and between thematic roles and grammatical functions. Tentatively defining the canonical noun phrase order as *Taro-ga Hanako-ni nagurareta*, if the third experiment were to reveal scrambling effects, thematic roles would be excluded while case particles and grammatical functions would remain as candidates of priority information in determining canonical order.

The fourth experiment used potential sentences such as *Taro-ni eigo-ga hanaseru-daroo-ka?* ('Can Taro speak English?'). The canonical order in such potential sentences is predicted by grammatical functions as *Taro-ni eigo-ga hanaseru-daroo-ka?* because the subject *Taro-ni* precedes the object *eigo-ga*. In contrast, prediction by case particles specifies the canonical order as *Eigo-ga Taro-ni hanaseru-daroo-ka?* Unlike in active and passive sentences, a noun with the dative case particle *–ni* is the subject in potential sentences (Harada, 1977; Shibatani, 1978; Ura, 1999). Thus, case particles provide information for canonical order other than grammatical roles in potential sentences. Comparing the sentence processing of two different

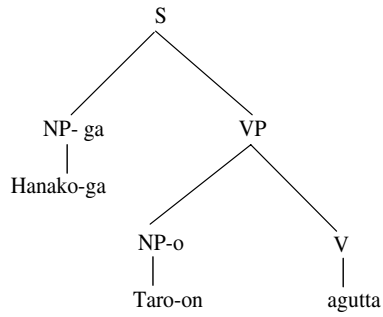
noun phrase orders, the fourth experiment excludes one of the possible information cues. Since the fourth experiment compared the effects of grammatical function and linear ordering of the nominative and dative case particles, the fifth experiment investigated the effect of other two case particles of dative and accusative. The results of the fifth experiment confirm the conclusion from the previous experiments and generalize them to all types of case particles.

Outline of the Five Experiments

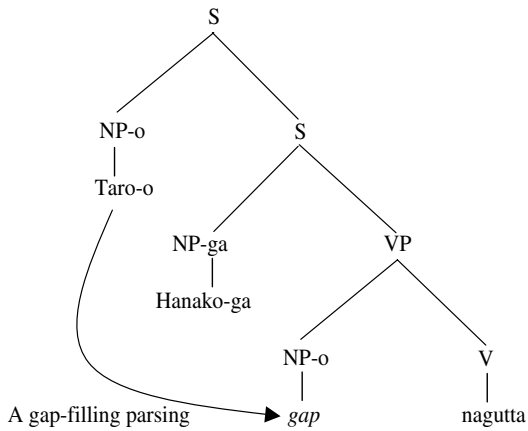
It was hypothesized that if scrambling effects were observed in the processing of the active sentences of the first and second experiments, the results would support all three information cues: thematic roles, case particles and grammatical functions. If the effects were observed in the passive sentences of the third experiment, the first information cue of thematic roles would be excluded. Finally, the fourth experiment with potential sentences and the fifth experiment with causative sentences would determine which type of information, case particles or grammatical functions, is the primary factor affecting the speed and accuracy of processing sentences with different noun phrase orders.

EXPERIMENT 1: ACTIVE SENTENCES WITH TRANSITIVE VERBS

The first experiment tested whether native Japanese speakers take longer to process active transitive sentences in scrambled noun phrase order than those in canonical order. For example, an active sentence containing a transitive verb, such as *Hanako-ga Taro-o nagutta* ('Hanako hit Taro') can be reordered by scrambling the subject and the object as *Taro-o Hanako-ga nagutta*. Nevertheless, both the canonical and scrambled sentences have the same meaning. If scrambling effects are apparent, these sentences must have a configurational structure as depicted in Fig. 1. Figure 1(i) describes canonical order while Fig. 1(ii) scrambled order. The transitive verb *nagutta* constructs a VP with the accusative noun phrase (NP-o) *Taro-o*. Once NP-o is placed in the initial position and the NP-ga follows it, native Japanese speakers initiate a search for 'gap' which produces VP with the verb. This gap-filling parsing requires extra sentence decision time. However, if no scrambling effects are found in sentence processing, such a structure may not exist and it would therefore be possible that noun phrases of NP-ga and NP-o are located parallel to one another.



(i) Canonical Order



(ii) Scrambled Order

Fig. 1. A gap-filling parsing in an active sentence with a transitive verb *Hanako-ga Taro-o nagutta* (Hanako hit Taro).
Note: NP-ga refers to a nominative case-marked noun phrase. NP-o refers to an accusative case-marked noun phrase.

Method

Participants

Twenty-eight graduate and undergraduate students (22 females and 6 males) at Hiroshima University in Japan, all native speakers of Japanese, participated in the first experiment. Ages ranged from 21 years and 1 month to 29 years and 0 months, with the average age being 23 years and 2 months on the day of testing.

Materials

As listed in Appendix A, 52 correct, 32 incorrect and 20 control sentences (a total of 104 sentences) were prepared for the sentence correctness decision task. Correct 'Yes' responses consisted of 52 active sentences with transitive verbs. These 52 sentences were arranged in canonical order, and the nominative case marked subject (NP-ga) and the accusative case marked object (NP-o) were then swapped to create sentences of scrambled order. For example, a sentence *Tomoko-ga Taro-o hometa* ('Tomoko admired Taro') was altered to *Taro-o Tomoko-ga hometa*. Since a pair of canonical and scrambled sentences was identical in terms of words used, a difference in syntactic structure can be directly compared in reaction times and error rates.

It was expected that reading times would become shorter when participants saw sentences containing the same words. Thus, in order to prevent this problem of repeatedly encountering the same words, a counterbalanced design was used to assign participants to different words. Two lists of sentences were given to two groups of participants. Each list consisted of 52 sentences (26 canonical and 26 scrambled) for correct 'Yes' responses.

Thirty-two syntactically or semantically incorrect sentences were used for correct 'No' responses to the task. As with sentences with correct 'Yes' responses, scrambled sentences were created on the basis of canonical sentences. For example, the phrase order of a canonical sentence *Junko-ga Kenji-o nutta* ('Kenji stitched Junko') was re-arranged to read *Kenji-o Junko-ga nutta*. This counterbalanced design was also used for sentences with correct 'No' responses: Two lists of sentences were given to two groups of participants. Each list consisted of a total of 32 sentences (16 canonical and 16 scrambled) for correct 'Yes' responses.

In addition, 20 control sentences were added to each of the two stimulus lists. The same control sentences were used for the two stimulus lists. Consequently, a total of 104 sentences in each list consisted of 52 correct (26 canonical and 26 scrambled), 32 incorrect (16 canonical and 16 scrambled), and 20 control sentences.

Procedure

The presentation was controlled by a computer program Microsoft Visual Basic 6.0 + Microsoft DirectX8. Stimuli with both 'Yes' and 'No' correct responses were presented to participants in random order in the center of a computer screen 600 ms after the appearance of an asterisk '*' indicating an eye fixation point. Participants were instructed to respond as quickly and as accurately as possible in deciding whether or not the sentence made sense. Response was registered by pressing a 'Yes' or 'No'

button. Twenty practice trials were given to the participants prior to the commencement of actual testing.

Analysis and Results

Extremes among sentence correctness decision times (less than 400 ms and longer than 4000 ms) were recorded as missing values. The means of correct 'Yes' and 'No' reaction times and error rates for sentence correctness decisions are presented in Table I. Before performing the analysis, reaction times outside of 2.5 standard deviations at both the high and low ranges were replaced by boundaries indicated by 2.5 standard deviations from the individual means of participants in each category. The statistical tests which follow analyze both subject ($F1$) and item ($F2$) variability. Only stimulus items of correct responses were used in the analyses of reaction times.

A series of one-way analyses of variance (ANOVAs) with repeated measures in canonical and scrambled noun phrase order were conducted on reaction times (milliseconds) and error rates (percents), using subject (F_1) and item (F_2) variabilities. The first experiment of active sentences with transitive verbs indicated that for correct 'Yes' responses, sentences with canonical order resulted in shorter reaction times [$F_1(1, 27) = 58.90$, $p < 0.001$;$F_2(1, 51) = 61.88$, $p < 0.001$] and lower error rates [$F_1(1, 27) = 15.71$, $p < 0.001$; $F_2(1, 51) = 17.14$, $p < 0.001$] than those with scrambled order. The same ANOVAs were carried out for correct 'No' responses. Sentences with canonical order processed shorter reaction times than those with scrambled order in subject analysis [$F_1(1, 27) = 14.49$, $p < 0.001$], but not in item analysis [$F_2(1, 31) = 0.02$, n.s.]. Thus, some items must strongly affect the results of reaction times for 'No' responses. On the other hand, error rates for correct 'No' responses indicated no significant main effect in subject and item analysis [$F_1(1, 27) = 0.05$, n.s.; $F_2(1, 31) = 1.56$, n.s.].

Table I. Reaction Times and Error Rates for Active Sentences with Transitive Verbs

		Reaction time (ms)		Error rate (%)	
Response type	Sentence type	*M*	*SD*	*M*	*SD*
'Yes'	SOV	1209	238	3.02	3.37
Responses	OSV	1432	308	9.07	6.96
	OSV-SOV	Δ223			Δ6.04
'No'	SOV	1297	224	4.91	6.96
Responses	OSV	1388	216	9.38	9.95
	OSV-SOV	Δ91			Δ4.47

Discussion

Experiment 1 revealed scrambling effects on the processing of active sentences with transitive verbs for correct 'Yes' responses. This result supports that these sentences have a configurational syntactic structure for canonical order as depicted in Fig. 1(i). For the processing of scrambled sentences, the accusative NP-o, which is placed in the sentence-initial position, initiates search for 'gap' to complete the verb phrase constructed by NP-o (i.e., 'gap') and a transitive verb as shown in Fig. 1(ii). This gap-filling parsing must lead to longer reaction times for scrambled sentences than canonical sentences. Some confusion involved in this parsing process resulted in higher error rates for scrambled sentences than canonical ones, whereas this tendency was not observed in sentence correctness decisions for correct 'No' responses. Since these sentences contained syntactic or semantic errors, the gap-filling parsing did not make a difference between canonical and scrambled sentences.

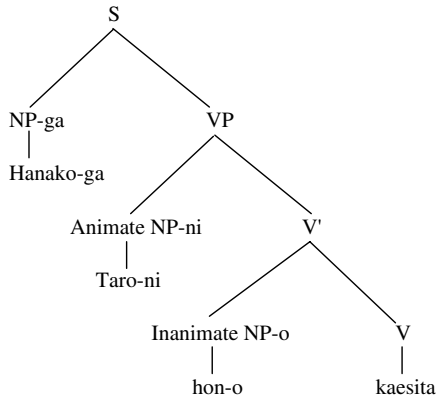
EXPREIMENT 2: ACTIVE SENTENCES WITH DITRANSITIVE VERBS

As discussed in the introduction, there are conflicting results for scrambling effects on sentence processing. Although active sentences with transitive verbs showed significant scrambling effects in the first experiment, an additional experiment was conducted to ascertain the effects in different conditions. Therefore, the second experiment used active sentences containing ditransitive verbs such as *Hanako-ga Taro-ni hon-o kaeshita* ('Hanako returned a book to Taro') as represented by the canonical sentence in Fig. 2(i). This type of sentence can exchange three noun phrases in any order, so that six different word orders can be produced as one canonical and five scrambled sentences. These sentences still impart the same meaning. In the present study, as depicted in Fig. 2(ii), an inanimate (i.e., the thirdly-positioned) NP-o noun phrase is placed in the sentence-initial position as in *hon-o Hanako-ga Taro-ni kaeshita*. If scrambling effects are observed in the second experiment in addition to the first, then, the gap-filling parsing must play a role in the processing of scrambled sentences with ditransitive verbs as well as those with transitive verbs.

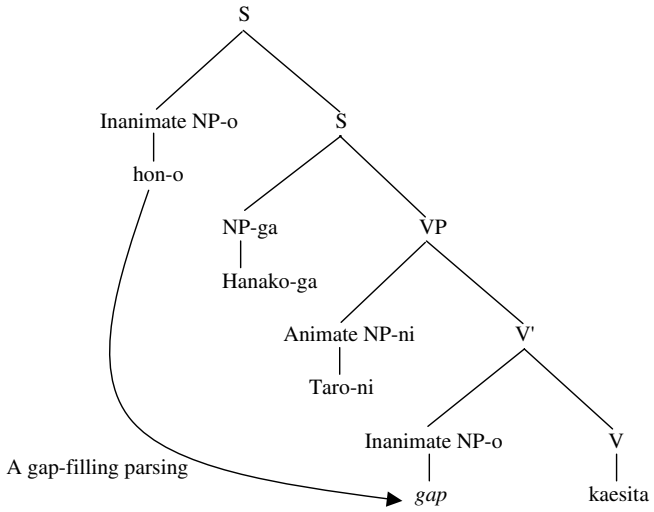
Method

Participants

Same as Experiment 1.



(i) Canonical Order



(ii) Scrambled Order

Fig. 2. A gap-filling parsing in an active sentence with a ditransitive verb *Hanako-ga Taro-ni hon-o kaesita* (Hanako returned a book to Taro).
Note: NP-ga refers to a nominative case-marked noun phrase. NP-o refers to an accusative case-marked noun phrase. NP-ni refers to a dative case-marked noun phrase.

Materials

As listed in Appendix B, 20 correct, 20 incorrect and 20 control sentences (a total of 60 sentences) were prepared for the second experiment.

Correct 'Yes' responses consisted of 20 active sentences with ditransitive verbs, which were arranged in canonical order. The nominative case marked subject (NP-ga) and the inanimate accusative case marked object (NP-o) were then swapped to create sentences of scrambled order. For example, a sentence *Kenji-ga Junko-ni hana-o okutta* ('Kenji sent followers to Junko') was altered to *hana-o Kenji-ga Junko-ni okutta*. Since the canonical and scrambled sentences were identical in terms of words used, a difference in syntactic structure can be directly compared in reaction times and error rates. Again, as in the first experiment, a counterbalanced design was used to assign participants to different sentences to avoid repeatedly showing the same words. Two lists of sentences were given to two groups of participants. Each list consisted of 20 sentences (10 canonical and 10 scrambled) for correct 'Yes' responses.

Twenty syntactically or semantically incorrect sentences were used for correct 'No' responses to the task. Scrambled sentences were created on the basis of canonical sentences. For example, the phrase order of the canonical sentence *Kazuko-ga Kenji-ni senttaki-o odotta* ('Kazuko danced a washing-machine to Kenji') was re-arranged to *senttaki-o Kazuko-ga Kenji-ni odotta*. The counter balanced design was also used for sentences with correct 'No' responses: Two lists of sentences were given to two groups of participants. Each list consisted of a total of 20 sentences (10 canonical and 10 scrambled) for correct 'No' responses.

In addition, the same 20 control sentences were added to each of the two lists. Consequently, a total of 60 sentences in each list consisted of 20 correct (10 canonical and 10 scrambled), 20 incorrect (10 canonical and 10 scrambled), and 20 control sentences.

Procedure

Same as Experiment 1.

Analysis and Results

Extremes among sentence correctness decision times (less than 400 ms and longer than 5000 ms) were recorded as missing values. The means of correct 'Yes' and 'No' reaction times and error rates for sentence correctness decisions are presented in Table II. Before performing the analysis, reaction times outside of 2.5 standard deviations in both the high and low ranges were replaced by the boundaries indicated by 2.5 standard deviations from the individual means of participants in each category. Only stimulus items of correct responses were used in the analyses of reaction times.

Table II. Reaction Times and Error Rates for Active Sentences with Ditransitive Verbs

		Reaction time (ms)		Error rate (%)	
Response type	Sentence type	*M*	*SD*	*M*	*SD*
'Yes'	SO_1O_2V	1359	320	1.79	3.90
Responses	O_2SO_1V	1963	643	11.79	17.44
	O_2SO_1V-SO_1O_2V	Δ604		Δ10.00	
'No'	SO_1O_2V	1436	265	1.79	4.76
Responses	O_2SO_1V	1597	398	4.29	10.34
	O_2SO_1V-SO_1O_2V	Δ161		Δ2.50	

As in the first experiment, ANOVAs with repeated measures in canonical and scrambled sentences were conducted on reaction times and error rates for correct 'Yes' responses. Again, the second experiment of active sentences with ditransitive verbs showed significant main effects on both reaction times ($F_1(1, 27) = 56.36$, $p < 0.001$; $F_2(1, 19) = 70.25$, $p < 0.001$) and error rates ($F_1(1, 27) = 10.80$, $p < 0.001$; $F_2(1, 19) = 24.18$, $p < 0.001$). The results revealed that the processing for scrambled sentences took longer reaction times and resulted in higher error rates than canonical sentences. The same ANOVAs were carried out for correct 'No' responses. Canonical sentences were processed more quickly than those with scrambled order in subject ($F_1(1, 27) = 16.07$, $p < 0.001$) and item ($F_2(1, 19) = 8.58$, $p < 0.01$) analysis. However, error rates for correct 'No' responses indicated no significant main effect ($F_1(1, 27) = 3.10$, n.s.; $F_2(1, 19) = 3.20$, n.s.).

Discussion

The results of the second experiment for correct 'Yes' responses replicated those of the first experiment. The processing of scrambled sentences was slower and yielded higher error rates when compared to that of canonical sentences. Consequently, as shown in Fig. 2, active sentences with ditransitive verbs must form configurational structures as well as those with transitive verbs. Again, the second experiment suggested gap-filling parsing performed for scrambled sentences as depicted in Fig. 2(ii). Interestingly, there was a large difference in reaction times between canonical and scrambled sentences. The time for ones with ditransitive verbs was 604 ms (see Table II), which was far longer than the 223 ms for ones with transitive verbs (see Table I). This difference in the scrambling effect on the sentence processing between transitive and ditransitive verbs was

produced by differences in the distance of the scrambling; a long distance scrambling was used for sentences with ditransitive verbs while a short distance scrambling for ones with transitive verbs.

As opposed to the findings of the first experiment, the results for correct 'No' responses (i.e., incorrect sentences) in the second experiment revealed scrambling effects: scrambled sentences were processed more slowly than canonical sentences. A difference in the distance probably created a longer parsing time for scrambled sentences with ditransitive verbs for correct 'No' responses. Again, the difference in reaction times between canonical and scrambled sentences was longer for ditransitive verbs than transitive verbs: 91 ms (non-significant) in the first experiment, 161 ms (significant) in the second experiment. Since neither experiment indicated differences in error rates, the longer distance in structure did not seem to influence the accuracy of processing for scrambled sentences for correct 'No' responses of both transitive and ditransitive verbs.

EXPERIMENT 3: PASSIVE SENTENCES WITH TRANSITIVE VERBS

In the first and second experiments, active sentences with transitive and ditransitive verbs supported the existence of scrambling effects. Upon proving these, the question arose as to what kind of information cues native Japanese speakers use for identifying canonical noun phrase order. There are three possibilities for active sentences: thematic roles, case particles and grammatical functions. Using the example in Fig. 2, thematic roles provide information that an agent *Hanako* returns to a goal *Taro* a theme *hon* ('book'). Case particles provide information for canonical order as a nominative noun phrase *Hanako-ga*, a dative noun phrase *Taro-ni*, and an accusative noun phrase *hon-o*. Grammatical functions show noun phrases from the initial position in the configurational structure: a subject *Hanako-ga*, an indirect object *Taro-ni*, a direct object *hon-o*, and a predicate *kaeshita* ('returned') at the end of the sentence. All three linguistic explanations provide appropriate information for canonical order of active sentences. Table III summarizes predicted canonical noun phrase orders, for the purpose of sentence processing, determined based on the three information cues.

To determine priority information used for native Japanese speakers, the third experiment employed passive sentences with transitive verbs, whereby thematic roles and case markers provided a conflicting picture. Figure 3 gives an example of a passive sentence *Taro-ga Hanako-ni nagurareta* ('Taro was hit by Hanako').

Table III. Information Cases and Predicted Canonical Noun Phrase Orders

Information cases	Predicted canonical noun phrase orders
Thematic roles	Agent > Goal > Theme
Case particles	Nominative > Dative > Accusative
Grammatical functions	Subject > Indirect object > Direct object

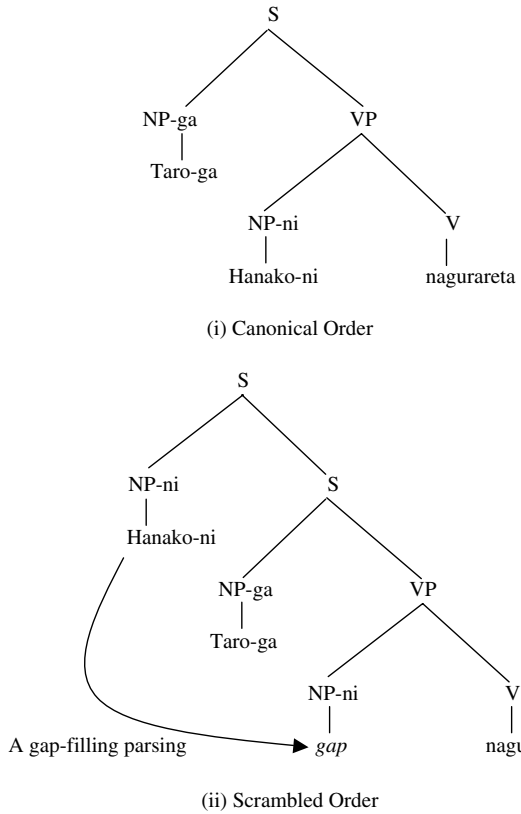


Fig. 3. A gap-filling parsing in a passive sentence with a transitive verb *Taro-ga Hanako-ni nagurareta* (Taro was hit by Hanako).

Thematic roles provide information that the agent NP follows the theme NP, so that an agent *Taro-ni* precedes a theme *Hanako-ga*, predicting the canonical order as *Hanako-ni Taro-ga nagurareta*. Assuming the existence of scrambling effects on the processing of passive sentences, if native Japanese speakers follow information guided by thematic roles,

the canonical order of *Hanako-ni Taro-ga nagurareta* would be processed more quickly and accurately than the scrambled order of *Taro-ga Hanako-ni nagurareta*. However, the canonical order is defined by case particles as a noun with the nominative case particle *–ga* preceding a noun with the dative case particle *–ni*. Thus, case particles define the canonical order as *Taro-ga Hanako-ni nagurareta* in Fig. 3(i) and the scrambled order as *Hanako-ni Taro-ga nagurareta* in Fig. 3(ii). The prediction for sentence processing is then reversed in a way that the canonical order *Taro-ga Hanako-ni nagurareta* should be processed more quickly and accurately than *Hanako-ni Taro-ga nagurareta*. The third experiment offers an answer as to which type of information, thematic roles or case particles, is actually used by native Japanese speakers.

Method

Participants

Twenty-four graduate and undergraduate students (9 females and 15 males, none of whom participated in the first and second experiments) at Hiroshima University in Japan, all native speakers of Japanese, participated in the third experiment. Ages ranged from 21 years and 8 months to 31 years and 8 months, with the average age being 26 years and 5 months on the day of testing.

Materials

As listed in Appendix C, 36 correct, 20 incorrect and 16 control sentences (a total of 72 sentences) were prepared for the third experiment. Correct 'Yes' responses consisted of 36 passive sentences with transitive verbs. These 36 sentences were arranged in canonical order based on case particles, the nominative case marked noun phrase (NP-ga) and the dative case marked noun phrase (NP-ni) were then swapped to create scrambled sentences. For example, a sentence *Junko-ga Kenji-ni osareta* ('Junko was pushed by Kenji') was altered to read *Kenji-ni Junko-ga osareta*. Yet, these two sentences carry the same meaning, so that a difference in syntactic structure can be directly compared in reaction times and error rates. Again, as in the previous two experiments, to avoid repeatedly showing the same words, a counterbalanced design was used to assign different sentences to participants. Two lists of sentences were given to two groups of participants. Each list consisted of 36 sentences (18 canonical and 18 scrambled) for correct 'Yes' responses.

Twenty syntactically or semantically incorrect sentences were used for correct 'No' responses to the task. Scrambled sentences were created on

the basis of canonical sentences. For example, phrase order of canonical sentence *sora-ga Junko-ni sentakusareta* ('Sky was washed by Junko') was re-arranged to *Junko-ni sora-ga sentakusareta*. The counterbalanced design was also used for sentences with correct 'No' responses: Two lists of sentences were given to two groups of participants. Each list consisted of a total of 20 sentences (10 canonical and 10 scrambled) for correct 'No' responses.

In addition, 16 control sentences were added to each of the two lists. Consequently, a total of 72 sentences in each list consisted of 36 correct (18 canonical and 18 scrambled), 20 incorrect (10 canonical and 10 scrambled), and 16 control sentences.

Procedure

Same as Experiments 1 and 2.

Analysis and Results

Extremes among sentence correctness decision times (less than 400 ms and longer than 4000 ms) were recorded as missing values. The means of correct 'Yes' and 'No' reaction times and error rates for sentence correctness decisions are presented in Table IV. Before performing the analysis, reaction times outside of 2.5 standard deviations at both high and low ranges were replaced by boundaries indicated by 2.5 standard deviations from the individual means of participants in each category. Only stimulus items of correct responses were used in the analyses of reaction times.

As in the previous two experiments, ANOVAs with repeated measures in canonical and scrambled sentences were conducted on reaction times and error rates for correct 'Yes' responses. Passive sentences in the third experiment indicated scrambling effects in both reaction times ($F_1(1, 23) =$

Table IV. Reaction Times and Error Rates for Passive Sentences with Transitive Verbs

		Reaction time (ms)		Error rate (%)	
Response type	Sentence type	*M*	*SD*	*M*	*SD*
'Yes'	SOV	1521	359	1.85	3.54
Responses	OSV	1722	497	6.25	8.08
	OSV-SOV	Δ201		Δ4.40	
'No'	SOV	1484	309	10.83	9.74
Responses	OSV	1582	366	9.17	10.60
	OSV-SOV	Δ98		Δ−1.60	

17.22, $p < 0.001$; $F_2(1.35) = 16.23$, $p < 0.001$) and error rates ($F_1(1, 23) = 10.18$, $p < 0.01$; $F_2(1.35) = 11.33$, $p < 0.01$). The results suggested that canonical order defined by case particles was processed faster and more accurately than scrambled order (see Fig. 3). The same ANOVAs were carried out for correct 'No' responses. Neither reaction times ($F_1(1, 23) = 2.67$, n.s.; $F_2(1, 19) = 2.06$, n.s.) nor error rates ($F_1(1, 23) = 0.19$, n.s.; $F_2(1.19) = 0.61$, n.s.) showed significant main effects. Thus, no scrambling effects were observed for correct 'No' responses.

Discussion

In passive sentences, the nominative case particle *–ga* comes before the dative case particle *–ni* (i.e., case particles) while the agent comes after the theme (i.e., thematic roles). The results of the third experiment indicated that canonical order defined based on case particles was more quickly and accurately identified than scrambled order. As shown in Fig. 3(ii), the gap-filling parsing must take place under the configurational structure described by case particles. The sentence-initially positioned dative NP-ni *Hanako-ni* initiates a search for 'gap' to match the verb *nagurareta* ('being hit'). Since grammatical functions also provide the same information as case participles, the results of the third experiment excluded the possibility of thematic roles as priority information for canonical order and supported the priority of case particles.

EXPERIMENT 4: POTENTIAL SENTENCES

The third experiment eliminated thematic roles as a candidate for priority information in sentence processing. Subsequently, the fourth experiment investigated which of the two remaining information cues, case particles or grammatical functions, is the primary factor. Potential sentences such as *Hanako-ni eigo-ga hanaseru-darooka* ('Can Hanako speak English?') supply conflicting circumstances between case particles and grammatical functions. In potential sentences, as the dative case particle *–ni* is assigned to syntactic subject properties, grammatical functions tell that a subject with *-ni* comes before an object with *–ga* in the canonical order. On the other hand, case particles indicate noun phrase order that a nominative case particle *–ga* should precede a dative particle *–ni*. Figure 4(i) describes the canonical order of potential sentences based on grammatical functions. If the order of the phrase, *Hanako-ni eigo-ga hanaseru-darooka* is processed faster and more accurately than *eigo-ga Hanako-ni hanaseru-darooka* (i.e., scrambling effects), grammatical functions will be the last remaining source for canonical order. In this case, as

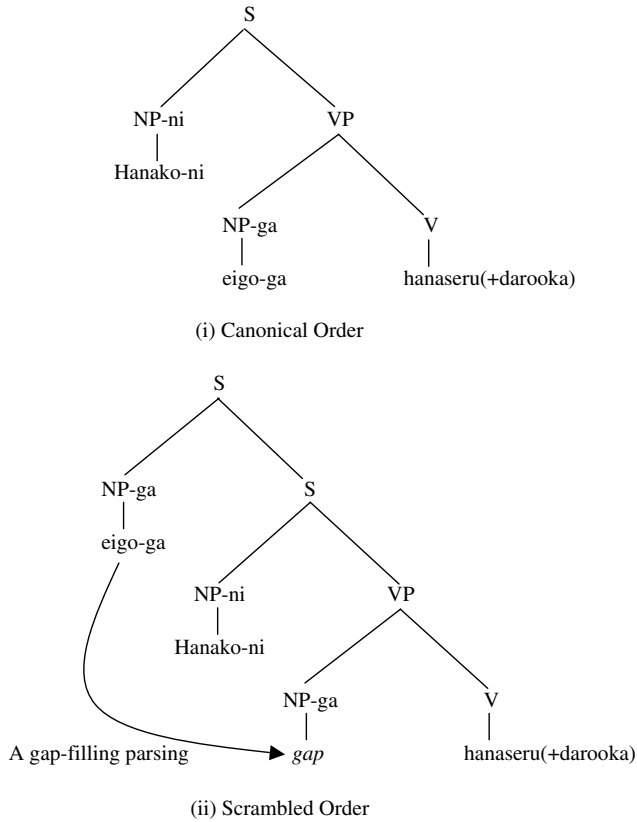


Fig. 4. A gap-filling parsing in a potential sentence *Hanako-ni eigo-ga hanaserudarooka* (Can Hanako speak English?).

depicted in Fig. 4(ii), native Japanese speakers will start searching for 'gap' soon after seeing the initially-positioned NP-ga *eigo-ga* ('English'). However, if the results are reversed, case particles are the priority information for canonical order provided to native Japanese speakers.

Method

Participants

Twenty-four graduate and undergraduate students (15 females and 9 males, none of whom participated in the previous three experiments) at Hiroshima University in Japan, all native speakers of Japanese, participated in the fourth experiment. Ages ranged from 19 years and 7 months

to 21 years and 10 months, with the average age being 20 years and 6 months on the day of testing.

Materials

As listed in Appendix D, 24 correct, 24 incorrect and 20 control sentences (a total of 68 sentences) were prepared in the fourth experiment. Correct 'Yes' responses consisted of 24 potential sentences. These were arranged in canonical order based on grammatical functions, the dative case marked subject (NP-ni) and the nominative case marked object (NP-ga) were then swapped to create sentences of scrambled order. For example, a sentence *Takashi-ni Girishaga-go kakeru-darooka* ('Can Takashi write Greek?') was altered to read *Girishago-ga Takashi-ni kakeru-darooka*. These two sentences have the same meaning, so that a difference in syntactic structure can be directly compared in reaction times and error rates. Again, a counterbalanced design was used to assign participants to different sentences. Two lists of 24 sentences (12 canonical and 12 scrambled) for correct 'Yes' responses were given to two groups of participants.

Twenty-four syntactically or semantically incorrect sentences were used for correct 'No' responses to the task. Scrambled sentences were created on the basis of canonical sentences. For example, the phrase order of the canonical sentence *keshigomu-ni Masako-ga tetsudaeru-darooka* (Can Masako help an eraser?) was re-arranged to *Masako-ga keshigomu-ni tetsudaeru-darooka*. The counterbalanced design was also used for sentences with correct 'No' responses. Each list consisted of a total of 24 sentences (12 canonical and 12 scrambled) for correct 'No' responses.

In addition, the same 20 control sentences were added to each of the two lists. A total of 68 sentences in each list consisted of 24 correct (12 canonical and 12 scrambled), 20 incorrect (10 canonical and 10 scrambled), and 20 control sentences.

Procedure

Same as Experiments 1–3.

Analysis and Results

Extremes among sentence correctness decision times (less than 400 ms and longer than 4000 ms) were recorded as missing values. The means of correct 'Yes' and 'No' reaction times and error rates for sentence correctness decisions are presented in Table V. Before performing the analysis, reaction times outside of 2.5 standard deviations at both the high and low ranges were replaced by boundaries indicated by 2.5 standard deviations

Table V. Reaction Times and Error Rates for Potential Sentences

		Reaction time (ms)		Error rate (%)	
Response type	Sentence type	*M*	*SD*	*M*	*SD*
'Yes'	SOV	1326	299	4.17	7.37
Responses	OSV	1542	366	29.86	24.93
	OSV-SOV	Δ216		Δ25.69	
'No'	SOV	1586	349	5.90	6.72
Responses	OSV	1602	318	7.99	8.33
	OSV-SOV	Δ16		Δ2.08	

from the individual means of participants in each category. Only stimulus items of correct responses were used in the analyses of reaction times.

As in the previous experiments, ANOVAs with repeated measures in canonical and scrambled sentences were conducted with reaction times and error rates for correct 'Yes' responses. Potential sentences in the fourth experiment indicated scrambling effects in both reaction times ($F_1(1, 23) = 25.47$, $p < 0.001$; $F_2(1.23) = 13.61$, $p < 0.001$) and error rates ($F_1(1, 23) = 30.54$, $p < 0.001$; $F_2(1.23) = 89.66$, $p < 0.001$). The results suggested that the canonical order defined by grammatical functions was processed faster and more accurately than the scrambled order (see Fig. 4). The same ANOVAs were carried out for correct 'No' responses. Neither reaction times ($F_1(1, 23) = 0.11$, n.s., $F_2(1, 24) = 0.02$, n.s.) nor error rates ($F_1(1, 23) = 0.85$, n.s., $F_2(1.24) = 1.21$, n.s.) showed significant main effects. Thus, no scrambling effects were observed for correct 'No' responses.

A very high error rate of 29.86% with a standard deviation of 24.93% was observed for the processing of correct scrambled sentences. Numbers of correct responses for each participant are reported in Table VI. Three participants properly responded to less than 3 of 12 scrambled potential sentences. Since they were likely to properly judge other canonical and scrambled conditions for both 'Yes' and 'No' responses, some native Japanese speakers may rely on the information provided by case particles.

Discussion

The results of the fourth experiment indicated that the processing of scrambled potential sentences of Fig. 4(ii) based on grammatical functions required longer reaction times and resulted in higher error rates than the canonical sentences depicted in Fig. 4(i). The results of scrambling effects in the fourth experiment excluded case particles; therefore canonical order

Table VI. Number of Correctly-judged Potentcial Sentences by Participants

	'Yes' Response		'No' Response	
Participants	Canonical	Scrambled	Canonical	Scrambled
1	12	12	10	11
2	12	12	12	11
3	12	11	12	11
4	12	11	12	9
5	12	11	10	11
6	12	10	11	12
7	12	10	12	12
8	12	10	12	12
9	12	10	11	9
10	11	10	11	11
11	10	10	10	12
12	12	9	11	9
13	12	9	12	12
14	12	9	12	11
15	10	9	10	11
16	12	8	10	12
17	12	8	11	12
18	12	8	12	11
19	11	8	12	10
20	12	6	12	10
21	9	5	11	11
22	12	3	11	11
23	11	2	12	12
24	10	1	12	12

Note: A total of 12 sentences in each category.

is guided by grammatical functions which stand alone throughout the four experiments. Native Japanese speakers must follow fundamental information provided by grammatical functions to decide whether or not a sentence is correct. The processing of scrambled sentences initiates a search for 'gap' to match the object NP-ga *eigo-ga* ('English') and the verb *hanas-eru-darooka* ('can speak') as depicted in Fig. 4(ii). An error pattern among participants indicated some peculiar trends; three participants continually rejected scrambled correct potential sentences (see Table VI). If native Japanese speakers receive information from case particles, the nominative case particle *–ga* cannot be attached to the inanimate noun *eigo* ('English'). As shown in Table VI, three of the participants may follow case particles rather than grammatical functions. Nevertheless, scrambling effects were observed including these data, so that this tendency does not alter the findings of the fourth experiment.

EXPERIMENT 5: CAUSATIVE SENTENCES

The fifth experiment further investigated whether or not case particle ordering has any effect on sentence processing. This experiment differed from the fourth experiment in two important respects. First, the fourth experiment used sentences with the dative and nominative case particles, whereas the fifth experiment employed sentences with the dative and accusative case particles. Different pairs of case particles might have different effects on sentence processing. Second, the results of the fourth experiment suggested that the effect of grammatical functions is more prominent than that of case particles. However, it has not yet been shown whether or not case particles still have some effect albeit weaker than that of grammatical functions. The fifth experiment addressed this issue.

In the fifth experiment, two kinds of verbs were used; transitive verbs taking accusative object (i.e., accusative verbs) and transitive verbs taking dative object (i.e., dative verbs). Examples are presented in Table VII.

When an accusative verb is used in the causative construction, the causee (which corresponds to the subject argument in the simple transitive use) appears as an indirect object in the *dative*. On the other hand, in the causative construction with a dative verb, the causee appears as an indirect object in the *accusative*. The linear ordering of the indirect and direct objects can be freely altered by scrambling. These possible orders are shown in Table VIII.

Given the four types of causative sentences shown in Table VIII, grammatical functions and case particles make different predictions regarding canonical noun phrase order. According to the grammatical function hierarchy specified in Table III, A1 and D1 are in canonical order, and A2 and D2 assume scrambled order. Thus, A1 and D1 should be processed faster and more accurately than A2 and D2. In contrast, from the view point of the case particle hierarchy in Table III, A1 and D2 are canonical, and A2 and D1 are scrambled. Therefore, A1 and D2 should be processed faster and more accurately than A2 and D1. Finally, if both grammatical functions and case particles affect sentence processing,

Table VII. Simple Transitive Sentences with Accusative and Dative Verbs

Verb type	Examples		
Accusative verb	*Deshi-ga*	*atorie-o*	*tukutta*
	pupil-NOM	atelier-ACC	built
	'The pupil built the atelier.'		
Dative verb	*Deshi-ga*	*atorie-ni*	*komotta*
	pupil-NOM	atelier-DAT	stayed
	'The pupil shut himself up in the atelier.'		

Table VIII. Causative Sentences with Accusative and Dative Verbs

Verb Type	Sentence type (Word order)	Examples			
Accusative Verb	A1 (S.IO.DO.V/Nom-Dat-Acc-V)	*Junko-ga*	*deshi-ni*	*atorie-o*	*tsukur-ase-ta*
		Junko-NOM	pupil-DAT	atelier-ACC	build-CAUSE-PAST
		'Junko made her pupil build the atelier.'			
	A2 (S.DO.IO.V/Nom-Acc-Dat-V)	*Junko-ga*	*atorie-o*	*deshi-ni*	*tsukur-ase-ta*
		Junko-NOM	atelier-ACC	pupil-DAT	build-CAUSE-PAST
		'Junko made her pupil build the atelier.'			
Dative Verb	D1 (S.IO.DO.V/Nom-Acc-Dat-V)	*Junko-ga*	*deshi-o*	*atorie-ni*	*komor-ase-ta*
		Junko-NOM	pupil-DAT	atelier-ACC	stay-CAUSE-PAST
		'Junko made her pupil shut himself up in the atelier.'			
	D2 (S.DO.IO.V/Nom-Dat-Acc-V)	*Junko-ga*	*atorie-ni*	*deshi-o*	*komor-ase-ta*
		Junko-NOM	atelier-ACC	pupil-DAT	stay-CAUSE-PAST
		'Junko made her pupil shut himself in the atelier.'			

A1 should be the easiest to comprehend (i.e., the shortest reaction time and the lowest error rate), because it is the noun phrase order both hierarchies favor. A2 should be the hardest as neither grammatical functions nor case particles provide support for it. The reaction times and error rates of D1 and D2 should be between those of A1 and those of A2, since grammatical functions and case particles make conflicting contributions in processing D1 and D2.

Method

Participants

Thirty-two graduate and undergraduate students (18 females and 14 males, none of whom participated in the previous four experiments) at Hiroshima University in Japan, all native speakers of Japanese, participated in the fifth experiment. Ages ranged from 19 years and 0 months to 32 years and 3 months, with the average age being 22 years and 10 months on the day of testing.

Materials

As listed in Appendix E, 32 sets of causative sentences for correct 'Yes' responses like those in Table VIII, and 32 sets of causative sentences for correct 'No' responses (a total of 256 sentences) were prepared in the fifth experiment. Since three nouns used in both types of sentences with accusative and dative verbs, the only difference between two types of sentences was the type of verbs. Thus, in order to make a direct comparison between sentences with accusative and dative verbs, these two types of verbs were controlled by three variables of printed-frequency (utilizing the lexical corpus of Amano and Kondo, 2000), number of morae and number of script symbols (i.e., kanji and hiragana) for both correct 'Yes' and 'No' responses, respectively. For correct 'Yes' responses, t-tests were conducted on these three variables between the two types of verbs. A t-test showed that printed-frequencies ($M = 21,609$, $SD = 28,180$) for accusative verbs did not differ from those ($M = 15,173$, $SD = 19,595$) for dative verbs ($t(62) = 1.06$, n.s.). There was no difference between the number of morae for accusative verbs ($M = 5.78$, $SD = 1.01$) and for dative verbs ($M = 5.53$, $SD = 0.88$) ($t(62) = 1.06$, n.s.]. Likewise, the number of script symbols ($M = 4.72$, $SD = 0.52$) for accusative verbs did not differ from those ($M = 4.59$, $SD = 0.56$) for dative verbs ($t(62) = 0.92$, n.s.). For correct 'No' responses, the same t-tests were conducted on these three variables between the two types of verbs. Printed-frequencies ($M = 10,341$, $SD = 11,598$) for accusative verbs did not differ from those

($M = 11,405$, $SD = 21,460$) for dative verbs ($t(62) = -0.25$, n.s.). The number of morae ($M = 5.38$, $SD = 0.87$) for accusative verbs did not differ from those ($M = 5.66$, $SD = 0.87$) for dative verbs ($t(62) = -1.30$, n.s.). Likewise, the number of script symbols ($M = 4.59$, $SD = 0.56$) for accusative verbs did not differ from those ($M = 4.78$, $SD = 0.66$) for dative verbs ($t(62) = -1.23$, n.s.). Four lists were created by distributing the test items according to a Latin square design and intermixing 20 filler sentences in random order. Each participant saw only one list.

Procedure

Same as Experiments 1–4.

Analysis and Results

Extremes among sentence correctness decision times (less than 500 ms and longer than 5000 ms) were recorded as missing values. The means of correct 'Yes' reaction times and error rates for sentence correctness decisions are presented in Table IX. Before performing the analysis, reaction times outside of 2.5 standard deviations at both the high and low ranges were replaced by boundaries indicated by 2.5 standard deviations from the individual means of participants in each category. Only stimulus items of correct responses were used in the analyses of reaction times.

For correct 'Yes' responses, 2 (accusative or dative verbs) × 2 (orders of case particles, *nominative-dative-accusative* or *nominative-accusative-dative*) ANOVAs with repeated measures were conducted with reaction times and error rates.

The result of reaction times did not show the significant main effect of either accusative/dative verbs ($F_1(1,31) = 0.461$, n.s., F_2 $(1,31) = 1.299$, n.s.) or order of case particles ($F_1(1,31) = 0.979$, n.s., F_2 $(1,31) = 0.687$, n.s.). However, there was a significant interaction in both variables

Table IX. Reaction Times and Error Rates for Causative Sentences

		Reaction time (ms)		Error rate (%)	
Verb type	Sentence type	*M*	*SD*	*M*	*SD*
Accusative Verb	S.IO.DO.V (NOM-DAT-ACC-V)	2199	497	10.55	11.93
	S.DO.IO.V (NOM-ACC-DAT-V)	2386	559	23.44	16.11
	S.IO.DO.V-S.DO.IO.V	Δ187		Δ12.89	
Dative Verb	S.IO.DO.V (NOM-ACC-DAT-V)	2166	442	10.55	12.74
	S.DO.IO.V (NOM-DAT-ACC-V)	2351	542	20.70	16.98
	S.IO.DO.V-S.DO.IO.V	Δ185		Δ10.15	

($F_1(1,31)= 15.517$, $p < 0.001$, $F_2(1,31)= 15.139$, $p < 0.001$). As shown in Table IX, the means of reaction times indicate effects in opposite directions between accusative and dative verbs; the particle order of nominative-dative-accusative seems to be faster to process than the order of nominative-accusative-dative for accusative verbs, while this tendency seems to be reversed for dative verbs. It was assumed that the significant interaction would be created by the reversal directions between accusative and dative verbs. Thus, a one-way ANOVA repeated measures was conducted for each type of verbs to examine the effect of case particle orders. The result showed that sentences with the nominative-dative-accusative order were processed faster than those with the nominative-accusative-dative order ($F_1(1, 31) = 6.196$, $p < 0.05$, $F_2(1, 31) = 8.841$, $p < 0.01$) for accusative verbs. As expected, this result was reversed in the dative verbs that sentences with the nominative-accusative-dative order was processed faster than those with the nominative-dative-accusative order ($F_1(1, 31) = 8.836$, $p < 0.01$, $F_2(1, 31) = 4.155$, $p < 0.05$) These analyses confirmed that accusative and dative verbs behave differently in the processing of sentences regarding the order of case particles.

As for error rates, the same ANOVA analysis was conducted. As in the case of reaction times, the result of error rates also showed no significant main effect of either accusative/dative verbs ($F_1(1,31)= 0.725$, n.s., $F_2(1,31)= 0.104$, n.s.) or order of case particles ($F_1(1,31)= 0.309$, n.s., $F_2(1, 31) = 0.274$, n.s.) but, there was a significant interaction in both variables ($F_1(1,31)= 29.524$, $p < 0.001$, $F_2(1, 31) = 35.791$, $p < 0.001$). The trend of error rates also seems to display the same pattern as reaction times. Thus, a one-way ANOVA repeated measures was conducted for each type of verb. The result showed that sentences with the nominative-dative-accusative order were processed more accurately than those with the nominative-accusative-dative order for accusative verbs ($F_1(1,31) = 17.303$, $p < 0.001$, $F_2(1, 31) = 11.597$, $p < 0.01$). As expected, this result was reversed in the case of dative verbs; sentences with the nominative-accusative-dative order were processed more accurately than those with the nominative-dative-accusative order ($F_1(1,31) = 8.986$, $p < 0.01$, $F_2(1,31) = 15.274$, $p < 0.001$). Consequently, error rates also depicted the same pattern as shown in reaction times.

Discussion

The results of the fifth experiment showed that the processing of scrambled causative sentences based on grammatical functions (A2 and D2) required longer reaction times and resulted in higher error rates than

the canonical sentences (A1 and D1) regardless of the order of case particles. This suggests that grammatical functions play a prominent role in sentence processing, and that strict linear ordering of case particles has no observable effect on the speed and accuracy in sentence comprehension.

GENERAL DISCUSSION

As outlined in Table X, the aim of the present study was two-fold: (1) to investigate scrambling effects on the processing of Japanese sentences; and (2) to identify the priority of information among thematic roles, case particles and grammatical functions used by native Japanese speakers in sentence processing. The following two sections discuss the results based upon the five experiments.

Scrambling Effects and Syntactic Structure

The first and second experiments indicated that reaction times for correct sentence decisions were significantly prolonged for scrambled active sentences. In addition, more errors were made with scrambled than canonical sentences. Thus, these two experiments supported scrambling effects previously found by Chujo (1983) and Mazuka *et al.* (2002). As discussed in the introduction, when an accusative noun phrase was placed in the sentence-initial position and followed by a nominative noun phrase, native Japanese speakers began searching for a 'gap' to match up with the verb. Active sentences with ditransitive verbs (scrambling effects of 604 ms) require a longer decision-making time for scrambled sentences than those with transitive verbs (scrambling effects of 223 ms). Since the configurational structure for ditransitive verbs as depicted in Fig. 2 has longer distances than transitive verbs in Fig. 1, a 'gap' for ditransitive verbs from the sentence-initial position of NP-o has a longer distance than a 'gap' for transitive verbs. The distance difference or longer-distance scrambling (Nemoto, 1999) may have resulted in a greater disparity in the processing speed for ditransitive verbs (i.e., 381 ms longer than the active sentences with transitive verbs). In addition to the great difference between the scrambling effects of transitive and ditransitive verbs in active sentences, the third and fourth experiments showed a similar degree of scrambling effects to the first experiment; 201 ms for passive sentences in the third experiment and 216 ms for potential sentences in the fourth experiment. Although types of sentences differ among the first, third and fourth experiments, all objects had the same distance to verbs. Therefore, it seems that the longer-distance scrambling between an object and a verb appeared to determine the degree of scrambling effects.

Table X. Possible Explanations for Scrambling Effects through Five Experiments

Purpose of experiments	Experiment #	Sentence types	Thematic roles	Case particles	Grammatical functions
Scrambling effects	Experiment 1	Active sentences with transitive verbs	**X**	**X**	**X**
	Experiment 2	Active sentences with ditransitive verbs	**X**	**X**	**X**
Priority Information	Experiment 3	Passive sentences with transitive verbs	**Excluded**	**X**	**X**
	Experiment 4	Potential sentences		**Excluded**	**X**
	Experiment 5	Causative Sentences		**Excluded**	**X**

Note: **X** refers to a possible explanation for the sentence processing.

The results of the first and second experiments also provide evidence for syntactic structure which appropriately explains the construction of Japanese sentences. Tamaoka *et al.* (2003) depicted three possible sentence structures. The first structure is the 'non-configurational' syntactic structure noun phrase order in Japanese does not alter the fundamental meaning, leading a group of linguists (e.g., Farmar, 1984; Hale, 1980, 1981) to claim that it is non-configurational or 'flat' in structure. This structural model predicts no differences in the processing of canonical and scrambled noun phrase order. The second structure is called a 'configurational' syntactic structure. Several linguists (e.g., Hoji, 1985; Miyagawa, 1989; Saito, 1985; Saito and Hoji, 1983 for Japanese; Mahajan, 1990; Müller and Wolfgang, 1994; Webelhuth, 1989 for other languages) claim that an instance of phrasal movement results in free noun phrase order phenomena. This structural model predicts to have a difference in speed and accuracy between canonical and scrambled order. The findings of the first and second experiments support this structure. The third structure is either a 'configurational structure without movement' or a 'base-generated structure'. Tonoike (1997) argues that certain instances of Japanese scrambled phrases and sentences are base-generated in their surface positions. Fukui (1989) makes a similar point that scrambling is a 'substitution' into a base-generated position. This structure predicts to result in equal processing speeds, but differs in accuracy between canonical and scrambled order. The findings of the first and second experiments indicated differences in speed and accuracy between canonical and scrambled sentences, so that the second candidate of the configurational structure seems to explain the results properly. Therefore, the first and second experiments supported the configurational structure in which the gap-filling parsing operation functions for scrambled sentences.

Finally the existence of the scrambling effects in the first and the second experiments of the present study on the one hand and the lack of such effects in Nakayama (1995) and Yamashita (1997) on the other, show important differences in experimental methodologies employed in these studies. Nakayama and Yamashita used self-paced reading paradigm, that required subjects to press a key when they finished reading a part of sentence presented in phrase-by-phrase fashion. Self-paced reading is usually regarded as a very informative measure because it provides information about the intermediate steps of sentence comprehension. At the same time the method is a less sensitive measure when compared to the sentence-final judgment method used in our experiment. This is because participants are likely to pay more attention to judgment components and are likely to create their own reading rhythm during the experiment unrelated to their natural reading pace. The self-paced reading method is thus successful in capturing scrambling

effects only if a scrambled phrase is moved far away and the effects becomes sufficiently large as reported by Miyamoto and Takahashi (2004). Given these considerations the sentence-final decision method used in this paper is an effective method that gives us valuable information about scrambling effects, even if it does not tell us the exact time line of sentence processing.

Priority Information for Identifying Canonical Order

Active sentences of the first and second experiments supported all three possible information cues of thematic roles, case particles and grammatical functions for identifying canonical noun phrase order. Thus, the present study further investigated priority information in the third, fourth and fifth experiments. In the passive sentences, thematic roles and case markers offer different information regarding canonical order. As depicted in Fig. 3, thematic roles provide information that the agent NP-ni follows the theme NP-ga, while case particles show the reverse pattern that a noun with the nominative case particle *–ga* precedes a noun with the dative case particle *–ni*. The third experiment proved scrambling effects in the direction indicated by case particles. Thus, thematic roles were excluded from the priority of information, while case particles and grammatical functions remained candidates.

The fourth and fifth experiments compared the effects of case particles and grammatical functions on sentence processing. In potential sentences, case particles and grammatical functions provide different information concerning canonical order. In potential sentences the dative case particle *–ni* is assigned to syntactic properties of the subject (Fukui, 1988, 1995; Shibatani, 1978). Thus, grammatical functions indicate the canonical order that a subject with *–ni* comes before an object with *–ga*. In contrast, case particles provide information that the noun phrase particle-marked *–ga* precedes the noun phrase particle-marked *–ni*. The fourth experiment revealed the scrambling effects on potential sentences which were ordered on the basis of grammatical functions as shown in Fig. 4. Using four types of causative sentences, the fifth experiment further investigated the possible effect of case particles on sentence processing. The fifth experiment differed from the fourth experiment in two respects: (i) it examined the combination of the dative and accusative case particles rather than the dative and nominative particles, and (ii) its experimental design made it possible to directly compare the effects of the two possible case particle orders (i.e., dative-accusative vs. accusative-dative) in addition to compare the effect of case particle ordering and that of grammatical functions. The result of the fifth experiment clearly showed that linear ordering of the dative and accusative case particles does not affect the speed and accuracy in sentence

comprehension. Therefore, case particles were excluded from the list of priority information, leaving only the possibility of grammatical functions.

Consequently, the scrambling effects found in the present study indicated that neither thematic roles nor case particles can provide fully satisfactory information for canonical phrase order, and that only grammatical functions offer plausible information in all active, passive and potential sentences. An important issue which remained unexamined in this paper was exactly when gap-filling parsing was initiated. Since grammatical function information is usually dependent on the type of predicates, native speakers sometime cannot determine the correct grammatical function of noun phrases by the end of sentence in a head-final language like Japanese. This suggests that at least some part of the idea of the wait-and-see model must be true in the sentence processing mechanism of head-final languages. Since the sentence-final judgment paradigm used in this paper does not give us decisive information about the timing of gap-filling operation, we leave this possibility as an avenue for future research.

APPENDIX A. The Active Sentences with Transitive Verbs for Experiment 1

	Canonical sentences	Scrambled sentences
Items for Correct 'Yes' Responses		
1	友子が太郎をほめた。 Tomoko-ga Taro-o home-ta. Tomoko-NOM Taro-ACC praise-PAST Tomoko praised Taro.	太郎を友子がほめた。 Taro-o Tomoko-ga home-ta. Taro-ACC Tomoko-NOM praise-PAST Tomoko praised Taro.
2	太郎が順子を助けた。 Taro-ga Junko-o tasuke-ta. Taro-NOM Junko-ACC help-PAST Taro helped Junko.	順子を太郎が助けた。 Junko-o Taro-ga tasuke-ta. Junko-ACC Taro-NOM help-PAST Taro helped Junko.
3	次郎が和子を殴った。 Jiro-ga Kazuko-o nagut-ta. Jiro-NOM Kazuko-ACC strike-PAST Jiro struck Kazuko.	和子を次郎が殴った。 Kazuko-o Jiro-ga nagut-ta. Kazuko-ACC Jiro-NOM strike-PAST Jiro struck Kazuko.
4	太郎が順子を雇った。 Taro-ga Junko-o yatot-ta. Taro-NOM Junko-ACC employ-PAST Taro employed Junko.	順子を太郎が雇った。 Junko-o Taro-ga yatot-ta. Junko-ACC Taro-NOM employ-PAST Taro employed Junko.
5	次郎が和子をだました。 Jiro-ga Kazuko-o damashi-ta. Jiro-NOM Kazuko-ACC deceive-PAST Jiro deceived Kazuko.	和子を次郎がだました。 Kazuko-o Jiro-ga damashi-ta. Kazuko-ACC Jiro-NOM deceive-PAST Jiro deceived Kazuko.
6	太郎が友子を殺した。 Taro-ga Tomoko-o koroshi-ta. Taro-NOM Tomoko-ACC kill-PAST Taro killed Tomoko.	友子を太郎が殺した。 Tomoko-o Taro-ga koroshi-ta. Tomoko-ACC Taro-NOM kill-PAST Taro killed Tomoko.
7	友子が健二を憎んだ。 Tomoko-ga Kenji-o nikun-da. Tomoko-NOM Kenji-ACC hate-PAST Tomoko hated Kenji.	健二を友子が憎んだ。 Kenji-o Tomoko-ga nikun-da. Kenji-ACC Tomoko-NOM hate-PAST Tomoko hated Kenji.
8	順子が健二を許した。 Junko-ga Kenji-o yurushi-ta. Junko-NOM Kenji-ACC forgive-PAST Junko forgave Kenji.	健二を順子が許した。 Kenji-o Junko-ga yurushi-ta. Kenji-ACC Junko-NOM forgive-PAST Junko forgave Kenji.
9	順子が健二を産んだ。 Junko-ga Kenji-o un-da. Junko-NOM Kenji-ACC give birth-PAST Junko gave birth to Kenji.	健二を順子が産んだ。 Kenji-o Junko-ga un-da. Kenji-ACC Junko-NOM give birth-PAST Junko gave birth to Kenji.
10	和子が太郎を信じた。 Kazuko-ga Taro-o shinji-ta. Kazuko-NOM Taro-ACC believe-PAST Kazuko believed Kenji.	太郎を和子が信じた。 Taro-o Kazuko-ga shinji-ta. Taro-ACC Kazuko-NOM believe-PAST Kazuko believed Kenji.
11	次郎が和子を指導した。 Jiro-ga Kazuko-o shidooshi-ta. Jiro-NOM Kazuko-ACC lead-PAST Jiro led Kazuko.	和子を次郎が指導した。 Kazuko-o Jiro-ga shidooshi-ta. Kazuko-ACC Jiro-NOM lead-PAST Jiro led Kazuko.
12	和子が太郎を疑った。 Kazuko-ga Taro-o utagat-ta. Kazuko-NOM Taro-ACC doubt-PAST Kazuko doubted Taro.	太郎を和子が疑った。 Taro-o Kazuko-ga utagat-ta. Taro-ACC Kazuko-NOM doubt-PAST Kazuko doubted Taro.
13	次郎が順子を叩いた。 Jiro-ga Junko-o tatai-ta. Jiro-NOM Junko-ACC hit-PAST Jiro hit Junko.	順子を次郎が叩いた。 Junko-o Jiro-ga tatai-ta. Junko-ACC Jiro-NOM hit-PAST Jiro hit Junko.

APPENDIX A. Continued

	Canonical sentences	Scrambled sentences
14	順子が次郎を追いかけた。 Junko-ga Jiro-o oikake-ta. Junko-NOM Jiro-ACC chase-PAST Junko chased Jiro.	次郎を順子が追いかけた。 Jiro-o Junko-ga oikake-ta. Jiro-ACC Junko-NOM chase-PAST Junko chased Jiro.
15	友子が健二を尊敬した。 Tomoko-ga Kenji-o sonkeeshi-ta. Tomoko-NOM Kenji-ACC respect-PAST Tomoko respected Kenji.	健二を友子が尊敬した。 Kenji-o Tomoko-ga sonkeeshi-ta. Kenji-ACC Tomoko-NOM respect-PAST Tomoko respected Kenji.
16	太郎が友子を逃がした。 Taro-ga Tomoko-o nigashi-ta. Taro-NOM Tomoko-ACC release-PAST Taro released Tomoko.	友子を太郎が逃がした。 Tomoko-o Taro-ga nigashi-ta. Tomoko-ACC Taro-NOM release-PAST Taro released Tomoko.
17	次郎が順子を突き飛ばした。 Jiro-ga Junko-o tsukitobashi-ta. Jiro-NOM Junko-ACC push away-PAST Jiro pushed away Junko.	順子を次郎が突き飛ばした。 Junko-o Jiro-ga tsukitobashi-ta. Junko-ACC Jiro-NOM push away-PAST Jiro pushed away Junko.
18	健二が和子を驚かした。 Kenji-ga Kazuko-o odorokashi-ta. Kenji-NOM Kazuko-ACC surprise-PAST Kenji surprised Kazuko.	和子を健二が驚かした。 Kazuko-o Kenji-ga odorokashi-ta. Kazuko-ACC Kenji-NOM surprise-PAST Kenji surprised Kazuko.
19	太郎が窓を閉めた。 Taro-ga mado-o shime-ta. Taro-NOM (the) window-ACC close-PAST Taro closed the window.	窓を太郎が閉めた。 mado-o Taro-ga shime-ta. (the) window-ACC Taro-NOM close-PAST Taro closed the window.
20	和子がケーキを食べた。 Kazuko-ga keeki-o tabe-ta. Kazuko-NOM cake-ACC eat-PAST Kazuko ate cake.	ケーキを和子が食べた。 keeki-o Kazuko-ga tabe-ta. cake-ACC Kazuko-NOM eat-PAST Kazuko ate cake.
21	友子が花瓶を壊した。 Tomoko-ga kabin-o kowashi-ta. Tomoko-NOM (a) vase-ACC break-PAST Tomoko broke a vase.	花瓶を友子が壊した。 kabin-o Tomoko-ga kowashi-ta. (a) vase-ACC Tomoko-NOM break-PAST Tomoko broke a vase.
22	次郎がシャツを汚した。 Jiro-ga shatsu-o yogoshi-ta. Jiro-NOM (his) shirt-ACC get dirty-PAST Jiro got his shirt dirty.	シャツを次郎が汚した。 shatsu-o Jiro-ga yogoshi-ta. (his) shirt-ACC Jiro-NOM get dirty-PAST Jiro got his shirt dirty.
23	順子が財布を拾った。 Junko-ga saifu-o hirot-ta. Junko-NOM (a) purse-ACC pick up-PAST Junko picked up a purse.	財布を順子が拾った。 saifu-o Junko-ga hirot-ta. (a) purse-ACC Junko-NOM pick up-PAST Junko picked up a purse.
24	和子が宿題を終えた。 Kazuko-ga shukudai-o oe-ta. Kazuko-NOM (her) homework-ACC finish-PAST Kazuko finished her homework.	宿題を和子が終えた。 shukudai-o Kazuko-ga oe-ta. (her) homework-ACC Kazuko-NOM finish-PAST Kazuko finished her homework.
25	健二が靴下を洗った。 Kenji-ga kutsushita-o arat-ta. Kenji-NOM (his) socks-ACC wash-PAST Kenji washed his socks.	靴下を健二が洗った。 kutsushita-o Kenji-ga arat-ta. (his) socks-ACC Kenji-NOM wash-PAST Kenji washed his socks.
26	友子が電気を消した。 Tomoko-ga denki-o keshi-ta. Tomoko-NOM (a) light-ACC turn off-PAST Tomoko turned off a light.	電気を友子が消した。 denki-o Tomoko-ga keshi-ta. (a) light-ACC Tomoko-NOM turn off-PAST Tomoko turned off a light.
27	太郎が順子を蹴った。 Taro-ga Junko-o ket-ta. Taro-NOM Junko-ACC kick-PAST Taro kicked Junko.	順子を太郎が蹴った。 Junko-o Taro-ga ket-ta. Junko-ACC Taro-NOM kick-PAST Taro kicked Junko.

APPENDIX A. Continued

	Canonical sentences	Scrambled sentences
28	次郎が和子を投げ飛ばした。 Jiro-ga Kazuko-o nagetobashi-ta. Jiro-NOM Kazuko-ACC fling away-PAST Jiro flung away Kazuko.	和子を次郎が投げ飛ばした。 Kazuko-o Jiro-ga nagetobashi-ta. Kazuko-ACC Jiro-NOM fling away-PAST Jiro flung away Kazuko.
29	健二が友子を刺した。 Kenji-ga Tomoko-o sashi-ta. Kenji-NOM Tomoko-ACC stab-PAST Kenji stabbed Tomoko.	友子を健二が刺した。 Tomoko-o Kenji-ga sashi-ta. Tomoko-ACC Kenji-NOM stab-PAST Kenji stabbed Tomoko.
30	太郎が和子を縛った。 Taro-ga Kazuko-o shibat-ta. Taro-NOM Kazuko-ACC bind-PAST Taro bound Kazuko.	和子を太郎が縛った。 Kazuko-o Taro-ga shibat-ta. Kazuko-ACC Taro-NOM bind-PAST Taro bound Kazuko.
31	次郎が友子を呼び止めた。 Jiro-ga Tomoko-o yobitome-ta. Jiro-NOM Tomoko-ACC call out and stop-PAST Jiro called out and stopped Tomoko.	友子を次郎が呼び止めた。 Tomoko-o Jiro-ga yobitome-ta. Tomoko-ACC Jiro-NOM call out and stop-PAST Jiro called out and stopped Tomoko.
32	健二が順子を引っ掻いた。 Kenji-ga Junko-o hikkai-ta. Kenji-NOM Junko-ACC scrach-PAST Kenji scrached Junko.	順子を健二が引っ掻いた。 Junko-o Kenji-ga hikkai-ta. Junko-ACC Kenji-NOM scrach-PAST Kenji scrached Junko.
33	太郎が友子を起こした。 Taro-ga Tomoko-o okoshi-ta. Taro-NOM Tomoko-ACC wake-PAST Taro woke Tomoko.	友子を太郎が起こした。 Tomoko-o Taro-ga okoshi-ta. Tomoko-ACC Taro-NOM wake-PAST Taro woke Tomoko.
34	和子が次郎を誤解した。 Kazuko-ga Jiro-o gokaishi-ta. Kazuko-NOM Jiro-ACC misunderstand-PAST Kazuko misunderstood Jiro.	次郎を和子が誤解した。 Jiro-o Kazuko-ga gokaishi-ta. Jiro-ACC Kazuko-NOM misunderstand-PAST Kazuko misunderstood Jiro.
35	健二が和子を背負った。 Kenji-ga Kazuko-o seot-ta. Kenji-NOM Kazuko-ACC carry on (his) back-PAST Kenji carried Kazuko on his back.	和子を健二が背負った。 Kazuko-o Kenji-ga seot-ta. Kazuko-ACC Kenji-NOM carry on (his) back-PAST Kenji carried Kazuko on his back.
36	太郎が順子をにらんだ。 Taro-ga Junko-o niran-da. Taro-NOM Junko-ACC stare at-PAST Taro stared at Junko.	順子を太郎がにらんだ。 Junko-o Taro-ga niran-da. Junko-ACC Taro-NOM stare at-PAST Taro stared at Junko.
37	次郎が和子を突き落とした。 Jiro-ga Kazuko-o tsukiotoshi-ta. Jiro-NOM Kazuko-ACC push down-PAST Jiro pushed down Kazuko.	和子を次郎が突き落とした。 Kazuko-o Jiro-ga tsukiotoshi-ta. Kazuko-ACC Jiro-NOM push down-PAST Jiro pushed down Kazuko.
38	健二が友子を見つけた。 Kenji-ga Tomoko-o mitsuke-ta. Kenji-NOM Tomoko-ACC find-PAST Kenji found Tomoko.	友子を健二が見つけた。 Tomoko-o Kenji-ga mitsuke-ta. Tomoko-ACC Kenji-NOM find-PAST Kenji found Tomoko.
39	太郎が和子を脅した。 Taro-ga Kazuko-o odoshi-ta. Taro-NOM Kazuko-ACC threaten-PAST Taro threatened Kazuko.	和子を太郎が脅した。 Kazuko-o Taro-ga odoshi-ta. Kazuko-ACC Taro-NOM threaten-PAST Taro threatened Kazuko.
40	次郎が友子を見送った。 Jiro-ga Tomoko-o miokut-ta. Jiro-NOM Tomoko-ACC see off-PAST Jiro saw off Tomoko.	友子を次郎が見送った。 Tomoko-o Jiro-ga miokut-ta. Tomoko-ACC Jiro-NOM see off-PAST Jiro saw off Tomoko.
41	健二が順子を捕まえた。 Kenji-ga Junko-o tsukamae-ta. Kenji-NOM Junko-ACC catch-PAST Kenji caught Junko.	順子を健二が捕まえた。 Junko-o Kenji-ga tsukamae-ta. Junko-ACC Kenji-NOM catch-PAST Kenji caught Junko.

APPENDIX A. Continued

	Canonical sentences	Scrambled sentences
42	太郎が友子を呼んだ。 Taro-ga Tomoko-o yon-da. Taro-NOM Tomoko-ACC call-PAST Taro called Tomoko.	友子を太郎が呼んだ。 Tomoko-o Taro-ga yon-da. Tomoko-ACC Taro-NOM call-PAST Taro called Tomoko.
43	次郎が順子を泣かせた。 Jiro-ga Junko-o nakase-ta. Jiro-NOM Junko-ACC make cry-PAST Jiro made Junko cry.	順子を次郎が泣かせた。 Junko-o Jiro-ga nakase-ta. Junko-ACC Jiro-NOM make cry-PAST Jiro made Junko cry.
44	健二が順子を押した。 Kenji-ga Junko-o oshi-ta. Kenji-NOM Junko-ACC push-PAST Kenji pushed Junko.	順子を健二が押した。 Junko-o Kenji-ga oshi-ta. Junko-ACC Kenji-NOM push-PAST Kenji pushed Junko.
45	太郎が自転車を直した。 Taro-ga jitensha-o naoshi-ta. Taro-NOM (his) bicycle-ACC repair-PAST Taro repaired his bicycle.	自転車を太郎が直した。 jitensha-o Taro-ga naoshi-ta. (his) bicycle-ACC Taro-NOM repair-PAST Taro repaired his bicycle.
46	和子が水を飲んだ。 Kazuko-ga mizu-o non-da. Kazuko-NOM water-ACC drink-PAST Kazuko drank water.	水を和子が飲んだ。 mizu-o Kazuko-ga non-da. water-ACC Kazuko-NOM drink-PAST Kazuko drank water.
47	次郎がお金を払った。 Jiro-ga okane-o harat-ta. Jiro-NOM money-ACC pay-PAST Jiro paid money.	お金を次郎が払った。 okane-o Jiro-ga harat-ta. money-ACC Jiro-NOM pay-PAST Jiro paid money.
48	順子がタクシーを探した。 Junko-ga takushii-o sagashi-ta. Junko-NOM taxi-ACC look for-PAST Junko looked for a taxi.	タクシーを順子が探した。 takushii-o Junko-ga sagashi-ta. taxi-ACC Junko-NOM look for-PAST Junko looked for a taxi.
49	和子が髪を切った。 Kazuko-ga kami-o kit-ta. Kazuko-NOM (her) hair-ACC have cut-PAST Kazuko had her hair cut.	髪を和子が切った。 kami-o Kazuko-ga kit-ta. (her) hair-ACC Kazuko-NOM have cut-PAST Kazuko had her hair cut.
50	友子が車を運転した。 Tomoko-ga kuruma-o untenshi-ta. Tomoko-NOM (her) car-ACC drive-PAST Tomoko drove her car.	車を友子が運転した。 kuruma-o Tomoko-ga untenshi-ta. (her) car-ACC Tomoko-NOM drive-PAST Tomoko drove her car.
51	健二が公園を散歩した。 Kenji-ga kooen-o sanposhi-ta. Kenji-NOM (the) park-ACC take a walk-PAST Kenji took a walk in the park.	公園を健二が散歩した。 kooen-o Kenji-ga sanposhi-ta. (the) park-ACC Kenji-NOM take a walk-PAST Kenji took a walk in the park.
52	太郎がビールを冷やした。 Taro-ga biiru-o hiyashi-ta. Taro-NOM beer-ACC cool-PAST Taro cooled beer.	ビールを太郎が冷やした。 biiru-o Taro-ga hiyashi-ta. beer-ACC Taro-NOM cool-PAST Taro cooled beer.

APPENDIX B. The Active Sentences with Ditransitive Verbs for Experiment 2

Canonical sentences	Scrambled sentences
Items for Correct 'Yes' Responses	
1 太郎が友子にかばんを預けた。	かばんを友子に太郎が預けた。
Taro-ga Tomoko-ni kaban-o azuke-ta.	kaban-o Tomoko-ni Taro-ga azuke-ta.
Taro-NOM Tomoko-DAT (a) bag-ACC leave-PAST	(a) bag-ACC Tomoko-DAT Taro-NOM leave-PAST
Taro left a bag with Tomoko.	Taro left a bag with Tomoko.
2 健二が順子に花を贈った。	花を順子に健二が贈った。
Kenji-ga Junko-ni hana-o okut-ta.	hana-o Junko-ni Kenji-ga okut-ta.
Kenji-NOM Junko-DAT flowers-ACC present-PAST	flowers-ACC Junko-DAT Kenji-NOM present-PAST
Kenji presented flowers to Junko.	Kenji presented flowers to Junko.
3 和子が次郎に道を教えた。	道を次郎に和子が教えた。
Kazuko-ga Jiro-ni michi-o oshie-ta.	michi-o Jiro-ni Kazuko-ga oshie-ta.
Kazuko-NOM Jiro-DAT (the) way-ACC show-PAST	(the) way-ACC Jiro-DAT Kazuko-NOM show-PAST
Kazuko showed the way to Jiro.	Kazuko showed the way to Jiro.
4 和子が太郎に本を貸した。	本を太郎に和子が貸した。
Kazuko-ga Taro-ni hon-o kashi-ta.	hon-o Taro-ni Kazuko-ga kashi-ta.
Kazuko-NOM Taro-DAT (a) book-ACC lend-PAST	(a) book-ACC Taro-DAT Kazuko-NOM lend-PAST
Kazuko lent a book to Taro.	Kazuko lent a book to Taro.
5 和子が次郎にピアノを習った。	ピアノを次郎に和子が習った。
Kazuko-ga Jiro-ni piano-o narat-ta.	piano-o Jiro-ni Kazuko-ga narat-ta.
Kazuko-NOM Jiro-DAT (the) piano-ACC learn-PAST	(the) piano-ACC Jiro-DAT Kazuko-NOM learn-PAST
Kazuko learned the piano from Jiro.	Kazuko learned the piano from Jiro.
6 健二が順子に秘密を漏らした。	秘密を順子に健二が漏らした。
Kenji-ga Junko-ni himitsu-o morashi-ta.	himitsu-o Junko-ni Kenji-ga morashi-ta.
Kenji-NOM Junko-DAT (a) secret-ACC reveal-PAST	(a) secret-ACC Junko-DAT Kenji-NOM reveal-PAST
Kenji revealed a secret to Junko .	Kenji revealed a secret to Junko .
7 太郎が順子に絵を見せた。	絵を順子に太郎が見せた。
Taro-ga Junko-ni e-o mise-ta.	e-o Junko-ni Taro-ga mise-ta.
Taro-NOM Junko-DAT (a) picture-ACC show-PAST	(a) picture-ACC Junko-DAT Taro-NOM show-PAST
Taro showed Junko a picture.	Taro showed Junko a picture.
8 和子が健二にテレビをゆずった。	テレビを健二に和子がゆずった。
Kazuko-ga Kenji-ni terebi-o yuzut-ta.	terebi-o Kenji-ni Kazuko-ga yuzut-ta.
Kazuko-NOM Kenji-DAT (a) TV-ACC give-PAST	(a) TV-ACC Kenji-DAT Kazuko-NOM give-PAST
Kazuko gave Kenji a TV.	Kazuko gave Kenji a TV.
9 和子が太郎にプレゼントをあげた。	プレゼントを太郎に和子があげた。
Kazuko-ga Taro-ni purezento-o age-ta.	purezento-o Taro-ni Kazuko-ga age-ta.
Kazuko-NOM Taro-DAT (a) present-ACC give-PAST	(a) present-ACC Taro-DAT Kazuko-NOM give-PAST
Kazuko gave Taro a present.	Kazuko gave Taro a present.

10 友子が太郎に辞書を返した。
Tomoko-ga Taro-ni jisho-o kaeshi-ta.
Tomoko-NOM Taro-DAT (a) dictionary-ACC return-PAST
Tomoko returned a dictionary to Taro.
辞書を太郎に友子が返した。
jisho-o Taro-ni Tomoko-ga kaeshi-ta.
(a) dictionary-ACC Taro-DAT Tomoko-NOM return-PAST
Tomoko returned a dictionary to Taro.

11 次郎が和子に外出を禁止した。
Jiro-ga Kazuko-ni gaishutsu-o kinshishi-ta.
Jiro-NOM Kazuko-DAT to go out-ACC prohibit-PAST
Jiro prohibited Kazuko to go out.
外出を和子に次郎が禁止した。
gaishutsu-o Kazuko-ni Jiro-ga kinshishi-ta.
to go out-ACC Kazuko-DAT Jiro-NOM prohibit-PAST
Jiro prohibited Kazuko to go out.

12 順子が太郎に結果を報告した。
Junko-ga Taro-ni kekka-o hookokushi-ta.
Junko-NOM Taro-DAT (a) result-ACC report-PAST
Junko reportd a result to Taro.
結果を太郎に順子が報告した。
kekka-o Taro-ni Junko-ga hookokushi-ta.
(a) result-ACC Taro-DAT Junko-NOM report-PAST
Junko reportd a result to Taro.

13 友子が次郎にボールをぶつけた。
Tomoko-ga Jiro-ni booru-o butsuke-ta.
Tomoko-NOM Jiro-DAT (a) ball-ACC throw-PAST
Tomoko threw a ball to Jiro.
ボールを次郎に友子がぶつけた。
booru-o Jiro-ni Tomoko-ga butsuke-ta.
(a) ball-ACC Jiro-DAT Tomoko-NOM throw-PAST
Tomoko threw a ball to Jiro.

14 太郎が順子に教科書を借りた。
Taro-ga Junko-ni kyookasho-o kari-ta.
Taro-NOM Junko-DAT (a) textbook-ACC borrow-PAST
Taro borrowed a textbook from Junko.
教科書を順子に太郎が借りた。
kyookasho-o Junko-ni Taro-ga kari-ta.
(a) textbook-ACC Junko-DAT Taro-NOM borrow-PAST
Taro borrowed a textbook from Junko.

15 和子が健二に友達を紹介した。
Kazuko-ga Kenji-ni tomodachi-o shookaishi-ta.
Kazuko-NOM Kenji-DAT (her) friend-ACC inrtoduce-PAST
Kazuko introduced her friend to Kenji.
友達を健二に和子が紹介した。
tomodachi-o Kenji-ni Kazuko-ga shookaishi-ta.
(her) friend-ACC Kenji-DAT Kazuko-NOM inrtoduce-PAST
Kazuko introduced her friend to Kenji.

16 友子が太郎にビールをすすめた。
Tomoko-ga Taro-ni biiru-o susume-ta.
Tomoko-NOM Taro-DAT beer-ACC offer-PAST
Tomoko offered beer to Taro.
ビールを太郎に友子がすすめた。
biiru-o Taro-ni Tomoko-ga susume-ta.
beer-ACC Taro-DAT Tomoko-NOM offer-PAST
Tomoko offered beer to Taro.

17 次郎が友子に理由を話した。
Jiro-ga Tomoko-ni riyuu-o hanashi-ta.
Jiro-NOM Tomoko-DAT (the) reason-ACC tell-PAST
Jiro told the reason to Tomoko.
理由を友子に次郎が話した。
riyuu-o Tomoko-ni Jiro-ga hanashi-ta.
(the) reason-ACC Tomoko-DAT Jiro-NOM tell-PAST
Jiro told the reason to Tomoko.

18 健二が順子にカメラを向けた。
Kenji-ga Junko-ni kamera-o muke-ta.
Kenji-NOM Junko-DAT (a) camera-ACC point at-PAST
Kenji pointed a camera at Junko.
カメラを順子に健二が向けた。
kamera-o Junko-ni Kenji-ga muke-ta.
(a) camera-ACC Junko-DAT Kenji-NOM point at-PAST
Kenji pointed a camera at Junko.

19 友子が次郎に買い物を頼んだ。
Tomoko-ga Jiro-ni kaimono-o tanon-da.
Tomoko-NOM Jiro-DAT to go shopping-ACC ask-PAST
Tomoko asked Jiro to go shopping.
買い物を次郎に友子が頼んだ。
kaimono-o Jiro-ni Tomoko-ga tanon-da.
to go shopping-ACC Jiro-DAT Tomoko-NOM ask-PAST
Tomoko asked Jiro to go shopping.

20 順子が健二に書類を渡した。
Junko-ga Kenji-ni shorui-o watashi-ta.
Junko-NOM Kenji-DAT documents-ACC hand-PAST
Junko handed documents to Kenji.
書類を健二に順子が渡した。
shorui-o Kenji-ni Junko-ga watashi-ta.
documents-ACC Kenji-DAT Junko-NOM hand-PAST
Junko handed documents to Kenji.

APPENDIX C. The Passive Sentences with Transitive Verbs for Experiment 3

Canonical sentences	Scrambled sentences
Items for Correct 'Yes' Responses	
1 順子が太郎に蹴られた。	太郎に順子が蹴られた。
Junko-ga Taro-ni ker-are-ta.	Taro-ni Junko-ga ker-are-ta.
Junko-NOM Taro-DAT hit-PASS-PAST.	Taro-DAT Junko-NOM hit-PASS-PAST.
Junko was hit by Taro.	Junko was hit by Taro.
2 和子が次郎に投げ飛ばされた。	次郎に和子が投げ飛ばされた。
Kazuko-ga Jiro-ni nagetobas-are-ta	iro-ni Kazuko-ga Jnagetobas-are-ta
Kazuko-NOM Jiro-DAT fling away-PASS-PAST	Jiro-DAT Kazuko-NOM fling away-PASS-PAST
Kazuko was flung away by Jiro.	Kazuko was flung away by Jiro.
3 友子が健二に刺された。	健二に友子が刺された。
Tomoko-ga Kenji-ni sas-are-ta.	Kenji-ni Tomoko-ga sas-are-ta.
Tomoko-NOM Kenji-DAT stab-PASS-PAST	Kenji-DAT Tomoko-NOM stab-PASS-PAST
Tomoko was stabbed by Kenji.	Tomoko was stabbed by Kenji.
4 和子が太郎に縛られた。	太郎に和子が縛られた。
Kazuko-ga Taro-ni shibar-are-ta.	Taro-ni Kazuko-ga shibar-are-ta.
Kazuko-NOM Taro-DAT bind-PASS-PAST	Taro-DAT Kazuko-NOM bind-PASS-PAST
Kazuko was bound by Taro.	Kazuko was bound by Taro.
5 友子が次郎に呼び止められた。	次郎に友子が呼び止められた。
Tomoko-ga Jiro-ni yobitomer-are-ta.	Jiro-ni Tomoko-ga yobitomer-are-ta.
Tomoko-NOM Jiro-DAT call and stop-PASS-PAST	Jiro-DAT Tomoko-NOM call and stop-PASS-PAST
Tomoko was called and stopped by Jiro.	Tomoko was called and stopped by Jiro.
6 順子が健二に引っ掻かれた。	健二に順子が引っ掻かれた。
Junko-ga Kenji-ni hikkak-are-ta.	Kenji-ni Junko-ga hikkak-are-ta.
Junko NOM Kenji DAT scratch PASS PAST.	Kenji DAT Junko NOM scratch PASS PAST.
Junko was scratched by Kenji.	Junko was scratched by Kenji.
7 友子が次郎に起こされた。	次郎に友子が起こされた。
Tomoko-ga Jiro-ni okos-are-ta.	Jiro-ni Tomoko-ga okos-are-ta.
Tomoko-NOM Jiro-DAT awaken-PASS-PAST	Jiro-DAT Tomoko-NOM awaken-PASS-PAST
Tomoko was awakened by Jiro.	Tomoko was awakened by Jiro.
8 次郎が和子に誤解された。	和子に次郎が誤解された。
Jiro-ga Kazuko-ni gokais-are-ta.	Kazuko-ni Jiro-ga gokais-are-ta.
Jiro-NOM Kazuko-DAT misunderstand-PASS-PAST	Kazuko-DAT Jiro-NOM misunderstand-PASS-PAST
Jiro was misunderstood by Kazuko.	Jiro was misunderstood by Kazuko.
9 和子が健二に背負われた。	健二に和子が背負われた。
Kazuko-ga Kenji-ni seow-are-ta.	Kenji-ni Kazuko-ga seow-are-ta.
Kazuko-NOM Kenji-DAT carry on (Kenji's) back-PASS-PAST	Kenji-DAT Kazuko-NOM carry on (Kenji's) back-PASS-PAST
Kazuko was carried on Kanji's back.	Kazuko was carried on Kanji's back.
10 順子が太郎ににらまれた。	太郎に順子がにらまれた。
Junko-ga Taro-ni niram-are-ta.	Taro-ni Junko-ga niram-are-ta.
Junko-NOM Taro-DAT stare at-PASS-PAST	Taro-DAT Junko-NOM stare at-PASS-PAST
Junko was stared at by Taro.	Junko was stared at by Taro.

11 和子が次郎に突き落とされた。
Kazuko-ga Jiro-ni tsukiotos-are-ta.
Kazuko-NOM Jiro-DAT push down-PASS-PAST
Kazuko was pushed down by Jiro.
12 友子が健二に見つけられた。
Tomoko-ga Kenji-ni mituker-are-ta.
Tomoko-NOM Kenji-DAT find-PASS-PAST
Tomoko was found by Kanji.
13 和子が太郎に脅された。
Kazuko-ga Taro-ni odos-are-ta.
Kazuko-NOM Taro-DAT threaten-PASS-PAST
Kazuko was threatened by Taro.
14 友子が次郎に見送られた。
Tomoko-ga Jiro-ni miokur-are-ta.
Tomoko-NOM Jiro-DAT see off-PASS-PAST
Tomoko was seen off by Jiro.
15 順子が健二に捕まえられた。
Junko-ga Kenji-ni tsukamaer-are-ta.
Junko-NOM Kenji-DAT catch-PASS-PAST
Junko was caught by Kenji.
16 友子が太郎に呼ばれた。
Tomoko-ga Taro-ni yob-are-ta.
Tomoko-NOM Taro-DAT call-PASS-PAST
Tomoko was called by Taro.
17 順子が次郎に泣かされた。
Junko-ga Jiro-ni nakas-are-ta.
Junko-NOM Jiro-DAT cry-PASS-PAST
Junko was made to cry by Jiro.
18 順子が健二に押された。
Junko-ga Kenji-ni os-are-ta.
Junko-NOM Kenji-DAT push-PASS-PAST
Junko was pushed by Kenji.
19 太郎が友子にほめられた。
Taro-ga Tomoko-ni homer-are-ta.
Taro-NOM Tomoko-DAT praise-PASS-PAST
Taro was praised by Tomoko.
20 順子が太郎に助けられた。
Junko-ga Taro-ni tasuker-are-ta.
Junko-NOM Taro-DAT help-PASS-PAST
Junko was helped by Taro.

次郎に和子が突き落とされた。
Jiro-ni Kazuko-ga tsukiotos-are-ta.
Jiro-DAT Kazuko-NOM push down-PASS-PAST
Kazuko was pushed down by Jiro.
健二に友子が見つけられた。
Kenji-ni Tomoko-ga mituker-are-ta.
Kenji-DAT Tomoko-NOM find-PASS-PAST
Tomoko was found by Kanji.
太郎に和子が脅された。
Taro-ni Kazuko-ga odos-are-ta.
Taro-DAT Kazuko-NOM threaten-PASS-PAST
Kazuko was threatened by Taro.
次郎に友子が見送られた。
Jiro-ni Tomoko-ga miokur-are-ta.
Jiro-DAT Tomoko-NOM see off-PASS-PAST
Tomoko was seen off by Jiro.
健二に順子が捕まえられた。
Kenji-ni Junko-ga tsukamaer-are-ta.
Kenji-DAT Junko-NOM catch-PASS-PAST
Junko was caught by Kenji.
太郎に友子が呼ばれた。
Taro-ni Tomoko-ga yob-are-ta.
Taro-DAT Tomoko-NOM call-PASS-PAST
Tomoko was called by Taro.
次郎に順子が泣かされた。
Jiro-ni Junko-ga nakas-are-ta.
Jiro-DAT Junko-NOM cry-PASS-PAST
Junko was made to cry by Jiro.
健二に順子が押された。
Kenji-ni Junko-ga os-are-ta.
Kenji-DAT Junko-NOM push-PASS-PAST
Junko was pushed by Kenji.
友子に太郎がほめられた。
Tomoko-ni Taro-ga homer-are-ta.
Tomoko-DAT Taro-NOM praise-PASS-PAST
Taro was praised by Tomoko.
太郎に順子が助けられた。
Taro-ni Junko-ga tasuker-are-ta.
Taro-DAT Junko-NOM help-PASS-PAST
Junko was helped by Taro.

APPENDIX C. Continued

	Canonical sentences	Scrambled sentences
21	和子が次郎に殴られた。 Kazuko-ga Jiro-ni nagur-are-ta. Kazuko-NOM Jiro-DAT strike-PASS-PAST Kazuko was struck by Jiro.	次郎に和子が殴られた。 Jiro-ni Kazuko-ga nagur-are-ta. Jiro-DAT Kazuko-NOM strike-PASS-PAST Kazuko was struck by Jiro.
22	順子が太郎に雇われた。 Junko-ga Taro-ni yatow-are-ta. Junko-NOM Taro-DAT employ-PASS-PAST Junko was employed by Taro.	太郎に順子が雇われた。 Taro-ni Junko-ga yatow-are-ta. Taro-DAT Junko-NOM employ-PASS-PAST Junko was employed by Taro.
23	和子が次郎にだまされた。 Kazuko-ga Jiro-ni damas-are-ta. Kazuko-NOM Jiro-DAT deceive-PASS-PAST Kazuko was deceived by Jiro.	次郎に和子がだまされた。 Jiro-ni Kazuko-ga damas-are-ta. Jiro-DAT Kazuko-NOM deceive-PASS-PAST Kazuko was deceived by Jiro.
24	友子が太郎に殺された。 Tomoko-ga Taro-ni koros-are-ta. Tomoko-NOM Taro-DAT kill-PASS-PAST Tomoko was killed by Taro.	太郎に友子が殺された。 Taro-ni Tomoko-ga koros-are-ta. Taro-DAT Tomoko-NOM kill-PASS-PAST Tomoko was killed by Taro.
25	健二が友子に憎まれた。 Kenji-ga Tomoko-ni nikum-are-ta. Kenji-NOM Tomoko-DAT hate-PASS-PAST Kenji was hated by Tomoko.	友子に健二が憎まれた。 Tomoko-ni Kenji-ga nikum-are-ta. Tomoko-DAT Kenji-NOM hate-PASS-PAST Kenji was hated by Tomoko.
26	健二が順子に許された。 Kenji-ga Junko-ni yurus-are-ta. Kenji-NOM Junko-DAT forgive-PASS-PAST Kenji was forgiven by Junko.	順子に健二が許された。 Junko-ni Kenji-ga yurus-are-ta. Junko-DAT Kenji-NOM forgive-PASS-PAST Kenji was forgiven by Junko.
27	健二が順子に育てられた。 Kenji-ga Junko-ni sodater-are-ta. Kenji-NOM Junko-DAT bring up-PASS-PAST Kenji was brought up by Junko.	順子に健二が育てられた。 Junko-ni Kenji-ga sodater-are-ta. Junko-DAT Kenji-NOM bring up-PASS-PAST Kenji was brought up by Junko.
28	太郎が和子に叱られた。 Taro-ga Kazuko-ni shikar-are-ta. Taro-NOM Kazuko-DAT scold-PASS-PAST Taro was scolded by Kazuko.	和子に太郎が叱られた。 Kazuko-ni Taro-ga shikar-are-ta. Kazuko-DAT Taro-NOM scold-PASS-PAST Taro was scolded by Kazuko.

29 和子が次郎に指導された。
Kazuko-ga Jiro-ni shidoos-are-ta.
Kazuko-NOM Jiro-DAT lead-PASS-PAST
Kazuko was led by Jiro.
次郎に和子が指導された。
Jiro-ni Kazuko-ga shidoos-are-ta.
Jiro-DAT Kazuko-NOM lead-PASS-PAST
Kazuko was led by Jiro.

30 太郎が和子に疑われた。
Taro-ga Kazuko-ni utagaw-are-ta.
Taro-NOM Kazuko-DAT doubt-PASS-PAST
Taro was doubted by Kazuko.
和子に太郎が疑われた。
Kazuko-ni Taro-ga utagaw-are-ta.
Kazuko-DAT Taro-NOM doubt-PASS-PAST
Taro was doubted by Kazuko.

31 順子が次郎に叩かれた。
Junko-ga Jiro-ni tatak-are-ta.
Junko-NOM Jiro-DAT hit-PASS-PAST
Junko was hit by Jiro.
次郎に順子が叩かれた。
Jiro-ni Junko-ga tatak-are-ta.
Jiro-DAT Junko-NOM hit-PASS-PAST
Junko was hit by Jiro.

32 次郎が順子に追いかけられた。
Jiro-ga Junko-ni oikaker-are-ta.
Jiro-NOM Junko-DAT chase-PASS-PAST
Jiro was chased by Junko.
順子に次郎が追いかけられた。
Junko-ni Jiro-ga oikaker-are-ta.
Junko-DAT Jiro-NOM chase-PASS-PAST
Jiro was chased by Junko.

33 健二が友子に尊敬された。
Kenji-ga Tomoko-ni sonkees-are-ta.
Kenji-NOM Tomoko-DAT respect-PASS-PAST
Kenji was respected by Tomoko.
友子に健二が尊敬された。
Tomoko-ni Kenji-ga sonkees-are-ta.
Tomoko-DAT Kenji-NOM respect-PASS-PAST
Kenji was respected by Tomoko.

34 友子が太郎に逃がされた。
Tomoko-ga Taro-ni nigas-are-ta.
Tomoko-NOM Taro-DAT release-PASS-PAST
Tomoko was released by Jiro.
太郎に友子が逃がされた。
Taro-ni Tomoko-ga nigas-are-ta.
Taro-DAT Tomoko-NOM release-PASS-PAST
Tomoko was released by Jiro.

35 順子が次郎に突き飛ばされた。
Junko-ga Jiro-ni tsukitobas-are-ta.
Junko-NOM Jiro-DAT push away-PASS-PAST
Junko was pushed away by Jiro.
次郎に順子が突き飛ばされた。
Jiro-ni Junko-ga tsukitobas-are-ta.
Jiro-DAT Junko-NOM push away-PASS-PAST
Junko was pushed away by Jiro.

36 和子が健二に驚かされた。
Kazuko-ga Kenji-ni odorokas-are-ta.
Kazuko-NOM Kenji-DAT surprise-PASS-PAST
Kenji was surprised by Kenji.
健二に和子が驚かされた。
Kenji-ni Kazuko-ga odorokas-are-ta.
Kenji-DAT Kazuko-NOM surprise-PASS-PAST
Kenji was surprised by Kenji.

APPENDIX D. The potential sentences for Experiment 4

Canonical sentences	Scrambled sentences
Items for Correct 'Yes' Responses	
1 高志にギリシャ文字が書けるだろうか。 Takashi-ni girishago-ga kak-eru-daroo-ka. Takashi-DAT Greek-NOM write-POT-wonder-Q I wonder if Takashi can write Greek?	ギリシャ文字が高志に書けるだろうか。 girishago-ga Takashi-ni kak-eru-daroo-ka. Greek-NOM Takashi-DAT write-POT-wonder-Q I wonder if Takashi can write Greek?
2 恵子にフランス語が話せるだろうか。 Keiko-ni furansugo-ga hanas-eru-daroo-ka. Keiko-DAT French-NOM speak-POT-wonder-Q I wonder if Keiko can speak French?	フランス語が恵子に話せるだろうか。 uransugo-ga Keiko-ni fhanas-eru-daroo-ka. French-NOM Keiko-DAT speak-POT-wonder-Q I wonder if Keiko can speak French?
3 健次に中国語が読めるだろうか。 Kenji-ni chuugokugo-ga yom-eru-daroo-ka. Kenji-DAT Chinese-NOM read-POT-wonder-Q I wonder if Kenji can read Chinese?	中国語が健次に読めるだろうか。 chuugokugo-ga Kenji-ni yom-eru-daroo-ka. Chinese-NOM Kenji-DAT read-POT-wonder-Q I wonder if Kenji can read Chinese?
4 康子にケーキが作れるだろうか。 Yasuko-ni keeki-ga tsukur-eru-daroo-ka. Yasuko-DAT cake-NOM make-POT-wonder-Q I wonder if Yasuko can make a cake?	ケーキが康子に作れるだろうか。 keeki-ga Yasuko-ni tsukur-eru-daroo-ka. cake-NOM Yasuko-DAT make-POT-wonder-Q I wonder if Yasuko can make a cake?
5 光一に家が買えるだろうか。 Koichi-ni ie-ga ka-eru-daroo-ka. Koichi-DAT ie-NOM buy-POT-wonder-Q I wonder if Koichi can buy a house?	家が光一に買えるだろうか。 ie-ga Koichi-ni ka-eru-daroo-ka. ie-NOM Koichi-DAT buy-POT-wonder-Q I wonder if Koichi can buy a house?
6 雅子にウイスキーが飲めるだろうか。 Masako-ni uisukii-ga nom-eru-daroo-ka. Masako-DAT whiskey-NOM drink-POT-wonder-Q I wonder if Masako can drink whiskey?	ウイスキーが雅子に飲めるだろうか。 uisukii-ga Masako-ni nom-eru-daroo-ka. whiskey-NOM Masako-DAT drink-POT-wonder-Q I wonder if Masako can drink whiskey?
7 高志にハープがひけるだろうか。 Takashi-ni haapu-ga hik-eru-daroo-ka. Takashi-DAT harp-NOM play-POT-wonder-Q I wonder if Takashi can play the harp?	ハープが高志にひけるだろうか。 haapu-ga Takashi-ni hik-eru-daroo-ka. harp-NOM Takashi-DAT play-POT-wonder-Q I wonder if Takashi can play the harp?
8 恵子にフルートが吹けるだろうか。 Keiko-ni furuuto-ga fuk-eru-daroo-ka. Keiko-DAT flute-NOM play-POT-wonder-Q I wonder if Keiko can play the flute?	フルートが恵子に吹けるだろうか。 uruuto-ga Keiko-ni ffuk-eru-daroo-ka. flute-NOM Keiko-DAT play-POT-wonder-Q I wonder if Keiko can play the flute?
9 健次に和太鼓がたたけるだうか。 Kenji-ni wadaiko-ga tatak-eru-daroo-ka. Kenji-DAT (the) Japanese drums-NOM play-POT-wonder-Q I wonder if Kenji can play the Japanese drums?	和太鼓が健次にたたけるだうか。 wadaiko-ga Kenji-ni tatak-eru-daroo-ka. (the) Japanese drums-NOM Kenji-DAT play-POT-wonder-Q I wonder if Kenji can play the Japanese drums?

10 康子にお金が払えるだろうか。
Yasuko-ni okane-ga hara-eru-daroo-ka.
Yasuko-DAT money-NOM pay-POT-wonder-Q
I wonder if Yasuko can pay money?

お金が康子に払えるだろうか。
okane-ga Yasuko-ni hara-eru-daroo-ka.
money-NOM Yasuko-DAT pay-POT-wonder-Q
I wonder if Yasuko can pay money?

11 光一にパソコンが使えるだろうか。
Koichi-ni pasokon-ga tsuka-eru-daroo-ka.
Koichi-DAT (a) personal computer-NOM use-POT-wonder-Q
I wonder if Koichi can use a personal computer?

パソコンが光一に使えるだろうか。
pasokon-ga Koichi-ni tsuka-eru-daroo-ka.
(a) personal computer-NOM Koichi-DAT use-POT-wonder-Q
I wonder if Koichi can use a personal computer?

12 雅子にラジオが直せるだろうか。
Masako-ni rajio-ga naos-eru-daroo-ka.
Masako-DAT (a) radio-NOM repair-POT-wonder-Q
I wonder if Masako can repair a radio?

ラジオが雅子に直せるだろうか。
rajio-ga Masako-ni naos-eru-daroo-ka.
(a) radio-NOM Masako-DAT repair-POT-wonder-Q
I wonder if Masako can repair a radio?

13 高志に鉛筆が削れるだろうか。
Takashi-ni enpitsu-ga kezur-eru-daroo-ka.
Takashi-DAT (a) pencil-NOM sharpen-POT-wonder-Q
I wonder if Takashi can sharpen a pencil?

鉛筆が高志に削れるだろうか。
enpitsu-ga Takashi-ni kezur-eru-daroo-ka.
(a) pencil-NOM Takashi-DAT sharpen-POT-wonder-Q
I wonder if Takashi can sharpen a pencil?

14 恵子にたばこが吸えるだろうか。
Keiko-ni tabako-ga su-eru-daroo-ka.
Keiko-DAT cigarette-NOM smoke-POT-wonder-Q
I wonder if Keiko can smoke?

たばこが恵子に吸えるだろうか。
tabako-ga Keiko-ni su-eru-daroo-ka.
cigarette-NOM Keiko-DAT smoke-POT-wonder-Q
I wonder if Keiko can smoke?

15 健次にりんごがむけるだろうか。
Kenji-ni ringo-ga muk-eru-daroo-ka.
Kenji-DAT (an) apple-NOM peel-POT-wonder-Q
I wonder if Kenji can peel an apple?

りんごが健次にむけるだろうか。
ringo-ga Kenji-ni muk-eru-daroo-ka.
(an) apple-NOM Kenji-DAT peel-POT-wonder-Q
I wonder if Kenji can peel an apple?

16 康子にセーターが編めるだろうか。
Yasuko-ni seetaa-ga am-eru-daroo-ka.
Yasuko-DAT (an) sweater-NOM knit-POT-wonder-Q
I wonder if Yasuko can knit a sweater?

セーターが康子に編めるだろうか。
seetaa-ga Yasuko-ni am-eru-daroo-ka.
(an) sweater-NOM Yasuko-DAT knit-POT-wonder-Q
I wonder if Yasuko can knit a sweater?

17 光一に魚が焼けるだろうか。
Koichi-ni sakana-ga yak-eru-daroo-ka.
Koichi-DAT (a) fish-NOM broil-POT-wonder-Q
I wonder if Koichi can broil a fish?

魚が光一に焼けるだろうか。
sakana-ga Koichi-ni yak-eru-daroo-ka.
(a) fish-NOM Koichi-DAT broil-POT-wonder-Q
I wonder if Koichi can broil a fish?

18 雅子にペンキが塗れるだろうか。
Masako-ni penki-ga nur-eru-daroo-ka.
Masako-DAT paint-NOM paint-POT-wonder-Q
I wonder if Masako can paint?

ペンキが雅子に塗れるだろうか。
penki-ga Masako-ni nur-eru-daroo-ka.
paint-NOM Masako-DAT paint-POT-wonder-Q
I wonder if Masako can paint?

APPENDIX D. Continued

	Canonical sentences	Scrambled sentences
19	高志にホームランが打てるだろうか。 Takashi-ni hoomuran-ga ut-eru-daroo-ka. Takashi-DAT (a) home run-NOM hit-POT-wonder-Q I wonder if Takashi can hit a home run?	ホームランが高志に打てるだろうか。 hoomuran-ga Takashi-ni ut-eru-daroo-ka. (a) home run-NOM Takashi-DAT hit-POT-wonder-Q I wonder if Takashi can hit a home run?
20	恵子に火がおこせるだろうか。 Keiko-ni hi-ga okos-eru-daroo-ka. Keiko-DAT (a) fire-NOM make-POT-wonder-Q I wonder if Keiko can make a fire?	火が恵子におこせるだろうか。 hi-ga Keiko-ni okos-eru-daroo-ka. (a) fire-NOM Keiko-DAT make-POT-wonder-Q I wonder if Keiko can make a fire?
21	健次にバレエが踊れるだろうか。 Kenji-ni baree-ga odor-eru-daroo-ka. Kenji-DAT ballet-NOM dance-POT-wonder-Q I wonder if Kenji can dance ballet?	バレエが健次に踊れるだろうか。 baree-ga Kenji-ni odor-eru-daroo-ka. ballet-NOM Kenji-DAT dance-POT-wonder-Q I wonder if Kenji can dance ballet?
22	康子に釜飯が炊けるだろうか。 Yasuko-ni kamameshi-ga tak-eru-daroo-ka. Yasuko-DAT *kamameshi*-NOM cook-POT-wonder-Q I wonder if Yasuko can cook *kamameshi*?	釜飯が康子に炊けるだろうか。 kamameshi-ga Yasuko-ni tak-eru-daroo-ka. kamameshi-NOM Yasuko-DAT cook-POT-wonder-Q I wonder if Yasuko can cook *kamameshi*?
23	光一に問題が解けるだろうか。 Koichi-ni mondai-ga tok-eru-daroo-ka. Koichi-DAT (a) problem-NOM solve-POT-wonder-Q I wonder if Koichi can solve a problem?	問題が光一に解けるだろうか。 mondai-ga Koichi-ni tok-eru-daroo-ka. (a) problem-NOM Koichi-DAT solve-POT-wonder-Q I wonder if Koichi can solve a problem?
24	雅子にオペラが歌えるだろうか。 Masako-ni opera-ga uta-eru-daroo-ka. Masako-DAT (an) opera-NOM sing-POT-wonder-Q I wonder if Masako can sing an opera?	オペラが雅子に歌えるだろうか。 opera-ga Masako-ni uta-eru-daroo-ka. (an) opera-NOM Masako-DAT sing-POT-wonder-Q I wonder if Masako can sing an opera?

APPENDIX E. The causative sentences for Experiment 5

Canonical sentences	Scrambled sentences
Items for Correct 'Yes' Responses for Sentences with Accusative Verbs	
1 順子が弟子にアトリエを造らせた	順子がアトリエを弟子に造らせた
Junko-ga deshi-ni atorie-o tukur-ase-ta	Junko-ga atorie-o deshi-ni tukur-ase-ta
Junko-NOM (her) pupil-DAT studio-ACC buid-CAUS-PAST	Junko-NOM studio-ACC (her) pupil-DAT buid-CAUS-PAST
Junko had her pupil build a studio.	Junko had her pupil build a studio.
2 次郎が役員に命令を撤回させた	次郎が命令を役員に撤回させた
Jiro-ga yakuin-ni meeree-o tekkais-ase-ta	Jiro-ga meeree-o yakuin-ni tekkais-ase-ta
Jiro-NOM (an) executive-DAT (an) order-ACC withdaw-CAUS-PAST	Jiro-NOM (an) order-ACC executive-DAT (an) withdaw-CAUS-PAST
Jiro had an executive withdraw an order.	Jiro had an executive withdraw an order.
3 和子が子供達に自然を満喫させた	和子が自然を子供達に満喫させた
Kazuko-ga kodomotachi-ni shizen-o mankitsus-ase-ta	Kazuko-ga shizen-o kodomotachi-ni mankitsus-ase-ta
Kazuko-NOM (her) children-DAT nature-ACC enjoy fully-CAUS-PAST	Kazuko-NOM nature-ACC (her) children-DAT enjoy fully-CAUS-PAST
Kazuko had her children enjoy nature fully.	Kazuko had her children enjoy nature fully.
4 太郎が孫に医学部を目指させた	太郎が医学部を孫に目指させた
Taro-ga mago-ni igakubu-o mezas-ase-ta	Taro-ga igakubu-o mago-ni mezas-ase-ta
Taro-NOM (his) grandchild-DAT (the) Faculty of Medicine-ACC aim-CAUS-PAST	Taro-NOM (his) Faculty of Medicine-ACC grandchild-DAT (the) aim-CAUS-PAST
Taro had his grandchild aim for the Faculty of Medicine.	Taro had his grandchild aim for the Faculty of Medicine.
5 司令官が部隊に敵地を襲わせた	司令官が敵地を部隊に襲わせた
shireekan-ga butai-ni tekichi-o osow-ase-ta	shireekan-ga tekichi-o butai-ni osow-ase-ta
(the) commander-NOM (his) party-DAT enemy's land-ACC attack-CAUS-PAST	(the) commander-NOM enemy's land-ACC (his) party-DAT attack-CAUS-PAST
The commander had his party attack the enemy's land.	The commander had his party attack the enemy's land.
6 健二が社員に緊急事態を体験させた	健二が緊急事態を社員に体験させた
Kenji-ga shain-ni kinkyuujitai-o taikens-ase-ta	Kenji-ga kinkyuujitai-o shain-ni taikens-ase-ta
Kenji-NOM (the) staff-DAT (a) state of emergency-ACC experience-CAUS-PAST	Kenji-NOM (a) state of emergency-ACC (the) staff-DAT experience-CAUS-PAST
Kenji had the staff experience a state of emergency.	Kenji had the staff experience a state of emergency.
7 次郎が長女に田舎を思い出させた	次郎が田舎を長女に思い出させた
Jiro-ga tchoojo-ni inaka-o omoidas-ase-ta	Jiro-ga inaka-o tchoojo-ni omoidas-ase-ta
Jiro-NOM (his) oldest daughter-DAT (the) countryside-ACC remind-CAUS-PAST	Jiro-NOM (the) countryside-ACC (his) oldest daughter-DAT remind-CAUS-PAST
Jiro reminded his oldest daughter of the countryside.	Jiro reminded his oldest daughter of the countryside.
8 順子が児童にゲームを止めさせた	順子がゲームを児童に止めさせた
Junko-ga jidoo-ni geemu-o yame-sase-ta	Junko-ga geemu-o jidoo-ni yame-sase-ta
Junko-NOM (the) child-DAT (a) game-ACC stop-CAUS-PAST	Junko-NOM (a) game-ACC (the) child-DAT stop-CAUS-PAST
Junko had the child stop playing a game.	Junko had the child stop playing a game.
9 署長が警官に現場を調べさせた	署長が現場を警官に調べさせた
shochoo-ga keekan-ni genba-o shirabe-sase-ta	shochoo-ga genba-o keekan-ni shirabe-sase-ta
(the) head-NOM (an) officer-DAT (the) scene-ACC search-CAUS-PAST	(the) head-NOM (the) scene-ACC (an) officer-DAT search-CAUS-PAST
The head of the police station had an officer search the scene.	The head of the police station had an officer search the scene.

APPENDIX E. Continued

	Canonical sentences	Scrambled sentences
10	和子が園児に富士山を描かせた Kazuko-ga enji-ni Fujisan-o kak-ase-ta. Kazuko-NOM (a) kindergarten pupil-DAT Mt.Fuji-ACC paint-CAUS-PAST Kazuko had a kindergarten pupil paint Mt.Fuji.	和子が富士山を園児に描かせた Kazuko-ga Fujisan-o enji-ni kak-ase-ta. Kazuko-NOM Mt.Fuji-ACC (a) kindergarten pupil-DAT paint-CAUS-PAST Kazuko had a kindergarten pupil paint Mt.Fuji.
11	順子が清掃係に公園を掃除させた Junko-ga seesoogakari-ni kooen-o sooji-sase-ta. Junko-NOM (a) garbage man-DAT (the) park-ACC clean-CAUS-PAST Junko had a garbage man clean the park.	順子が公園を清掃係に掃除させた Junko-ga kooen-o seesoogakari-ni sooji-sase-ta. Junko-NOM (the) park-ACC (a) garbage man-DAT clean-CAUS-PAST Junko had a garbage man clean the park.
12	健二が親戚に舞台を見学させた Kenji-ga shinseki-ni butai-o kengaku-sase-ta. Kenji-NOM (his) relative-DAT (the) stage-ACC observe-CAUS-PAST Kenji had his relative observe the stage.	健二が舞台を親戚に見学させた Kenji-ga butai-o shinseki-ni kengaku-sase-ta. Kenji-NOM (the) stage-ACC (his) relative-DAT observe-CAUS-PAST Kenji had his relative observe the stage.
13	太郎が妹にソファーを買わせた Taro-ga imooto-ni sofaa-o kaw-ase-ta Taro-NOM (his) younger sister-DAT (a) sofa-ACC buy-CAUS-PAST Taro had his younger sister buy a sofa.	太郎がソファーを妹に買わせた Taro-ga sofaa-o imooto-ni kaw-ase-ta Taro-NOM (a) sofa-ACC (his) younger sister-DAT buy-CAUS-PAST Taro had his younger sister buy a sofa.
14	和子が次男に高校を休ませた Kazuko-ga jinan-ni kookoo-o yasum-ase-ta Kazuko-NOM (her) second son-DAT (his) high school-ACC be absent-CAUS-PAST Kazuko had her second son be absent from his high school.	和子が高校を次男に休ませた Kazuko-ga kookoo-o jinan-ni yasum-ase-ta Kazuko-NOM (his) high school-ACC (her) second son-DAT be absent-CAUS-PAST Kazuko had her second son be absent from his high school.
15	次郎が息子に実家を改装させた Jiro-ga musuko-ni jikka-o kaisoo-sase-ta Jiro-NOM (his) son-DAT (his) parents' home-ACC repair-CAUS-PAST Jiro had his son repair his parents' home.	次郎が実家を息子に改装させた Jiro-ga jikka-o musuko-ni kaisoo-sase-ta Jiro-NOM (his) parents' home-ACC (his) son-DAT repair-CAUS-PAST Jiro had his son repair his parents' home.
16	代議士が支援者に地元銀行を訪問させた daigishi-ga shiensha-ni jimotoginkoo-o hoomon-sase-ta (a) diet member-NOM (his) supporter-DAT (the) local bank-ACC visit-CAUS-PAST A diet member had his supporter visit the local bank.	代議士が地元銀行を支援者に訪問させた daigishi-ga jimotoginkoo-o shiensha-ni hoomon-sase-ta (a) diet member-NOM (the) local bank-ACC (his) supporter-DAT visit-CAUS-PAST A diet member had his supporter visit the local bank.
17	順子が幹事にホテルを選ばせた Junko-ga kanji-ni hoteru-o erab-ase-ta Junko-NOM (an) organizer-DAT (a) hotel-ACC choose-CAUS-PAST Junko had an organizer choose a hotel.	順子がホテルを幹事に選ばせた Junko-ga hoteru-o kanji-ni erab-ase-ta Junko-NOM (a) hotel-ACC (an) organizer-DAT choose-CAUS-PAST Junko had an organizer choose a hotel.
18	太郎が家族に外国文化を学ばせた Taro-ga kazoku-ni gaikokubunka-o manab-ase-ta Taro-NOM (his) family-DAT foreign culture-ACC study-CAUS-PAST Taro had his family study foreign culture.	太郎が外国文化を家族に学ばせた Taro-ga gaikokubunka-o kazoku-ni manab-ase-ta Taro-NOM foreign culture-ACC (his) family-DAT study-CAUS-PAST Taro had his family study foreign culture.
19	和子が赤ん坊に水を飲ませた Kazuko-ga akanboo-ni mizu-o nom-ase-ta Kazuko-NOM (her) baby-DAT water-ACC drink-CAUS-PAST Kazuko had her baby drink water.	和子が水を赤ん坊に飲ませた Kazuko-ga mizu-o akanboo-ni nom-ase-ta Kazuko-NOM water-ACC (her) baby-DAT drink-CAUS-PAST Kazuko had her baby drink water.

20 友子が弟にスキーを覚えさせた
Tomoko-ga otooto-ni sukii-o oboe-sase-ta
Tomoko-NOM (her) younger brother-DAT skiing-ACC master-CAUS-PAST
Tomoko had her younger brother master skiing.

21 次郎が生徒に稽古を始めさせた
Jiro-ga seeto-ni keeko-o hajime-sase-ta
Jiro-NOM (his) student-DAT practicing-ACC start-CAUS-PAST
Ziro had his student start practicing.

22 講師が塾生に難関校を受験させた
kooshi-ga jukusee-ni nankankoo-o juken-sase-ta
(the) lecturer-NOM (his) cram-school student-DAT (a) difficult university-ACC take (an entrance exam)-CAUS-PAST
The cram-school lecturer had his student take a difficult university entrance exam.

23 太郎が親友に大学を訴えさせた
Taro-ga shinyuu-ni daigaku-o uttae-sase-ta
Taro-NOM (his) close friend-DAT (the) univrtsity-ACC sue-CAUS-PAST
Taro had his close friend sue the university.

24 病院長が婦長にイタリアを視察させた
byooinchoo-ga fuchoo-ni itaria-o shisatsu-sase-ta
(the) head of the hospital-NOM (the) chief nurse-DAT Italy-ACC observe-CAUS-PAST
The head of the hospital had the chief nurse observe in Italy.

25 友子が部下にカナダを応援させた
Tomoko-ga buka-ni kanada-o oocn-sasc-ta
Tomoko-NOM (her) subordinate-DAT Canadian (team)-ACC cheer-CAUS-PAST
Tomoko had her subordinate cheer for the Canadian team.

26 和子が学生に机を運ばせた
Kazuko-ga gakusee-ni tsukue-o hakob-ase-ta
Kazuko-NOM (her) student-DAT (a) desk-ACC carry-CAUS-PAST
Kazuko had her student carry a desk.

27 友子が使用人に裏庭を掃かせた
Tomoko-ga shiyoonin-ni uraniwa-o hak-ase-ta
Tomoko-NOM (her) employee-DAT (the) backyard-ACC sweep-CAUS-PAST
Tomoko had her employee sweep the backyard.

28 太郎が娘にマンションを借りさせた
Taro-ga musume-ni manshon-o kaw-ase-ta
Taro-NOM (his) daughter-DAT (an) apartment-ACC rent-CAUS-PAST
Taro had his daughter rent an apartment

29 和子が妹に買物を手伝わせた
Kazuko-ga imooto-ni kaimono-o tetsudaw-ase-ta
Kazuko-NOM (her) younger sister-DAT (her) shopping-ACC help-CAUS-PAST
Kazuko had her younger sister help do her shopping.

30 裁判長が被告に和解案を提案させた
saibanchoo-ga hikoku-ni wakaian-o teian-sase-ta
(the) chief judge-NOM (a) defendant-DAT (a) proposalto make peace-ACC submit-CAUS-PAST
The chief judge had a defendant submit a proposal to make peace.

31 編集長が次郎に故郷を取材させた
an editor-ga Jiro-ni kokyoo-o shuzai-sase-ta
(an) editor-NOM Jiro-DAT (his) hometown-ACC collect information-CAUS-PAST
An editor had Jiro collect information on his hometown.

友子がスキーを弟に覚えさせた
Tomoko-ga sukii-o otooto-ni oboe-sase-ta
Tomoko-NOM (skiing-ACC her) younger brother-DAT master-CAUS-PAST
Tomoko had her younger brother master skiing.

次郎が稽古を生徒に始めさせた
Jiro-ga keeko-o seeto-ni hajime-sase-ta
Jiro-NOM practicing-ACC (his) student-DAT start-CAUS-PAST
Ziro had his student start practicing.

講師が難関校を塾生に受験させた
kooshi-ga nankankoo-o jukusee-ni juken-sase-ta
(the) lecturer-NOM (a) difficult university-ACC (his) cram-school student-DAT take (an entrance exam)-CAUS-PAST
The cram-school lecturer had his student take a difficult university entrance exam.

太郎が大学を親友に訴えさせた
Taro-ga daigaku-o shinyuu-ni uttae-sase-ta
Taro-NOM (the) univrtsity-ACC (his) close friend-DAT sue-CAUS-PAST
Taro had his close friend sue the university.

病院長がイタリアを婦長に視察させた
byooinchoo-ga itaria-o fuchoo-ni shisatsu-sase-ta
(the) head of the hospital-NOM Italy-ACC (the) chief nurse-DAT observe-CAUS-PAST
The head of the hospital had the chief nurse observe in Italy.

友子がカナダを部下に応援させた
Tomoko-ga kanada-o buka-ni oocn-sasc-ta
Tomoko-NOM Canadian (team)-ACC (her) subordinate-DAT cheer-CAUS-PAST
Tomoko had her subordinate cheer for the Canadian team.

和子が机を学生に運ばせた
Kazuko-ga tsukue-o gakusee-ni hakob-ase-ta
Kazuko-NOM (a) desk-ACC (her) student-DAT carry-CAUS-PAST
Kazuko had her student carry a desk.

友子が裏庭を使用人に掃かせた
Tomoko-ga uraniwa-o shiyoonin-ni hak-ase-ta
Tomoko-NOM (the) backyard-ACC (her) employee-DAT sweep-CAUS-PAST
Tomoko had her employee sweep the backyard.

太郎がマンションを娘に借りさせた
Taro-ga manshon-o musume-ni kaw-ase-ta
Taro-NOM (an) apartment-ACC (his) daughter-DAT rent-CAUS-PAST
Taro had his daughter rent an apartment

和子が買物を妹に手伝わせた
Kazuko-ga kaimono-o imooto-ni tetsudaw-ase-ta
Kazuko-NOM (her) shopping-ACC (her) younger sister-DAT help-CAUS-PAST
Kazuko had her younger sister help do her shopping.

裁判長が和解案を被告に提案させた
saibanchoo-ga hikoku-ni wakaian-o teian-sase-ta
(the) chief judge-NOM (a) proposalto make peace-ACC (a) defendant-DAT submit-CAUS-PAST
The chief judge had a defendant submit a proposal to make peace.

編集長が故郷を次郎に取材させた
an editor-ga kokyoo-o Jiro-ni shuzai-sase-ta
(an) editor-NOM (his) hometown-ACC Jiro-DAT collect information-CAUS-PAST
An editor had Jiro collect information on his hometown.

APPENDIX E. Continued

Canonical sentences	Scrambled sentences
32 父が健二にプロテストを受けさせた chichi-ga Kenji-ni purotesuto-o uke-sase-ta father-NOM Kenji-DAT (a) professional sport test-ACC take-CAUS-PAST Father had Kenji take a professional sport test.	父がプロテストを健二に受けさせた chichi-ga purotesuto-o Kenji-ni uke-sase-ta father-NOM (a) professional sport test-ACC Kenji-DAT take-CAUS-PAST Father had Kenji take a professional sport test.
Items for Correct 'Yes' Responses of Sentences with Dative Verbs	
1 順子がアトリエに弟子をこもらせた Junko-ga atorie-ni deshi-o komor-ase-ta Junko-NOM studio-DAT (her) pupil-ACC stay-CAUS-PAST Junko had her pupil stay in the studio.	順子が弟子をアトリエにこもらせた Junko-ga deshi-o atorie-ni komor-ase-ta Junko-NOM (her) pupil-ACC studio-DAT stay-CAUS-PAST Junko had her pupil stay in the studio.
2 次郎が命令に役員を従わせた Jiro-ga meeree-ni yakuin-o shitagaw-ase-ta Jiro-NOM (an) order-DAT (an) executive-ACC obey-CAUS-PAST Jiro had an executive obey an order.	次郎が役員を命令に従わせた Jiro-ga yakuin-o meeree-ni shitagaw-ase-ta Jiro-NOM (an) executive-ACC (an) order-DAT obey-CAUS-PAST Jiro had an executive obey an order.
3 和子が自然に子供達を親しませた Kazuko-ga shizen-ni kodomotachi-o shitashim-ase-ta Kazuko-NOM nature-DAT (her) children-ACC commune-CAUS-PAST Kazuko had her children commune with nature.	和子が子供達を自然に親しませた Kazuko-ga kodomotachi-o shizen-ni shitashim-ase-ta Kazuko-NOM (her) children-ACC nature-DAT commune-CAUS-PAST Kazuko had her children commune with nature.
4 太郎が医学部に孫を進ませた Taro-ga igakubu-ni mago-o susum-ase-ta Taro-NOM (the) Fuculty of Medicine-DAT (his) grandchild-ACC attend-CAUS-PAST Taro had his grandchild attend the Faculty of Medicine.	太郎が孫を医学部に進ませた Taro-ga mago-o igakubu-ni susum-ase-ta Taro-NOM (his) grandchild-ACC (the) Fuculty of Medicine-DAT attend-CAUS-PAST Taro had his grandchild attend the Faculty of Medicine.
5 司令官が敵地に部隊を迫らせた shireekan-ga tekichi-ni butai-o semar-ase-ta (the) commander-NOM (the) enemy's land-DAT (his) party-ACC approach-CAUS-PAST The commander had his party approach the enemy's land.	司令官が部隊を敵地に迫らせた shireekan-ga butai-o tekichi-ni semar-ase-ta (the) commander-NOM (his) party-ACC (the) enemy's land-DAT approach-CAUS-PAST The commander had his party approach the enemy's land.
6 健二が緊急事態に社員を対応させた Kenji-ga kinkyuujitai-ni shain-o taioo-sase-ta Kenji-NOM (a) state of emergency-DAT (the) staff-ACC respond-CAUS-PAST Kenji had the staff respond to a state of emergency.	健二が社員を緊急事態に対応させた Kenji-ga shain-o kinkyuujitai-ni taioo-sase-ta Kenji-NOM (the) staff-ACC (a) state of emergency-DAT respond-CAUS-PAST Kenji had the staff respond to a state of emergency.
7 次郎が田舎に長女を嫁がせた Jiro-ga inaka-ni choojo-o totsug-ase-ta Jiro-NOM (a man from the) countryside-DAT (his) oldest daughter-ACC marry-CAUS-PAST Jiro had his oldest daughter marry a man from the countryside.	次郎が長女を田舎に嫁がせた Jiro-ga choojo-o inaka-ni totsug-ase-ta Jiro-NOM (his) oldest daughter-ACC (a man from the) countryside-DAT marry-CAUS-PAST Jiro had his oldest daughter marry a man from the countryside.
8 順子がゲームに児童をはまらせた Junko-ga geemu-ni jidoo-o hamar-ase-ta Junko-NOM (a) game-DAT (the) child-ACC hooked-CAUS-PAST Junko got the child hooked on a game.	順子が児童をゲームにはまらせた Junko-ga jidoo-o geemu-ni hamar-ase-ta Junko-NOM (the) child-ACC (a) game-DAT hooked-CAUS-PAST Junko got the child hooked on a game.
9 署長が現場に警官を急がせた shochoo-ga genba-ni keekan-o isog-ase-ta (the) head of the police station-NOM (the) scene-DAT (an) officer-ACC hurry-CAUS-PAST The head of the police station had an officer hurry to the scene.	署長が警官を現場に急がせた shochoo-ga keekan-o genba-ni isog-ase-ta (the) head of the police station-NOM (an) officer-ACC (the) scene-DAT hurry-CAUS-PAST The head of the police station had an officer hurry to the scene.

10 和子が富士山に園児を登らせた
Kazuko-ga Fujisan-ni enji-o nobor-ase-ta
Kazuko-NOM Mt.Fuji-DAT (a) kindergarten pupil-ACC climb-CAUS-PAST
Kazuko had a kindergarten pupil climb Mt.Fuji.

11 順子が公園に清掃係を行かせた
Junko-ga kooen-ni seesoogakari-o ik-ase-ta
Junko-NOM (the) park-DAT (a) garbage man-ACC go-CAUS-PAST
Junko had a garbage man go to the park.

12 健二が舞台に親戚を上らせた
Kenji-ga butai-ni shinseki-o nobor-ase-ta
Kenji-NOM stage-DAT (his) relative-ACC go up-CAUS-PAST
Kenji had his relative go up on stage.

13 太郎がソファーに妹を座らせた
Taro-ga sofaa-ni imooto-o suwar-ase-ta
Taro-NOM (the) sofa-DAT (his) younger sister-ACC sit-CAUS-PAST
Taro had his younger sister sit on the sofa.

14 和子が高校に次男を通わせた
Kazuko-ga kookoo-ni jinan-o kayow-ase-ta
Kazuko-NOM high school-DAT (her) second son-ACC go-CAUS-PAST
Kazuko had her second son go to high school.

15 次郎が実家に息子を帰らせた
Jiro-ga jikka-ni musuko-o kaer-ase-ta
Jiro-NOM (his) parents' home-DAT (his) son-ACC reurn-CAUS-PAST
Jiro had his son return to his parents' home.

16 代議士が地元銀行に支援者を就職させた
daigishi-ga jimotoginkoo-ni shiensha-o shuushoku-sase-ta
(the) diet member-NOM (a) local bank-DAT (his) supporter-ACC find a job-CAUS-PAST
The diet member found a job at a local bank for his supporter.

17 順子がホテルに幹事を泊らせた
Junko-ga hoteru-ni kanji-o tomar-ase-ta
Junko-NOM (a) hotel-DAT (an) organizer-ACC stay-CAUS-PAST
Junko had an organizer stay at a hotel.

18 太郎が外国文化に家族を触れさせた
Taro-ga gaikokubunka-ni kazoku-o fure-sase-ta
Taro-NOM foreign culture-DAT (his) family-ACC experience-CAUS-PAST
Taro had his family experience foreign culture.

19 和子が水に赤ん坊を慣れさせた
Kazuko-ga mizu-ni akanboo-o nare-sase-ta
Kazuko-NOM water-DAT (his) baby-ACC get used-CAUS-PAST
Kazuko got his baby used to water.

20 友子がスキーに弟を挑戦させた
Tomoko-ga sukii-ni otooto-o choosen-sase-ta
Tomoko-NOM ski-DAT (his) younger brother-ACC make an attempt-CAUS-PAST
Tomoko had his younger brother make an attempt to ski.

和子が園児を富士山に登らせた
Kazuko-ga enji-o Fujisan-ni nobor-ase-ta
Kazuko-NOM (a) kindergarten pupil-ACC Mt.Fuji-DAT climb-CAUS-PAST
Kazuko had a kindergarten pupil climb Mt.Fuji.

順子が清掃係を公園に行かせた
Junko-ga seesoogakari-o kooen-ni ik-ase-ta
Junko-NOM (a) garbage man-ACC (the) park-DAT go-CAUS-PAST
Junko had a garbage man go to the park.

健二が親戚を舞台に上らせた
Kenji-ga shinseki-o butai-ni nobor-ase-ta
Kenji-NOM (his) relative-ACC stage-DAT go up-CAUS-PAST
Kenji had his relative go up on stage.

太郎が妹をソファーに座らせた
Taro-ga imooto-o sofaa-ni suwar-ase-ta
Taro-NOM (his) younger sister-ACC (the) sofa-DAT sit-CAUS-PAST
Taro had his younger sister sit on the sofa.

和子が次男を高校に通わせた
Kazuko-ga jinan-o kookoo-ni kayow-ase-ta
Kazuko-NOM (her) second son-ACC high school-DAT go-CAUS-PAST
Kazuko had her second son go to high school.

次郎が息子を実家に帰らせた
Jiro-ga musuko-o jikka-ni kaer-ase-ta
Jiro-NOM (his) son-ACC (his) parents' home-DAT reurn-CAUS-PAST
Jiro had his son return to his parents' home.

代議士が支援者を地元銀行に就職させた
daigishi-ga shiensha-o jimotoginkoo-ni shuushoku-sase-ta
(the) diet member-NOM (his) supporter-ACC (a) local bank-DAT find a job-CAUS-PAST
The diet member found a job at a local bank for his supporter.

順子が幹事をホテルに泊まらせた
Junko-ga kanji-o hoteru-ni tomar-ase-ta
Junko-NOM (an) organizer-ACC (a) hotel-DAT stay-CAUS-PAST
Junko had an organizer stay at a hotel.

太郎が家族を外国文化に触れさせた
Taro-ga kazoku-o gaikokubunka-ni fure-sase-ta
Taro-NOM (his) family-ACC foreign culture-DAT experience-CAUS-PAST
Taro had his family experience foreign culture.

和子が赤ん坊を水に慣れさせた
Kazuko-ga akanboo-o mizu-ni nare-sase-ta
Kazuko-NOM his) baby-ACC water-DAT (get used-CAUS-PAST
Kazuko got his baby used to water.

友子が弟をスキーに挑戦させた
Tomoko-ga ototo-o sukii-ni choosen-sase-ta
Tomoko-NOM (his) younger brother-ACC ski-DAT make an attempt-CAUS-PAST
Tomoko had his younger brother make an attempt to ski.

APPENDIX E. Continued

	Canonical sentences	Scrambled sentences
21	次郎が稽古に生徒を励ませた Jiro-ga keeko-ni seeto-o hagem-ase-ta Jiro-NOM practice-DAT (his) student-ACC make efforts-CAUS-PAST Ziro had his student make efforts to practice.	次郎が生徒を稽古に励ませた Jiro-ga seeto-o keeko-ni hagem-ase-ta Jiro-NOM (his) student-ACC practice-DAT make efforts-CAUS-PAST Ziro had his student make efforts to practice.
22	講師が難関校に塾生を合格させた kooshi-ga nankankoo-ni jukusee-o gookaku-sase-ta (the) lecturer-NOM (a) difficult university-DAT (his) cram-school student-ACC pass an entrance exam-CAUS-PAST The cram-school lecturer had his student pass a difficult university entrance exam.	講師が塾生を難関校に合格させた kooshi-ga jukusee-o nankankoo-ni gookaku-sase-ta (the) lecturer-NOM (his) cram-school student-ACC (a) difficult university-DAT pass an entrance exam-CAUS-PAST The cram-school lecturer had his student pass a difficult university entrance exam.
23	太郎が大学に親友を入学させた Taro-ga daigagu-ni shinyuu-o nyuugaku-sase-ta Taro-NOM (a) university-DAT (his) close friend-ACC enter-CAUS-PAST Taro had his close friend enter a university.	太郎が親友を大学に入学させた Taro-ga shinyuu-o daigagu-ni nyuugaku-sase-ta Taro-NOM (his) close friend-ACC (a) university-DAT enter-CAUS-PAST Taro had his close friend enter a university.
24	病院長がイタリアに婦長を留学させた byooinchoo-ga itaria-ni fuchoo-o ryuugaku-sase-ta (the) head of the hospital-NOM Italy-DAT the chief nurse-ACC study abroad-CAUS-PAST The head of the hospital had the chief nurse go to Italy to study.	病院長が婦長をイタリアに留学させた byooinchoo-ga fuchoo-o itaria-ni ryuugaku-sase-ta (the) head of the hospital-NOM the chief nurse-ACC Italy-DAT study abroad-CAUS-PAST The head of the hospital had the chief nurse go to Italy to study.
25	友子がカナダに部下を転勤させた Tomoko-ga canada-ni buka-o tenkin-sase-ta Tomoko-NOM Canada-DAT (her) subordinate-ACC transfer-CAUS-PAST Tomoko transfered her subordinate to Canada.	友子が部下をカナダに転勤させた Tomoko-ga buka-o canada-ni tenkin-sase-ta Tomoko-NOM (her) subordinate-ACC Canada-DAT transfer-CAUS-PAST Tomoko transfered her subordinate to Canada.
26	和子が机に学生を向かわせた Kazuko-ga tsukue-ni gakusee-o mukaw-ase-ta Kazuko-NOM (his) desk-DAT (her) student-ACC sit-CAUS-PAST Kazuko had her student sit at his desk.	和子が学生を机に向かわせた Kazuko-ga gakusee-o tsukue-ni mukaw-ase-ta Kazuko-NOM (her) student-ACC (his) desk-DAT sit-CAUS-PAST Kazuko had her student sit at his desk.
27	友子が裏庭に使用人をまわらせた Tomoko-ga uraniwa-ni shiyoonin-o mawar-ase-ta Tomoko-NOM (the) backyard-DAT (her) employee-ACC go round-CAUS-PAST Tomoko had her employee go round to the backyard.	友子が使用人を裏庭にまわらせた Tomoko-ga shiyoonin-o uraniwa-ni mawar-ase-ta Tomoko-NOM (her) employee-ACC (the) backyard-DAT go round-CAUS-PAST Tomoko had her employee go round to the backyard.
28	太郎がマンションに娘を住まわせた Taro-ga manshon-ni musume-o sumaw-ase-ta Taro-NOM (an) apartment-DAT (his) daughter-ACC live-CAUS-PAST Taro had his daughter live in an apartment	太郎が娘をマンションに住まわせた Taro-ga musume-o manshon-ni sumaw-ase-ta Taro-NOM (his) daughter-ACC (an) apartment-DAT live-CAUS-PAST Taro had his daughter live in an apartment
29	和子が買物に妹を出かけさせた Kazuko-ga kaimono-ni imooto-o dekake-sase-ta Kazuko-NOM shopping-DAT (her) younger sister-ACC go-CAUS-PAST Kazuko had her younger sister go shopping.	和子が妹を買物に出かけさせた Kazuko-ga imooto-o kaimono-ni dekake-sase-ta Kazuko-NOM (her) younger sister-ACC shopping-DAT go-CAUS-PAST Kazuko had her younger sister go shopping.
30	裁判長が和解案に被告を応じさせた saibanchoo-ga wakaian-ni hikoku-o ooji-sase-ta (the) chief judge-NOM (a) proposal to make peace-DAT (a) defendant-ACC accept-CAUS-PAST The chief judge had a defendant accept a proposal to make peace.	裁判長が被告を和解案に応じさせた saibanchoo-ga hikoku-o wakaian-ni ooji-sase-ta (the) chief judge-NOM (a) defendant-ACC (a) proposal to make peace-DAT accept-CAUS-PAST The chief judge had a defendant accept a proposal to make peace.
31	編集長が故郷に次郎を戻らせた henshuuchoo-ga kokyoo-ni Jiro-o modor-ase-ta (an) editor-NOM (his) hometown-DAT Jiro-ACC return-CAUS-PAST An editor had Ziro return to his hometown.	編集長が次郎を故郷に戻らせた henshuuchoo-ga Jiro-o kokyoo-ni modor-ase-ta (an) editor-NOM Jiro-ACC (his) hometown-DAT return-CAUS-PAST An editor had Ziro return to his hometown.
32	父がプロテストに健二を挑ませた chichi-ga purotesuto-ni Kenji-o idom-ase-ta father-NOM (a) professional sport test-DAT Kenji-ACC try-CAUS-PAST Father had Kenji try for a professional sport test.	父が健二をプロテストに挑ませた chichi-ga Kenji-o purotesuto-ni idom-ase-ta father-NOM Kenji-ACC (a) professional sport test-DAT try-CAUS-PAST Father had Kenji try for a professional sport test.

REFERENCES

Amano, N., & Kondo, K. (2000). *Nihongo-no goi tokusei [Lexical Properties of Japanese]*. Tokyo: Sanseido.

Aoshima, S., Phillips, C., & Weinberg, A. (2002). Active filler effects and reanalysis: A study of Japanese *Wh*-scrambling constructions. *University of Maryland Working Papers in Linguistics, 12,* 1–24.

Chomsky, N. (1981). *Lectures on Government and Binding*. Dordrecht, the Netherlands: Foris Publications.

Chujo, K. (1983). Nihongo tanbun-no rikai katei — Bunrikai sutoratejii no sougo kankei [The interrelationships among strategies for sentence comprehension]. *Japanese Journal of Psychology, 54,* 250–256.

Farmar, A. (1984). *Modularity in Syntax: A Study of Japanese and English*. Cambridge, MA: MIT Press.

Frazier, L., & Clifton, Jr. C. (1989). Successive cyclicity in the grammar and the parser. *Language and Cognitive Processes, 4,* 93–126.

Frazier, L., & Flores d'Arcais (1989). Filler-driven parsing: A study of gap filling in Dutch. *Journal of Memory and Language, 28,* 331–344.

Fukui, N. (1989). Nichi/ei-go hikaku toogo-ron [Contrastive syntax of Japanese and English]. In K. Inoue (Ed.), *Nihon bunpoo shoo-jiten [The small dictionary of Japanese grammar]* (pp. 89–108). Tokyo: Taishukan Shoten.

Fukui, N. (1988). Deriving the differences between English and Japanese: A case study in parametric syntax. *English Linguistics, 5,* 249–270.

Fukui, N. (1995). *The Theory of Projection in Syntax*. Tokyo: Kuroshio Shuppan.

Hale, K. (1980). Remarks on Japanese Phrase Structure: Comments on the papers on Japanese Syntax. *MIT Working Papers in Linguistics, 2,* 185–203.

Hale, K. (1981). *On the Position of Warlpiri in a Typology of the Base*. Bloomington, IN: IULC.

Harada, S.-I. (1977). Nihongo-ni 'Henkei'-wa Hitsuyooda. *Gengo [Lanugage], 10*, 88–95.

Hasegawa, N. (1999). *Seisei nihongogaku nyuumon [An Introduction to Generative Grammar of the Japanese Language]*. Tokyo: Taishukan Shoten.

Hoji, H (1985). Logical Form Constraints and Configurational Structure in Japanese. Ph.D. dissertation, University of Washington, Seattle.

Inoue, K., Harada, K., & Abe, Y. (1999). *Seisei gengogaku nyuumon [An Introduction to Generative Linguistics]*. Tokyo: Taishukan Shoten.

Mahajan, A. (1990). *The A/A-Bar Distinction and Movement Theory*. Cambridge: Massachusetts Institute of Technology.

Mazuka, R., Itoh, K., & Kondo, T. (2002). Costs of scrambling in Japanese sentence processing. In M. Nakayama (Ed.), *Sentence Processing in East Asian Languages* (pp. 131–166), Stanford, CA: CSLI Publications.

Miyagawa, S. (1989). *Structure and Case Marking in Japanese — Syntax and Semantics Vol*. 22 San Diego, CA: Academic Press.

Miyamoto, E. T., & Takahashi, S. (2004). Filler-gap dependencies in the processing of scrambling in Japanese. *Language and Linguistics*, *5*, 153–166.

Miyamoto, E. T. (2004). Processing alternative word orders in Japanese. In M. Nakayama, R. Mazuka, Y. Shirai & P. Li (Eds.). *Handbook of East Asian Psycholinguistics: Japanese*. Cambridge, MA: Cambridge University Press.

Müller, G., & Wolfgang, S. (1994). Scrambling as A-bar movement. In N. Corver & H. van Riemsdijk (Eds.), *Studies on Scrambling* (pp. 331–385). Berlin: Mouton de Gruyter.

Nakayama, M. (1995). Scrambling and probe recognition. In R. Mazuka & N. Nagai (Eds.), *Japanese Sentence Processing* (pp. 257–273). Hillsdale, NJ: Erlbaum.

Nakayama, M. (1999). Sentence processing. In M. Tsujimura (Ed.), *The Handbook of Japanese Linguistics* (pp. 398–424). Malden, Massachusetts: Blackwell Publishers.

Nemoto, N. (1999). Scrambling. In M. Tsujimura (Ed.), *The Handbook of Japanese Linguistics* (pp. 121–153). Malden, Massachusetts: Blackwell Publishers.

Ross, J.-R. (1967). *Constraints on Variables in Syntax*. Ph.D. dissertation, Massachusetts Institute of Technology, Cambridge.

Saito, M. (1985). *Some Asymmetries in Japanese and Their Theoretical Implications*. Ph.D. dissertation, Massachusetts Institute of Technology, Cambridge.

Saito, M., & Hoji, H. (1983). Weak cross-over and move α in Japanese. *Natural Language and Linguistic Theory, 1,* 245–259.

Sakamoto, T. (2001). Bun-no rikai — kakimaze bun [Understanding of Sentences — Scrambling]. *Gengo [Language], 30*(10), 106–111.

Sakamoto, T. (2002). Processing filler-gap constructions in Japanese. In M. Nakayama (Ed.), *Sentence Processing in East Asian Languages* (pp. 189–221), Stanford, CA: CSLI Publications.

Shibatani, M. (1978). *Nihongo no bunseki [Analysis of the Japanese Language]*. Tokyo: Taishukan Shoten.

Tamaoka, K., Sakai, H., Kawahara, J., & Miyaoka, Y. (2003). The effects of phrase-length order and scrambling in the processing of visually-presented Japanese sentences. *Journal of Psycholinguistic Research, 32,* 431–454.

Tonoike, S. (1997). On scrambling — Scrambling as a base-generated scopal construction. In S. Tonoike (Ed.), *Scrambling* (pp. 125–159). Tokyo: Kurosiho Shuppan.

Webelhuth, G. (1989). *Syntactic Saturation Phenomena and the Modern Germanic Languages.* Ph.D. dissertation, University of Massachusetts, Amherst.

Ura, H. (1999). Checking theory and dative subject constructions in Japanese and Korean. *Journal of East Asian Linguistics, 8,* 223–254.

Yamashita, H. (1997). The effects of word-order and case marking information on the processing of Japanese. *Journal of Psycholinguistic Research, 26,* 163–188.