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Processing Filler-gap Constructions in Japanese: The Case of Empty Subject Sentences*

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1 Introduction

In English, there are a number of syntactic constructions known as 'control sentences.' Some examples are shown below:

(1) John promised Mary to go to Tokyo.

(2) John persuaded Mary to go to Tokyo.

In (1) *John* is supposed to go to Tokyo, while in (2) the person going to Tokyo is *Mary*. An 'empty subject' is assumed to exist in these infinitival clauses. This empty subject is 'controlled' by the main clause subject in (1)

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while it is controlled by the main clause object in (2); therefore, in linguistic literature, (1) would be called a 'subject-control' (henceforth, S-control) sentence and (2) would be called an 'object-control' (henceforth, O-control) sentence. In the framework of the generative grammar called GB theory (or the principles and parameters approach, see Chomsky 1981), it is a common practice to postulate an empty element (represented as PRO) in the subject position of infinitival (and gerundive) clauses. Thus, (1) and (2) would be represented as follows:[1]

(3) John_1 promised Mary_2 [PRO_1 to go to Tokyo].
(4) John_1 persuaded Mary_2 [PRO_2 to go to Tokyo].

The main clause verb carries information that indicates whether the antecedent for the empty subject will be the main clause's subject or object. In English, thus, one can make use of this verb information before encountering the empty subject in the embedded infinitival clause. In Japanese, however, the verb information is not readily available, since the main clause verb is located at the end of a sentence. Consider the following sentences:[2]

(5) Taro_1-ga Hanako_2-ni [PRO_1 Tokyo iki]-o hakuzyoosita.
-Nom -Dat going-Acc confessed
'Taro confessed to Hanako that *he* would go to Tokyo.'

(6) Taro_1-ga Hanako_2-ni [PRO_2 Tokyo iki]-o meireisita.
-Nom -Dat going-Acc ordered
'Taro ordered Hanako, (saying) *she* would go to Tokyo.'

The existence of an empty subject is also assumed in the above Japanese examples. This theoretical construct (i.e., empty subject) may or may not be a syntactic entity. Note that the term 'subject' is used in a broader sense, which includes not only 'true arguments' but also 'default arguments' in the sense of Pustejovsky (1998).[3] The important point is that the interpretation of the sentence depends on identifying the Agent of the embedded event, namely identifying *who it is that goes to Tokyo* in the above examples. The

[1] Identical numbers in subscript indicate a co-indexation relation.
[2] Nom=Nominative, Dat=Dative, Acc=Accusative, *Taro* is a male first name, and *Hanako* is a female first name
[3] See also the discussions about an implicit argument (Williams, 1985; Roeper, 1987; Abney, 1987).

detailed characterization of this empty subject is a matter of theoretical concern.[4]

Summarizing the above observations, the surface order of the relevant elements in English is 'Subject - Verb - Object – PRO' (S-V-O-P), while in Japanese the order is 'Subject - Object - PRO – Verb' (S-O-P-V). The crucial point is the position of the main clause verb that carries the control information. It is important to note that the above two Japanese sentences are completely equivalent until the main clause verbs. In other words, these two sentences construct a 'minimal pair' in the sense that the only one element, the main verb, produces the different interpretations. In this situation, how should the human parser process these sentences? Should one 'wait and see' the final verb before parsing? Alternatively, does one make some decision regarding the interpretation before the final verb? If so, what kind of information does one utilize?

2 Multi-level Parsing Model

Examining the results of four experiments to be reported later, I claim that there are at least two distinct levels of sentence processing in Japanese. One level involves rather automatic and shallow mode of processing, in which the human parser uses Case information to perform the given task of comprehension. The other level involves rather conscious and deep mode of processing, in which the parser relies on Theta-role information to perform the given task of comprehension. In this 'Multi-level Parsing Model,' these two levels may correspond to the syntactic and semantic levels respectively, because Case and Theta-role are considered to be relevant to these two levels. However, I do not deny other possibilities, such that both are syntactic and/or semantic. It would be a matter of controversy whether the distinction of Case and Theta-role directly reflect the distinction of the syntactic and semantic level of sentence processing.

The basic idea of this multi-level parsing model is essentially the same as what Frazier and Fodor (1978) call 'Two Stage Parsing Model' that postulates two levels of sentence processing. Employing the Cross Modal Lexical Priming method, Hickok et al. (1992) claim that there is positive evidence to support this dichotomy of processing levels. Hahne and Friederici (1999) also argue that they have found neurolinguistic evidence for the two levels of sentence processing by conducting experiments with Event-related brain potentials. Our experiments with Japanese data also support the claim that two different levels are involved in sentence processing. If the same

[4] See Sakamoto (1996) for a more detailed discussion.

property is observed in the processing of two fairly different languages, it suggests that the observed property is a universal characteristic of the human sentence-processing mechanism.

There is, however, an important difference between these previous studies and the present study. Most of the previous studies assume a sequential ordering between the two stages (or steps) of the processing. The ‘Principle of Processing’ proposed by Kimball (1973) claims that “When a phrase is closed, it is pushed down into a syntactic (possibly semantic) processing stage and cleared from short-term memory”. Frazier and Fodor (1978) claim that there are two steps of syntactic operation called ‘Preliminary Phrase Packager (PPP)’ and ‘Sentence Structure Supervisor (SSS),’ and that PPP always precedes SSS. However, the present study neither support nor deny this kind of step-wise process of parsing. Although the experimental findings do support the claim that there exist (at least) two distinct levels of processing, the results do not allow us the commitment to the sequential ordering of these levels. This is simply because the experiments were not designed to examine the ordering of the two levels, but designed to clarify the difference of the two levels of parsing. We need another experimental setting to investigate the sequential ordering of these levels (see Hahne and Friederici 1999; Hickok et al. 1992).

Needless to say, it is necessary to integrate all kinds of linguistic information in order to comprehend a sentence: phonetic perception, phonological segmentation, lexical meaning, syntactic construction, semantic interpretation, and pragmatic consideration. Furthermore, the final understanding of any utterance requires not only linguistic information but also world knowledge, memory, inference, etc. However, the present study suggests that the ‘comprehension’ itself is not restricted to a single (or, final) level, but there are some levels of understanding. Although these levels may not represent the full-fledged (or, final) comprehension, they do represent some level of comprehension. Even in our everyday life, shallow understanding could be enough for some routine work such as greetings. On the other hand, deep understanding would be required in reading instructions for entrance examinations. The point is that the level of comprehension is not uni-level but multi-level. The fundamental claim drawn from our experiments is that there are (at least) two distinct levels of parsing, in which the human parser makes use of different types of information in performing different tasks.

3 Filler-gap Dependency

As in (5) and (6) above, the sentences examined in the following experiments contain an antecedent as a possible filler and an empty subject as a possible gap. Before going on to the discussion of the experiments, let us briefly consider some general aspects of filler-gap dependencies. Such dependencies can be divided into three types.

(7) Three Types of Filler-gap Dependency

A: antecedent - trace
Who does John love *trace*? / John seems *trace* to be rich.

B: antecedent - PRO
John promised Mary [PRO to leave].

C: antecedent - trace - PRO
John loved the girl who the boy forced *trace* [PRO to sing this song].

Type A represents the relationship between a Wh-element and its trace. This kind of 'antecedent-trace' relationship is also shown by a moved NP and its trace, a so-called 'raising' structure. Fodor (1989) argues that the antecedent is recognized at the trace position. On the other hand, Pickering and Barry (1991) propose the 'Direct Access Hypothesis,' claiming that a trace does not play a role in the gap-filling process. They argue that the antecedent is accessed directly at the position of the main verb.

Type B exhibits the relationship between the antecedent and the base-generated empty subject: PRO.[5] Nicol and Swinney (1989) claim that the identification of the antecedent for PRO is delayed. On the other hand, Boland et al. (1990) argue that the antecedent for PRO is determined immediately.

Type C is a combination of Types A and B. Frazier et al. (1983) claim that the parser does not recognize a trace as a possible antecedent for a PRO. That is, the parser chooses the lexical antecedent as the only filler for a PRO. Their claim does not agree with Fodor (1989), who says that the antecedent is recognized at the trace position. On the other hand, Frazier et al.'s argument may support the claim by Pickering & Barry (1991) that a trace does not play a role in identifying the antecedent. Furthermore, the claim by Frazier et al. may not be in line with the claim that the identification of a PRO is delayed (Nicol and Swinney 1989), but may support the claim that a PRO is accessed by the parser without delay (Boland et al. 1990).

As this section has shown, the findings accumulated through English data exhibit the complexity of the issue of filler-gap dependencies. The cur-

[5] Here, for the sake of simplicity, we do not deal with *pro*, which is assumed to be base-generated at a governed position.

rent study provides an opportunity to consider the issue from a different viewpoint by presenting some experimental findings from Japanese data. The experimental sentences examined in Experiments 1 and 3 correspond to Type B, and the sentences in Experiments 2 and 4 correspond to Type C. The main focus of the discussion is not on the linguistic characterization of trace and PRO (see Sakamoto (1996) for the related discussion). The principal issue of the present study is to examine the relationship between the experimental tasks and the levels of processing in filler-gap constructions.

4 Experiments

This section presents the results of four experiments conducted by various researchers. The first experiment was originally reported in Oda et al. (1997) and the second in Ninose et al. (1998). From these two experiments, however, I have extracted relevant results to our discussion. The detail is to be explained later. The third and fourth experiments were reported in Sakamoto (1995, 1996). Because these findings were reported separately, they have not been examined in a unified fashion. In this paper, I will present an integrated interpretation of the results of these four experiments and reexamine their theoretical implications.

4.1 Experiment 1

In the following experimental setting, to begin with, we tested whether the participants were able to identify the correct antecedent of the empty subject in filler-gap constructions.[6] And then, the purpose of this experiment was to examine whether there was any difference of preference between the two types of control sentences: Subject-control and Object-control sentences. If there is a detectable difference concerning a response time and/or a percentage of correct answer, which of them would be preferred? Then, what is the reason why one of them is preferred?

4.1.1 Materials

The stimuli were twelve S-control sentences and twelve O-control sentences. Below are examples of these two types of control sentences (*Kooiti* is a male first name, and *Tamae* is a female first name. In total, six names were used.). Both types of sentences have the same construction: [NP_1-*ga* Locative-PP NP_2-*ni* [($PRO_{1/2}$) *Tokyo iki*]-*o* Adverb Verb]. Sentence (8) is called a Sub-

[6] The term "subject" refers to both a "subject for an experiment" and a "grammatical subject" and may cause confusion. When it is necessary, thus, I use the term "participant" instead of "subject."

ject-control (S-control) sentence because the person going to Tokyo is the subject referent. Sentence (9) is called an Object-control (O-control) sentence because the person going to Tokyo is the object.

(8) Subject-Control Sentence
Kooiti-ga kaisya-de Tamae-ni Tokyo iki-o wazato <u>moosideta</u>.
-Nom company-at -Dat going-Acc purposely offered.
'Kooiti, at the company, purposely offered Tamae that *he* would go to Tokyo.'

(9) Object-Control Sentence
Kooiti-ga kaisya-de Tamae-ni Tokyo iki-o wazato <u>saisokusita</u>.
-Nom company-at -Dat going-Acc purposely urged.
'Kooiti, at the company, purposely urged Tamae that *she* would go to Tokyo.'

The experimental sentences were made-up in the following way. Fifty-two phrases (called *bunsetsu* in Japanese) were randomly read by a woman and recorded by a computer. She was totally unaware of the sentential construction of the experimental sentences. The sentences were produced through combining these phrases, which had been recorded separately. Each phrase has only a phrasal contour, and a 100 msec interval was automatically inserted between phrases. This means that the sentences did not have a normal sentential intonation. Thus, all the experimental sentences were 'synthesized sentences' in the sense that the combination of phrases created each sentence. The purpose of synthesizing sentences in this way was to examine the syntactic and/or semantic aspects of sentence processing by eliminating the effect of phonological information on sentential constructions.

In the original experiment by Oda et al. (1997), there were six test points from the end of the sentence with 300msec intervals: 0msec, 300msec, 600msec, 900msec, and 1500msec. Here, we concentrate on the comparison between the RTs of the S-control and O-control sentences in the case of 'Yes' response at 0msec. In this paper, thus, I selectively report the response times at the end of the sentence among six different points. There were so many test points in the original experiment that distracting sentences were not affordable in considering the heavy burden of the participants. Also, a Latin Square design was adopted with the counterbalance concerning sentence types and test points. See Oda et al. (1997) for more detail.

4.1.2 Participants and Procedure

Eight native speakers of Japanese participated in this experiment. They were undergraduate students, aged nineteen to twenty two, at Kyushu University. The experiment took about fifty minutes, including a five-minute break. Note that the time was for six test points, among which I selectively reported only one test point. They were paid nominal fees for their participation.

Through a headphone, the participants heard a sentence in one ear. Right after the end of each sentence, the participants heard a possible antecedent for the empty subject, either the subject or the object of the main clause, in the other ear. The task was to decide whether the given antecedent was really the person who would go to Tokyo. The participant responded by pressing Yes-key or No-key as quickly as possible. This experiment is therefore a 'recognition' experiment in which the participants have to decide whether the given answer is correct or not. The time was measured how long the participants took to press the Yes-key for both S-control and O-control sentences when the correct answer was given right after the end of the sentence. Note that the response time includes the time for presenting the possible antecedent, since the timer starts at the end of each sentence.

4.1.3 Results and Discussion

The time was measured from the onset (not the end) of the stimulus (the name of the possible antecedent) to the point that the participant pressed the key. The mean reaction time (RT) and the mean percentage of Consistency Score (CS) were computed. CS indicates the percentage of agreement among the participants concerning the classification of S-control and O-control sentences. For example, there are 8 (participants) x 12 (sentences) = 96 cases that should be classified as S-control sentences. When all 96 cases were classified as S-control, the CS of S-control sentences came to 100 %.

The data was submitted to an analysis of variance (ANOVA) to determine statistical significance. F_1 represents the analysis by subjects (across items), and F_2 represents the analysis by items (across subjects). In calculating RTs, missing data points were replaced by the grand mean RT. In calculating CS, the angular (or inverse sine) transformation was used to adjust the percentage.[7] The results are shown in Table 1.

The mean RT of the S-control sentences is significantly faster than that of the O-control sentences in both the subject analysis (F_1) and item analysis

[7] ANOVA assumes that the population exhibits "normal distribution". However, the distribution of the data represented by the percentage is not 'normal' because the variance of the data becomes smaller as the data departs from 50%. Thus, we need to adjust the data so that it follows normal distribution.

(F_2). This suggests that there is a significant time difference in responding that the given answer is correct, even if the correct answer is given equally to both types of sentences.

	Sentence Type		
	S-control	O-control	Difference
RT (msec)	752	835	-83[a]
CS (%)	95.8	85.4	10.4[b]

a: $F_1\,(1, 7) = 9.16$, $p < .05$, $F_2\,(1, 11) = 5.07$, $p < .05$
b: $F_1\,(1, 7) = 1.56$, $p < .26$, $F_2\,(1, 11) = 2.46$, $p < .15$

Table 1. Results of Experiment 1 (Recognition task with S-O order)

As for the percentage of Consistency Score (CS), the S-control sentences have a higher CS than the O-control sentences, although the difference is not big enough to reach a statistically significant level. Thus, the S-control sentences have a significantly faster RT and a (slightly) higher CS than the O-control sentences. It is therefore plausible to conclude that the results show a 'subject preference' phenomenon: the grammatical subject is preferred as the candidate for the empty subject.

This may suggest a parsing strategy that favors the subject as a possible antecedent. The subject might be the preferred antecedent because it has the grammatical function of 'subject.' However, this may not be the only possible way to explain the results because the subject is the first NP at the beginning of a sentence. It is plausible that the parser prefers the first mentioned NP as a possible antecedent for the empty subject. This preference may be explained by the very general cognitive phenomenon called the 'primacy effect.' In other words, a so-called 'first-in-first-out' strategy may be at work. In conclusion, one cannot determine whether the preference is due to some grammatical reason (i.e., 'subject' preference) or some general cognitive effect (i.e., 'primacy' effect). Since Experiment 1 alone cannot resolve this issue, the following section will consider the data of Experiment 2.

4.2 Experiment 2

The purpose of this experiment was to examine what would happen when the surface positions of the two antecedents were reversed. The 'scrambling' of NPs should directly affect the application of the primacy strategy, because the sentence initial NP is changed. If the primacy strategy applies, the parser will have to assign a different antecedent to the gap according to what the sentence initial NP is.

4.2.1 Materials

In Experiment 2, the only difference from Experiment 1 is the word order of the subject and object NPs. Sample sentences are presented below (*Tamae* is a female first name, and *Kooiti* is a male first name).

(10) Subject-Control Sentence
Tamae-ni kaisya-de Kooiti-ga Tokyo iki-o wazato <u>moosideta</u>.
-Dat company-at -Nom going-Acc purposely offered.
'To Tamae, at the company, Kooiti purposely offered that *he* would go to Tokyo.'

(11) Object-Control Sentence
Tamae-ni kaisya-de Kooiti-ga Tokyo iki-o wazato <u>saisokusita</u>.
-Dat company-at -Nom going-Acc purposely urged.
'To Tamae, at the company, Kooiti purposely urged that *she* would go to Tokyo.'

Both types of sentences have the same construction: [NP_2-*ni* Locative-PP NP_1-*ga* (*trace*$_2$) [($PRO_{1/2}$) *Tokyo iki*]-*o* Adverb Verb]. Sentences (10) and (11) are called Subject-control (S-control) and Object-control (O-control) sentences because the person who goes to Tokyo is the subject and object referent respectively. Despite the permutation of the subject and object NPs, the interpretation of the empty subject is the same as in (8) and (9).

4.2.2 Participants and Procedure

Eight native speakers of Japanese participated in this experiment. They were undergraduate students, aged nineteen to twenty two, at Kyushu University. They consisted of a different group of participants from those that participated in Experiment 1. The experiment took about fifty minutes, including a five-minute break(Note again that the time was for all the six test points.). They were all paid nominal fees for participation.

4.2.3 Results and Discussion

The results have been submitted to the same statistical analysis as in Experiment 1. Table 2 shows the summary of the results, which revealed that the RT for the S-control sentences was significantly faster than that for the O-control sentences. In addition, the difference of CS percentages between the two types of sentences increased in Experiment 2 when compared to Experiment 1, and the S-control sentences have a significantly higher CS than the O-control sentences.

	Sentence Type		
	S-control	O-control	Difference
RT (msec)	639	714	-75[a]
CS (%)	100	79.2	20.8[b]

a: F_1 (1, 7) = 21.41, $p < .005$, F_2 (1, 11) = 13.32, $p < .005$
b: F_1 (1, 7) = 6.34, $p < .05$, F_2 (1, 11) = 7.36, $p < .05$

Table 2. Results of Experiment 2 (Recognition task with O-S order)

Experiment 2 produced the results similar to Experiment 1. The findings showed that the 'subject preference' remained even if the order of the subject and object in the main clause was scrambled. Thus, the results of these two recognition experiments indicate that, regardless of the scrambling in word order, the participants tend to prefer the main clause subject as a possible antecedent for the empty subject. The findings from Experiments 1 and 2, then, suggest that not the 'primacy' but the 'subject' affects the preference in parsing these Japanese control sentences.

4.3 Comparison of Experiments 1 and 2

Now, let us consider the filler-gap relations in the examples of Experiments 1 and 2. The schematic representation for them would be as in Table 3 below (X=subject, Y=object, S-cont.V=subject control verb, O-cont.V=object control verb):

		stimuli	response
(A=8)	$\boxed{X_1\text{-ga}}$ Y_2-ni [PRO_1 Tokyo iki]-o S-cont.V	X	Yes (fast)
(B=9)	X_1-ga Y_2-ni [PRO_2 Tokyo iki]-o O-cont.V	Y	Yes (slow)
(C=10)	Y_2-ni $\boxed{X_1\text{-ga}}$ t_2 [PRO_1 Tokyo iki]-o S-cont.V	X	Yes (fast)
(D=11)	Y_2-ni X_1-ga t_2 [PRO_2 Tokyo iki]-o O-cont.V	Y	Yes (slow)

Table 3. Schematic representation of materials in Experiments 1 and 2

Reexamining the RTs in these two experiments, we notice that the RTs of Experiment 1 (Subject-Object word order) are slower than those of Experiment 2 (Object-Subject word order) in both the S-control and O-control sentences. Consider Table 4 and Figure 1 below.

The two-way ANOVA (2 x 2) revealed that there was a main effect of sentence type [F_1 (1, 14) = 24.714, $p < .001$, F_2 (1, 22) = 14.103, $p < .005$]. There was also a main effect of word order [F_1 (1, 14) = 6.155, $p < .01$, F_2 (1, 22) = 22.9, $p < .001$]. The interaction between sentence type and word order was not significant [F_1 (1, 14) = .052, p < .83, F_2 (1, 22) = .031, p < .87].

	Sentence Type		
	S-control	O-control	Effect of sentence type
Exp.1(S-O)	752	835	-83
Exp.2(O-S)	639	714	-75
Effect of word order	113	121	

Table 4. Mean RTs in Experiments 1 and 2 (Recognition task with S-O and O-S order)

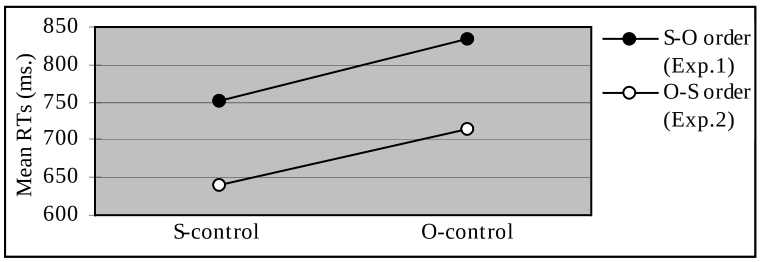

Figure 1. Comparison of Experiments 1 and 2

The results revealed that the RTs of S-control sentences were significantly faster that those of O-control sentences. The results also showed that the RTs of 'Object-Subject' word order (Experiment 2) are significantly faster than those obtained in the 'Subject-Object' word order (Experiment 1). Thus, the permutation of word order shortened response times. It could be possible that the 'recency' of the subject NP in Object-Subject order decreased the RTs of S-control sentences (752 msec → 639 msec). In O-control sentences, on the contrary, the 'primacy' of the object NP in the reversed word order could have decreased the RTs (835 msec → 714 msec). Therefore, neither the recency nor the primacy can account for the decrease of RTs across the board. Other than the distance of NPs, there must be some other, unknown reason ('synthesized prosody' could be the one) for the decrease of RTs.

This result is very interesting in comparing the experimental results reported by other researchers. Nakayama (1995) and Yamashita (1997) showed that the scrambling of word order does not affect the response times. On the other hand, Mazuka et al. (2001) and Miyamoto and Takahashi (2001) reported the experimental results that exhibited the *increase* of response times owing to the scrambling. In our experiment, the changing word order invited the *decrease* of RTs. I will return this issue later.

4.4 Experiment 3

The results of both Experiments 1 and 2 showed the same ‘subject preference’ in spite of the difference in word order. In these two recognition experiments, the participants were instructed to decide whether the given answer was correct or not. In the following experiments, we will investigate whether this preference holds for a different experimental paradigm. If the same results can be reproduced in a different setting, this attests to the significance of the subject in processing Japanese empty subject sentences. If not, it is necessary to further scrutinize the factors that affect the processing of empty subject sentences. Here, we are interested in whether this subject preference is prevailing at any level of parsing or whether it is a reflection of some limited aspect of parsing.

In the following sections, we examine the results of two ‘retrieval’ experiments, namely Experiments 3 and 4. The task in these experiments was to orally answer the correct filler (antecedent) for the gap (empty subject). The experimental sentences were read out by the experimenter, and then tape-recorded to present them to the participants. Thus, the task and the way of constructing sentences were altered so that we can test whether the different experimental settings affect the results.

4.4.1 Materials

Twenty-four S-control sentences, twenty-four O-control sentences, and forty-eight nontarget sentences were given to the participants. Four exercise and four warm-up sentences were also inserted at the beginning of the experiment. The total number of sentences given to each participants was 104. The experimenter tape-recorded the sentences that were read out with normal intonation and pauses; therefore, all the experimental sentences were ‘read-out sentences’ that had normal sentential contours. Examples of the two types of control sentence are the same as (8) and (9) in Experiment 1 which are repeated below as (12) and (13).

(12) Subject-Control Sentence

Kooiti-ga kaisya-de Tamae-ni Tokyo iki-o wazato moosideta.
-Nom company-at -Dat going-Acc purposely offered.
'Kooiti, at the company, purposely offered Tamae that *he* would go to Tokyo.'

(13) Object-Control Sentence

Kooiti-ga kaisya-de Tamae-ni Tokyo iki-o wazato saisokusita.
-Nom company-at -Dat going-Acc purposely urged.
'Kooiti, at the company, purposely urged Tamae that *she* would go to Tokyo.'

Both types of sentences have the same construction as those in Experiment 1: [NP_1-*ga* Locative-PP NP_2-*ni* [($PRO_{1/2}$) Tokyo iki]-*o* Adverb Verb]. Sentence (12) is a Subject-control (S-control) sentence because the person who is supposed to go to Tokyo is the subject. Sentence (13) is an Object-control (O-control) sentence because ‘the person who is to go to Tokyo’ is the object.

4.4.2 Participants and Procedure

Twenty-three native speakers of Japanese participated in this experiment. They were undergraduate students, aged nineteen to twenty three, at Kyoto University. The experiment took about half an hour including a five-minute break. They were paid nominal fees for their participation.

The task was for the participants to state orally ‘who is supposed to go to Tokyo’, i.e., the Agent of the embedded event, after listening to each sentences. That is, the participants were to ‘retrieve’ the correct filler for the empty subject. The time was measured from the end of the sentence to the beginning of the response utterance. Here, note that it was possible for the participants to start to respond slightly before the end of the sentence. The morphological ending of verb conjugation is fairly simple in Japanese. For example, *yakusokusita* can be analyzed as *yakusoku* ‘promise’ and *sita* ‘did.’ Thus, the participants could start responding before the ending such as *sita*. Therefore, the RTs for this retrieval task might have been shortened.

4.4.3 Results and Discussion

The results are summarized in Table 5 below. The findings showed that the O-control sentences had significantly faster RT and slightly higher CS (although not reached the significant level) than S-control sentences. This may suggest a parsing strategy that favors the ‘object’ as a possible antecedent. The object might be preferred because of its grammatical function.

However, the object could be preferred because it is the most ‘recent’ antecedent, given that it is closer to the end of a sentence than the subject. It is possible that the parser employed a very general strategy such as ‘last-in-first-out.’ In other words, the ‘recency effect’ might have played a role. Thus, it is not possible to determine whether the preference is caused by the grammatical object or by the recency effect. This issue can be resolved by examining the data from Experiment 4.

	Sentence Type		
	S-control	O-control	Difference
RT (msec)	666	607	59[a]
CS (%)	88.9	90.2	1.3[b]

a: $F_1\,(1, 22) = 6.23$, $p < .05$, $F_2\,(1, 23) = 6.87$, $p < .05$
b: $F_1\,(1, 22) = .491$, $p < .5$, $F_2\,(1, 23) = .183$, $p < .68$

Table 5. Results of Experiment 3 (Retrieval task with S-O order)

4.5 Experiment 4

This experiment was designed to examine whether the object preference detected in Experiment 3 arose for some grammatical reason or due to the recency effect. For this purpose, the order of the subject and object NPs was scrambled so that the most recent NP changed.

4.5.1 Materials and Methods

Examples of the two types of control sentence are the same as (10) and (11) in Experiment 2 which are repeated below as (14) and (15).

(14) Subject-Control Sentence
Tamae-ni kaisya-de Kooiti-ga Tokyo iki-o wazato <u>moosideta</u>.
-Dat company-at -Nom going-Acc purposely offered.
'To Tamae, at the company, Kooiti purposely offered that *he* would go to Tokyo.'

(15) Object-Control Sentence
Tamae-ni kaisya-de Kooiti-ga Tokyo iki-o wazato <u>saisokusita</u>.
-Dat company-at -Nom going-Acc purposely urged.
'To Tamae, at the company, Kooiti purposely urged that *she* would go to Tokyo.'

Both types of sentences have the same construction: [NP_2-*ni* Locative-PP NP_1-*ga* (*trace*$_2$) [($PRO_{1/2}$) *Tokyo iki-o* Adverb Verb]. Except for the word order, the stimulus sentences and the procedures were the same as those in Experiment 3. The participants were seventeen native speakers of Japanese. They were undergraduate students, aged nineteen to twenty three, at Kyoto University. They consisted of a different group of participants from those that participated in Experiment 3. The experiment took about half an hour with a five-minute break. They were paid a nominal sum for their participation.

4.5.2 Results and Discussion

The data was analyzed in the same way as in Experiment 3. If there was a recency effect (i.e., a word-order effect or a scrambling effect) affecting the parsing process, then the results would be opposite to those obtained in Experiment 3. On the other hand, if the object was preferred because of its grammatical function, then the results would be the same as those in Experiment 3. Table 6 shows the summary of the results.

	Sentence Type		
	S-control	O-control	Difference
RT (msec)	749	648	101[a]
CS (%)	84.4	90.8	6.4[b]

a: F_1 (1, 16) = 7.93, $p < .05$, F_2 (1, 23) = 14.23, $p < .001$
b: F_1 (1, 16) = 3.01, $p < .11$, F_2 (1, 23) = 6.13, $p < .05$

Table 6. Results of Experiment 4 (Retrieval task with O-S order)

The RT of the O-control sentences is significantly faster than that of the S-control sentences in both the subject analysis (F_1) and item analysis (F_2). The CS of the O-control sentences is higher than that of the S-control sentences. This difference is significant in the item analysis (F_2), although the difference did not reach a statistically significant level in the subject analysis (F_1).

The results of Experiment 4, in which the experimental sentences had 'object-subject' order, also showed that the object was preferred as a controller, even when the word order is reversed. Regardless of the change of word order, Experiment 4 exhibited the same 'object preference' effect observed in Experiment 3. The findings of Experiments 3 and 4 thus indicate that not the recency but the grammatical function of the object affects the preference in processing these sentences.

4.6 Comparison of Experiments 3 and 4

Now, let us consider the filler-gap relations in the examples of Experiments 3 and 4. The schematic representation for them would be as follows (X=subject, Y=object, S-cont.V=subject control verb, O-cont.V=object control verb):

		response	
(A=12)	X_1-ga Y_2-ni [PRO_1 Tokyo iki]-o S-cont.V	X	(slow)
(B=13)	X_1-ga Y_2-ni [PRO_2 Tokyo iki]-o O-cont.V	Y	(fast)
(C=14)	Y_2-ni X_1-ga t_2 [PRO_1 Tokyo iki]-o S-cont.V	X	(slow)
(D=15)	Y_2-ni X_1-ga t_2 [PRO_2 Tokyo iki]-o O-cont.V	Y	(fast)

Table 7. Schematic representation of materials in Experiments 3 and 4

Comparing these two experiments, it should be noticed that the RTs in Experiment 4 were slower than those in Experiment 3. Consider Table 8 and Figure 2 below. The two-way ANOVA (2 x 2) revealed that there was a main effect of sentence type [F_1 (1, 38) = 15.016, $p < .001$, F_2 (1, 46) = 20.919, $p < .001$]. On the other hand, there was no main effect of word order [F_1 (1, 38) = 1.184, $p < .29$, F_2 (1, 46) = 4.015, $p < .051$]. The interaction between word order and sentence type was not significant [F_1 (1, 38) = 1.009, $p < .33$, F_2 (1, 46) = 1.412, $p < .25$].

	Sentence Type		
	S-control	O-control	Effect of sentence type
Exp.3(S-O)	666	607	59
Exp.4(O-S)	749	648	101
Effect of word order	-83	-41	

Table 8. Mean RTs in Experiments 3 and 4 (Retrieval task with S-O and O-S order)

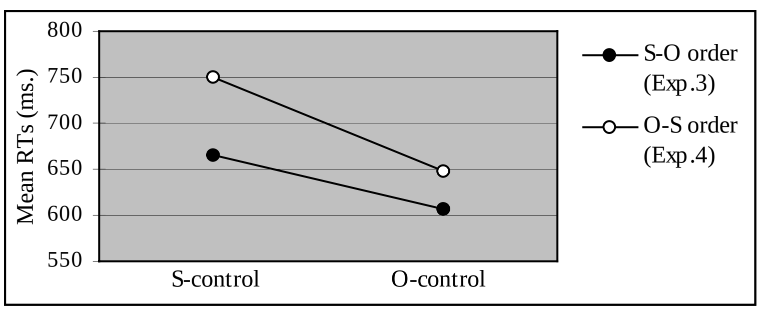

Figure 2. Comparison of Experiments 3 and 4

The results clearly showed that O-control sentences had faster RTs than S-control sentences. Although the difference did not reach a statistically significant level, as Table 8 and Figure 2 show, the permutation of the word order has increased response times. This finding is surprising when we reconsider the comparison between Experiments 1 and 2 in which the permutation of word order brought about a decrease in RTs. Interestingly, the change in experimental tasks invited the opposite effect. The scrambling of word order *decreased* RTs in the 'recognition' experiments while it *increased* RTs in the 'retrieval' experiments.

4.7 Summary of the Four Experiments

Experiments 1 and 2 utilized a 'recognition task' with a Yes/No decision, whereas Experiments 3 and 4 employed a 'retrieval task' that required the participants to answer orally with the proper antecedent. The findings of Experiments 1 and 2 indicated a 'subject preference' despite different word-orders. The results of Experiments 3 and 4 exhibited a constant 'object preference' regardless of word order. We can summarize the experimental findings in Table 9 and Figure 3 below.

	Task			
	Recognition		Retrieval	
	S-control	O-control	S-control	O-control
S-O	<u>752</u>	835	666	<u>607</u>
O-S	<u>639</u>	714	749	<u>648</u>

Table 9. Mean RTs in the four Experiments

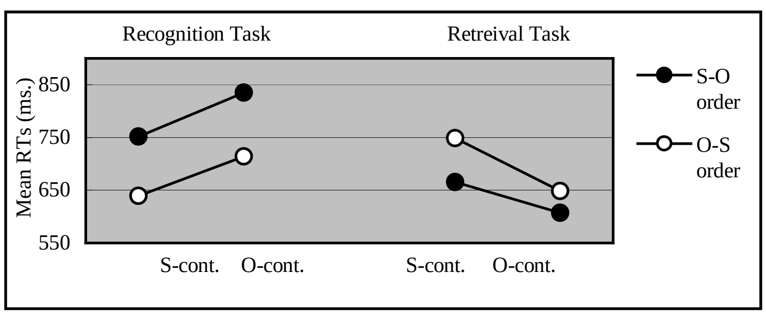

Figure 3. Comparison of the four Experiments

At a glace, RTs in the recognition task (Experiments 1 and 2) are slower than those in the retrieval task (Experiments 3 and 4). However, we need the following proviso. In the recognition task, the stimulus (one of six different names) was given right after the end of each sentence. Since the timer starts at the end of sentence, the time for presenting the stimulus was included in the RTs. In other words, the participants had to press the Yes-No key after they had recognized the stimulus at the end of each sentence. In the retrieval task, on the other hand, the participants were able to respond without any extra time for recognizing the stimulus of names. In Retrieval task, furthermore, it was possible to start to respond before the end of the sentence. The morphological ending of verb conjugation is fairly simple in Japanese. For example, *yakusokusita* can be analyzed as *yakusoku* 'promise' and *sita* 'did.' Thus, the participants could neglect the ending such as *sita*. Therefore, the RTs for recognition task were prolonged, and the RTs for retrieval task were shortened. So, it is impossible to compare directly the RTs between these two tasks.

With the above proviso in mind, let us examine the three-way ANOVA (2 x 2 x 2), which revealed that there was a significant effect of interaction between the tasks and sentence types [F_1 (1, 52) = 21.705, $p < .001$, F_2 (1, 68) = 30.345, $p < .001$]. No other interaction was significant. The mean RTs for this interaction is shown in Table 10 and Figure 4 below.

	Sentence Type		
	S-control	O-control	Effect of sentence type
Recognition	695	774	-79
Retrieval	707	627	80
Effect of task	-12	147	

Table 10. Mean RTs in interaction between Task and Sentence Type

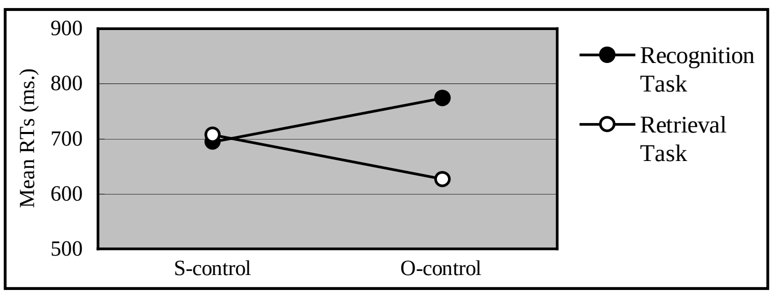

Figure 4. Comparison of RTs in the interaction between Task and Sentence Type

The simple main effect of task was not significant at S-control [F_1 (1, 104) = .054, $p < .82$, F_2 (1, 136) = .183, $p < .67$], but was significant at O-control [F_1 (1, 104) = 8.458, $p < .005$, F_2 (1, 136) = 28.169 , $p < .001$]. That is, the effect of task clearly showed up at O-control construction. The simple main effect of sentence type was significant at both the recognition task [F_1 (1, 52) = 10.757, $p < .005$, F_2 (1, 68) = 15.077, $p < .001$], and the retrieval task [F_1 (1, 52) = 10.948, $p < .005$, F_2 (1, 68) = 15.268 , $p < .001$]. Namely, the effect of sentence type clearly showed up in both the recognition and retrieval tasks. Here, note that the direction of effect is different: the RTs for O-control was <u>slower</u> in the recognition task, and the RTs for O-control was <u>faster</u> in the retrieval task.

There are two important findings that can be read form this preference pattern (see Figure 3). One is that the surface word order of the subject and object does not affect the preference pattern of the possible antecedent for the empty subject. That is, the preference pattern is stable between the two different word orders. The other important finding is that the preference pattern is reversed between the two different tasks. In short, there is a Subject-Object asymmetry of preference between the tasks but no such asymmetry between the word orders.

5 General Discussion

The findings from the four experiments lead to the following two questions: (i) Why does the scrambled word order fail to invite the reversed preference? (ii) Why do the different tasks cause the different preferences? Note that the scrambling of word orders is the change that affects the experimental materials. On the other hand, the alternation of tasks is the change of the instructions given to the participants.

5.1 Stable Preference Between Different Word Orders

A possible answer to the first question (i.e., the same preference between the different word orders) may be rather simple. Information about distance may not be important in constructing the structure of a sentence. It is not the *linear order* of the elements but the *relationship* among the elements that is crucial for processing a sentence. Consider the following examples from Yamashita (1997).

(16) a. (NP-*ga* NP-*ni* NP-*o* order: Canonical word order)
Wakai zimuin-*ga* mukuti-na syatyoo-*ni* omosiroi hon-*o*
young secretary-Nom quiet president-Dat fun book-Acc

ageta.
gave
'A young secretary gave the quiet president a fun book.'

b. (NP-*ni* NP-*ga* NP-*o* order: Scrambled word order)
Mukuti-na syatyoo-*ni* wakai zimuin-*ga* omosiroi hon-*o*
quiet president-Dat young secretary-Nom fun book-Acc

ageta.
gave
'To the quiet president, a young secretary gave a fun book.'

(16b) is a scrambled version of (16a). The word order is the only point of difference between the above two sentences. Yamashita (1997) gave a self-paced reading task to the participants in order to investigate whether this difference in word order caused any difference in parsing time. In these two conditions (Canonical vs. Scrambled), the reading times of each phrase were computed.[8] Since there are seven phrases, there were seven positions at which the times were measured. The results revealed "no significant differences across the conditions at any position" (p. 171). That is, Yamashita detected no word-order effect in parsing these sentences.

Therefore, it seems that there is neither primacy nor recency effect in processing Japanese sentences. This fundamental principle of sentence comprehension is reflected in the stability of preference between the different word orders in the four experiments reported here. As was mentioned in Section 4.3, the change of word order (i.e., scrambling) may affect the response times. However, the important point is that the response pattern is not affected by the scrambling. Of course, it is necessary to accumulate more experimental studies to support this claim. See also Nakayama (1995), Mazuka et al. (2001), and Miyamoto and Takahashi (2001) for the issue of scrambling effect in Japanese.

5.2 Reversed Preference Between Different Tasks

A plausible answer to the second question (i.e., the reversed preference between the two tasks) is rather complicated. There seems to be at least four points of difference between the recognition experiment (Experiments 1 and 2) and the retrieval experiment (Experiments 3 and 4). The first point con-

[8] The original data by Yamashita includes two more conditions for a total of four conditions. Although we reduced the number of conditions to two in order to save a space, the essence of the argument does not change.

cerns the number of participants and items. The number of participants and items in the recognition experiments (16 participants and 24 items) is less than that of the retrieval experiments (40 participants and 48 items). It has sometimes been observed that significant factors do not show up statistically when there are not enough number of participants and items for inspection; however, it would not make sense to say the experiment produces completely *opposite* results only because the number of participants and items is different.

The second point concerns the non-target sentences used to disguise the purpose of the experiments. Because non-target sentences were not used in the recognition experiments, there is a possibility that the participants may have created some specific strategy in responding to the sentences; however, it would not make sense to argue that the participants used completely *opposite* strategies simply because of the presence of non-target sentences.

The third point is related to the way of constructing the experimental sentences. Studies have pointed out that intonational information like pitch, loudness, and duration play an important role in sentence comprehension (Misono et al. 1997; Venditti and Yamashita 1994). In the recognition experiments, experimental sentences were synthesized by combining phrases that had been recorded separately, and therefore, the sentences did not have a normal sentential intonation. In the retrieval experiments, on the other hand, the experimenter read out the complete sentences with a normal sentential contour. This difference in the way of constructing experimental sentences may have caused preference patterns to differ. In order to examine this possibility, another experiment, the likes of which are discussed in the final section, would be necessary.

The fourth point has to do with the difference in the experimental tasks given to the participants. It is known that language processing is sensitive to the task involved. For example, Kamide and Mitchell (1997) report the different results between off-line and on-line tasks. Nagata (1993) also reports different results between probe recognition tasks and antecedent identification tasks. In the following two subsections, therefore, I will try to account for the difference of preference patterns in terms of the difference in the tasks.

5.3 Subject Preference and Case Hierarchy

In the experimental sentences, there were two possible candidates for the correct antecedent: *NP-ga* or *NP-ni*. The findings indicated that *NP-ga* was preferred in the recognition task, while *NP-ni* was selected in the retrieval task. In short, observation shows that the different tasks cause different preferences, and therefore, one must plausibly account for the relationship between the tasks and the preferences. It is natural to assume the human parser selects the most suitable strategy to accomplish the given task. The selection of a strategy requires relevant information. The preference pattern seems to be determined by what kind of information is utilized; that is, we assume that the participants pursue the following path:

(17) [task] → [strategy] → [preference]
↑
<information>

Note that the proposed process is not a sequence of logical steps, but a practical procedure that the participants might have adopted for solving the given task. In Experiments 1 and 2, the participants were given a recognition task that required them to decide whether the given name was the correct antecedent for the empty subject then to press the Yes-key or No-key. Because the question required the parser to answer simply Yes or No, the task was relatively easy to perform. In performing the task, thus, the parser could have relied on a strategy that works at rather automatic and shallow level of parsing. As is discussed below, we assume that the parser makes use of Case information in applying the strategy.

If the human parser ignores information available from the Case-marking particle or delays utilization of this information, the parser must wait until the final verb appears. With this ‘wait-and-see’ strategy, the parser should have made no mistake in determining which lexical unit was the controlling one. This means that the RTs of the S-control and O-control sentences should not have been different. This contradicts the findings of our experiments. Thus, it is reasonable to assume that the parser uses information from the Case markers before the final verb appears.

Yamashita (1997) presents positive evidence that indicate the parser constructs a tentative structure relying on Case-marker information. Consider the following examples:

(18) a. Kawaii onnanoko-*ga* wakai sensei-*ni* oisii otya-*o* *dasita*.
cute girl-Nom young teacher-Dat good tea-Acc served
‘The cute girl served the young teacher good tea.’

b. Kawaii onnanoko-*ga* wakai sensei-*ni* oisii otya-*o* *nonda*
cute girl-Nom young teacher-Dat good tea-Acc drank

(to itta).
(that said)

'The cute girl (told) the young teacher (that she) drank good tea.'

At the point of each verb (*dasita* 'served' vs. *nonda* 'drank'), the participants were asked to decide whether the given word was a correct Japanese word or not (some nonwords are also included). The results of this lexical decision task revealed that the response time of the ditransitive verb (*dasita*) was significantly faster than that of the transitive verb (*nonda*). If the parser did not make any predictions regarding the coming verb, there would not have been any difference in lexical decision time. Furthermore, the same results were obtained when the word order was scrambled (Wakai sensei-*ni* kawaii onnanoko-*ga* oisii otya-*o* *dasita/nonda*). Yamashita (1997), therefore, claims that "the parser appears to have utilized case information independently of word order when it made a decision on the syntactic computation prior to the verb" (p. 176).

So far, we have argued that the parser utilizes Case information in performing the recognition task. Then, why was the 'subject' preference detected in Experiments 1 and 2? To explain this, I propose a 'Case Filling Strategy,' which I will define as "filling the empty subject (PRO) with an NP carrying Nominative Case." The 'Case Hierarchy' explains why the parser selects the Nominative Case. Shibatani (1978) proposes the following Case Hierarchy:

(19) Nominative > Accusative > Dative > Other Cases

He presents four reasons to support this proposal: (i) The Nominative Case is indispensable at some level of derivation; (ii) Only the Nominative and Accusative Cases allow quantifier floating; (iii) When topicalized, the Dative marker (-*ni*) can be deleted very often compared to other Case markers except Nominative and Accusative; (iv) The topic marker (-*wa*) cannot cooccur with the Nominative and Accusative Cases. As this is not the place to discuss these points extensively, I will discuss only the final point. Take the following examples (Top=Topic marker).

(20) *Taro-<u>ga-wa</u> wakai.
Taro-Nom-Top young
(lit.) 'As for Taro, he is young.'

(21) *Taro-ga <u>Jiro-o-wa</u> nagutta.
Taro-Nom Jiro-Acc-Top hit
(lit.) 'As for Jiro, Taro hit him.'

(22) Taro-ga Jiro-ni-wa atta.
Taro-Nom Jiro-Dat-Top met
'As for Jiro, Taro met him.'

(23) Taro-ga Jiro-kara-wa tegami-o moratta.
Taro-Nom Jiro-from-Top letter-Acc received
'As for Jiro, Taro received a letter from him.'

The topic marker (-*wa*) cannot co-occur with the Nominative nor Accusative Cases as in (20) and (21), but it can co-occur with the Dative and Oblique Cases as in (22) and (23). Taking other conditions into consideration, Shibatani (1978) claims in (19) that the Nominative Case is located at the highest position in the Case Hierarchy.

The Nominative Case tends to correspond to the grammatical function of the 'subject' (although, as I will discuss below, this is not necessarily true). Thus, the human parser may assume this correspondence so that it regards a NP with the Nominative Case marker as a subject NP. Considering our experimental sentences, we notice that the preferred NP is marked with the Nominative marker (-*ga*). This means that this NP is in the highest position of the Case Hierarchy represented in (19). The subject preference in the recognition experiments appears to reflect the mental representation of this Case Hierarchy within the participants.

Here, one should notice that the syntactic category 'Subject' does not uniquely correspond to the 'Nominative' Case category. Take the following examples in (24) below (Gen = Genitive).

(24) a. Watasi-no otooto-wa Yamada sensei-ga sukida.
I-Gen brother-Top professor-Nom love
'My brother loves Professor Yamada.'

b. *Watasi-no otooto wa Yamada sensei-ga o-sukida.
(honorific form of (24a))

If the NP marked with the Nominative (*Yamada sensei-ga*) is really the subject, (24b) should be acceptable because the honorification rule applies to the referent of this NP who is worthy deference. The fact that (24b) is unacceptable indicates that this is not the subject. There are two types of -*ga*: one is 'Nominative subject' as in (22) and the other is 'Nominative object' as in (24a). Nonetheless, it is important to notice that the Nominative object is restricted to cases in which the predicate is a specific stative such as *sukida* 'like', *hosii* 'want', *wakaru* 'understandable', and *Verb + tai* 'want to do', etc.

Thus, it might be suitable to call the preference detected in our experiments a 'Nominative preference' instead of a 'subject preference,' even though the two terms are not distinguishable as long as the parser regards the Nominative as being equivalent to the subject. Thus, I will continue to use the term subject preference for the sake of simplicity. This hypothesis of Case Hierarchy accounts for the subject preference observed in Experiments 1 and 2. In what follows, I will present a hypothesis to explain the object preference detected in Experiments 3 and 4.

5.4 Object Preference and Theta-role Hierarchy

In Experiments 3 and 4, the participants were given the retrieval task that required them to identify the antecedent verbally. Because the task was to answer a 'who-did-what' question, the task was more difficult to perform than the task required in Experiments 1 and 2. (Although the RTs of Experiments 3 and 4 were faster than those of Experiments 1 and 2, this does not mean that Experiments 3 and 4 were easier to perform than Experiments 1 and 2. As was mentioned in Section 4.7, the <u>direct</u> comparison of RTs is meaningless because the measuring method is different.) The retrieval task does not allow to say just Yes or No, but it demands to select only one name among possible six names used in the experiments (two names were used in each sentence). To perform the task in Experiments 3 and 4, thus, the parser seemed to employ a strategy that works at rather conscious and deep level of processing. The parser appears to utilize Theta-role information in applying this strategy. Many studies have pointed out that Theta-roles play important roles in language processing (Ahrens and Swinney 1995, Boland et al. 1995, Carlson and Tanenhaus 1988, Tanenhaus et al. 1993).

Here, we argue that the 'Theta-checking Strategy' of Sakamoto and Walenski (1998) applies in performing the retrieval task for Japanese control constructions. This strategy says, "Assign a tentative Theta-role using information available from Case markers, and check it using verb information". We assume that Case markers (e.g., *-ga*, *-ni*, *-o*, etc.) are sources of two different levels of information: one for Case information (e.g., Nominative, Accusative, Dative, etc.), and the other for Theta-role (i.e., Agent, Theme, Goal, etc.). The human parser appears to make a top-down prediction using Theta-role information available from a noun with a Case marker. To begin with, take the following English examples in order to consider how this top-down prediction works.

(25) a. John gave [$_{NP}$ the boy] [$_{NP}$ the dog] bit a bandage?? : <u>Garden path</u>

b. John gave [$_{NP}$ the boy$_1$ [$_S$ the dog bit *e*$_1$]] a bandage. : <u>Reanalyzed</u>

In (25a), when the parser gets to the verb *gave*, it expects that two NPs will follow: one for Goal and another for Theme. This expectation is tentatively satisfied at the point where *the dog* is attached to a parse tree, but ultimately, this expectation is disappointed when the parser gets to the verb *bit*, because this verb requires an Agent and a Patient NP. (25a) results in a garden-path effect and must be reanalyzed as in (25b). Now, take the following examples from Japanese.

(26) a. [$_{NP}$ Taro-ga] [$_{NP}$ Hanako-ni] [$_{NP}$ ringo-o] tabeta inu-o ageta.
-Nom -Dat apple-Acc ate dog-Acc gave
'Taro ate an apple to Hanako gave a dog?? ' : (mild) <u>Garden path</u>

b. [$_{NP}$ Taro-ga] [$_{NP}$ Hanako-ni] [$_{NP}$ [$_S$ *e*$_1$ ringo-o tabeta] inu$_1$]-o
-Nom -Dat apple-Acc ate dog-Acc

ageta.
gave
'Taro gave Hanako the dog that ate the apple.' : <u>Reanalyzed</u>

In (26a), when the parser encounters three NPs in succession, it expects to find a three-place predicate such as *ageta* 'gave,' which can take Agent, Goal, and Theme Theta-roles. This expectation is not satisfied because *tabeta* 'ate' is a two-place predicate that does not subcategorize three NPs. This verb takes only Agent and Theme Theta-roles. In other words, the tentative construction expected from the three successive NPs (NP$_1$-*ga* NP$_2$-*ni* NP$_3$-*o*) is checked against this verb information. On encountering the following noun *inu* 'dog,' the parser has to reanalyze (26a) as (26b), resulting in a mild garden-path effect (or 'surprise effect' See Mazuka and Itoh 1995). This line of discussion is supported by Yamashita (1997) mentioned in Section 5.3, which indicates that the human parser makes prediction based on the sequence of NPs.[9]

I argue that in both a head-initial language (e.g., English) and a head-final language (e.g., Japanese), the parser utilizes Theta-role information. The only difference is the way in which the parser gets this information. In English, the parser relies on Theta-role information available from a <u>verb</u>. In Japanese, on the other hand, the parser uses Theta-role information available from a <u>noun</u> with a Case-marking particle. Here, we assume a very simple process is in operation. When the human parser gets to a verb that assigns a

[9] See also Inoue and Fodor (1995) and Mazuka and Itoh (1995).

certain Theta-role, it expects to encounter a noun with the pertinent Theta-role. By the same token (but the opposite direction), when the parser gets to a noun with a certain Case marker, it assumes that there must be some appropriate Theta-role associated with that Case marker. And then, the parser anticipates a verb that can assign the expected Theta-role.

Here, it is assumed that such-and-such Case marker corresponds uniquely to such-and-such Theta-role. For example, a NP marked with the Nominative particle (*-ga*) usually represents the Agent. An NP with the Dative particle (*-ni*) usually represents the Goal. An NP with the Accusative particle (*-o*) usually represents the Theme. Thus, it is assumed a sentence has (at least) two levels of representation: one for Case and the other for Theta-role as is shown in (27) below.

(27) Taro-ga Hanako-ni Jiro-o syookaisita.
-Nom -Dat -Acc introduced ← [Case level]
[Agent] [Goal] [Theme] ← [Theta-role level]
'Taro introduced Jiro to Hanako.'

Note that we are not claiming that there is *always* a unique correspondence between Case and Theta-role. In (24a), for example, the NP marked with the Nominative (*Yamada sensei-ga*) is not the Agent but the Theme. The point is that the human parser *assumes* that there is a one-to-one correlation between Case and Theta-role. Since it is costly to prepare for all possibilities, the parser seems to construct a tentative parse tree using this simple assumption.

If Theta-role information is consulted in performing the retrieval task, which Theta-role is to be selected as the preferred one? Sakamoto (1996) and Sakamoto and Walenski (1998) claim that the Goal role is preferred as a possible candidate for an empty subject because the Goal role is the highest in the 'Theta-role Hierarchy' proposed by Nishigauchi (1983). He claims that the Goal is chosen as the controller in the control constructions. Consider the following examples:

(28) a. Bill bought for Susan$_1$ a large flashy car [PRO$_1$ to drive].
b. John$_1$ received from Susan a book [PRO$_1$ to read].

Nishigauchi (1985) claims that the indirect object (*Susan*) denotes the Goal in (28a), since the Theme (*a large flashy car*) moves to this indirect object. On the other hand, the subject (*John*) is assumed to be the Goal in (28b) because the movement of the Theme (*a book*) is directed toward this subject. This difference of control behavior is explained by the difference of predicate (*buy* vs. *receive*) that governs the control relation. Regardless of the difference of the grammatical function (i.e., subject or object), the NP with the Goal role is always chosen as the controller.

However, there are cases in which no Goal is specified in a sentence. Consider the following examples (29) and (30). Nishigauchi (1985) argues that the subject of verbs such as *own*, *retain*, etc. is associated with the thematic relation of Location to which the Theme (e.g., *a car* in (29)) belongs. On the other hand, the object of verbs like *deprive*, *cure*, etc. is assumed to bear the thematic relation of Source from which the Theme (e.g., *the money* in (30)) is transferred.

(29) John_1 owns a car [PRO_1 to carry his own belongings in].
(30) They deprived Mary_1 of the money [PRO_1 to pay her rent with].

If the Goal is specified in a sentence, it is always chosen as the controller. When only the Location or Source is specified, it serves as the controller. Nishigauchi (1985) claims that there is a hierarchical relation among Theta-roles and this hierarchy determines which Theta-role is chosen as the controller:[10]

(31) The Primary Location Hierarchy
1. Goal > 2. Location, Source

Note that the proposed hierarchy is to account for the construal of the control constructions. It is not intended to apply for <u>any type of sentences</u>. Returning to Experiments 3 and 4, I claim that the parser is ready to assign the Goal role to an NP that is marked with the Dative (*-ni*). At this point, the parser commits to a decision about the thematic structure of the sentence. This tentative commitment is either confirmed by subsequent information provided by a final Object-control verb or not confirmed by a subsequent Subject-control verb. The failure of this confirmation seems to result in a slower processing time for S-control sentences.

[10] See Ladusaw and Dowty (1988) for a different view which claims that “principles of control of subjectless infinitives are ultimately determined by entailments of verbs together with principles of human action that exist quit apart from language.” This claim seems to be too strong, since some aspects of the control phenomenon should be explained in terms of linguistic properties. See Sakamoto (1996) for more discussion on this issue.

6 Concluding Remarks

So far, I have argued that different tasks require the parser to employ different strategies, which in turn use different sources of information. Then, it is assumed that these different levels of information affected the strategy to invite the different patterns of preference observed in our experiments. Except lexical information, Case markers are very informative cues for the parser when information about the sentence final predicate is not available (see Section 7 below about the importance of prosodic information). In both the recognition and retrieval experiments, the parser is supposed to construct a tentative sentence structure by making use of the available information provided by Case markers. The issue at hand is how the parser uses this information. I claim that the parser utilizes it in two different ways. In the recognition task, the parser selects a NP with Nominative as a possible antecedent because of the Case Hierarchy represented in (19). In the retrieval task, on the other hand, the parser selects a NP with Dative because of the Theta-role Hierarchy in (31).

However, note that I do not claim that the human parser uses these two types of information in this sequential order. Nothing is said about the timing to use the relevant information. Actually, it is not so easy to design an experiment to testify this kind of sequential ordering of sentence processing (see Hahne and Friederici 1999, Hickok et al. 1992). Since, in most experiments, participants are required to perform some task, what we can investigate is inevitably the process of task-oriented performance. The important point in our experiments is that there are (at least) two distinct levels of sentence processing. By altering the experimental tasks, one can find out which level is activated by the human parser.

7 Remaining Problems

In this paper, I have concentrated on the difference between the tasks performed by the participants: *recognition* and *retrieval*. However, when we closely observe the tasks and the experimental materials, we notice that Experiments 1 and 2 exhibit a ‘Recognition Task + Synthesized Sentence’ pattern while Experiments 3 and 4 exhibit a ‘Retrieval Task + Read-out Sentence’ pattern. We can summarize the situation in Table 11.

There are two factors (i.e., task and material) that could cause the difference in the response pattern, and there is a confounding between the task and the material. It is therefore necessary to fix one factor before examining the effect of the other factor. In other words, we need to examine the combinations ‘Retrieval Task + Synthesized Sentence’ and ‘Recognition Task +

Read-out Sentence'. As mentioned earlier, phonological information plays an important role in parsing. The proposed experiments should tell us more about the interaction of phonological, syntactic, and semantic information in sentence processing.

Task / Material	Recognition	Retrieval
Synthesized	Experiment 1 (S-O order) Experiment 2 (O-S order)	Not yet done
Read-out	Not yet done	Experiment 3 (S-O order) Experiment 4 (O-S order)

Table 11. Combination of Tasks and Sentences

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