Remarks and Replies

Psycholinguistic Evidence for the VP-Internal Subject Position in Japanese

Masatoshi Koizumi
Katsuo Tamaoka

The question of whether the subject stays in its thematic position within the VP or moves to Spec,TP is difficult to answer with respect to free word order languages such as Japanese because the surface constituent orders in these languages do not necessarily provide sufficient information to determine syntactic positions. In this article, we present psycholinguistic evidence for the theoretical hypothesis that, in Japanese, the subject must move to Spec,TP in sentences with the subject-object-verb word order, but may stay within the VP in sentences with the object-subject-verb word order.

Keywords: experimental syntax, scrambling, sentence processing, VP adverb, word order

1 Introduction

The introduction of the internal subject hypothesis (ISH) in the mid-1980s led to a debate regarding whether the subject in a particular language should stay in its thetamatic position at Spec,VP (or Spec,vP in more recent terminology) or move to its ''derived position'' at Spec,IP (or TP) (e.g., Fukui 1986, Kitagawa 1986, Koopman and Sportiche 1988, Kuroda 1988). This question is particularly difficult to answer with respect to free word order languages such as Japanese because the surface constituent orders in these languages do not necessarily provide sufficient information to determine syntactic positions. In this article, we present psycholinguistic evidence for the theoretical hypothesis that, in Japanese, the subject may stay within the VP in sentences with the object-subject-verb (OSV) word order (Miyagawa 2001). (Purely for the purpose of exposition, we will

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veer away from the distinction between VP and vP, and will use *VP* as a cover term throughout this article.)

The article is organized as follows. Section 2 provides essential background information regarding the distribution of adverbs in Japanese and its effects on sentence processing. Section 3 explains two competing syntactic analyses of the position of the external argument in scrambled sentences, together with their predictions about sentence processing. The results of the experiment that tests these predictions are presented in section 4, followed by a discussion in section 5. Section 6 concludes the article.

2 Adverb Positions and Sentence Processing

For the purpose of this study, we make the following two basic assumptions:

(1) a. *Assumption 1*
(Other things being equal) sentences involving an instance of scrambling are more difficult to process than their counterparts without an instance of scrambling.[1]

b. *Assumption 2*
The canonical positions for so-called VP adverbs such as manner and resultative adverbs are within the VP. Therefore, when VP adverbs occur outside the VP, they have undergone scrambling.

Assumption 1 is fairly standard in the psycholinguistic literature, and we adopt it without further discussion here (Mazuka, Itoh, and Kondo 2002, Miyamoto and Takahashi 2002, Tamaoka et al. 2005; see also Gibson 1998, Hawkins 2004, Marantz 2005).[2] As for Assumption 2, its meaning may be less obvious, and it thus requires explanation.

Japanese adverbs can be divided into three broad classes based on their syntactic distribution: (a) adverbs that are initially merged with a projection of a verb (i.e., *VP adverbs*); (b) adverbs that are initially merged with a projection of a tense (i.e., *TP adverbs*); and (c) adverbs that are initially merged with a projection of a modal (i.e., *MP adverbs*) (Koizumi 1993, Kimura 2004; see also Minami 1974, Nakau 1980, Noda 1984, Takubo 1987, Cinque 1999). The canonical positions of the three classes of adverbs are schematically shown in (2), where *A* represents an adverb.

(2) $[_{CP}[_{MP}$ (MP-A) $[_{TP}$ (TP-A) S (TP-A) $[_{VP}$ (VP-A) O (VP-A) V] T] M] C]

[1] As an example of ''other things,'' it has been observed that the longer the object, the stronger the preference for the OSV word order, in cases where the phrase length was counted in terms of the number of words involved (Yamashita and Chang 2001). In the experiment reported in section 4, the effects of factors such as phrase length were made minimal by using simple sentences without nominal modifiers. See also the methodological remarks in section 4.1.

[2] A generalized version of Assumption 1 is explicitly stated, for example, in Marantz 2005:439: ''[A]ll other things being equal, the more complex a representation . . . [is], the longer it should take for a subject to perform any task involving the representation and the more activity should be observed in the subject's brain areas associated with creating or accessing the representation and with performing the task.''

VP adverbs include manner and resultative adverbs such as *hayaku* ‘fast’ and *konagonani* ‘into pieces’. Their canonical positions within a VP are c-commanded by the negative morpheme in short negation sentences such as (3), where the negative morpheme occurs between a verb stem and a tense morpheme. VP adverbs therefore tend to be the focus of negation; hence, (3) is interpreted as ‘I ran not fast’ (i.e., ‘I ran slowly’).

(3) [$_{VP}$ Hayaku hasir]-ana-katta.
fast run-NEG-PAST
‘(I) did not run fast.’

TP adverbs include time and aspectual adverbs such as *kinoo* ‘yesterday’ and *sibasiba* ‘frequently’. Their canonical positions within a TP are outside the c-command domain of the negative morpheme in short negation sentences. Thus, in the short negation sentence (4a), the verb ‘run’ is negated rather than the adverb ‘yesterday’. However, a TP adverb can be the target of negation in a long negation sentence with *wakedewanai* ‘it is not the case’, which takes a TP as its complement. Therefore, the preferred reading of (4b) is ‘The time when I ran was not yesterday’.

(4) a. [$_{TP}$ Kinoo [[$_{VP}$ hasir]-ana]-katta].
yesterday run-NEG-PAST
‘(I) did not run yesterday.’
b. [$_{TP}$ Kinoo [$_{VP}$ hasir]-ta]-wakedewanai.
yesterday run-PAST-it.is.not.the.case
‘It is not the case that (I) ran yesterday.’

Finally, MP adverbs include various types of modal adverbs such as *osoraku* ‘probably’ and *saiwai* ‘fortunately’. MP adverbs occur outside the c-command domain of the negative morpheme in both short and long negation sentences. Hence, they cannot be the target of negation, as shown in (5).

(5) a. [$_{MP}$ Osoraku [$_{TP}$[$_{VP}$ hasir]-ana-katta] daroo].
probably run-NEG-PAST seem
‘Probably (he or she) did not run.’
b. [$_{MP}$ Osoraku [[$_{TP}$[$_{VP}$ hasir]-ta]-wakedewanai] daroo].
probably run-PAST-it.is.not.the.case seem
‘Probably it is not the case that (he or she) ran.’

According to the structure shown in (2), for sentences with a VP adverb, subject-adverb-object-verb (SAOV) and subject-object-adverb-verb (SOAV) are the canonical word orders, and adverb-subject-object-verb (ASOV) is a noncanonical derived word order involving adverb scrambling (6a–c).

(6) a. *ASOV (derived word order with a VP adverb)*
Yukkuri Taroo-ga sinbun-o yonda.
slowly Taro-NOM newspaper-ACC read
‘Taro read a newspaper slowly.’

b. *SAOV (canonical word order with a VP adverb)*
Taroo-ga yukkuri sinbun-o yonda.
Taro-NOM slowly newspaper-ACC read
c. *SOAV (canonical word order with a VP adverb)*
Taroo-ga sinbun-o yukkuri yonda.
Taro-NOM newspaper-ACC slowly read

Similarly, for sentences with a TP adverb, ASOV and SAOV are the canonical word orders, and SOAV is a noncanonical derived word order (7a–c). Further, for sentences with an MP adverb, ASOV is the canonical word order, and SAOV and SOAV are noncanonical derived word orders (8a–c).

(7) a. *ASOV (canonical word order with a TP adverb)*
Kinoo Taroo-ga kabin-o kowasita.
yesterday Taro-NOM vase-ACC broke
'Taro broke a vase yesterday.'
b. *SAOV (canonical word order with a TP adverb)*
Taroo-ga kinoo kabin-o kowasita.
Taro-NOM yesterday vase-ACC broke
c. *SOAV (derived word order with a TP adverb)*
Taroo-ga kabin-o kinoo kowasita.
Taro-NOM vase-ACC yesterday broke

(8) a. *ASOV (canonical word order with an MP adverb)*
Zannennagara Taroo-ga syoosin-o zitaisita.
unfortunately Taro-NOM promotion-ACC refused
'Unfortunately Taro refused (an offer of) promotion.'
b. *SAOV (derived word order with an MP adverb)*
Taroo-ga zannennagara syoosin-o zitaisita.
Taro-NOM unfortunately promotion-ACC refused
c. *SOAV (derived word order with an MP adverb)*
Taroo-ga syoosin-o zannennagara zitaisita.
Taro-NOM promotion-ACC unfortunately refused

The relationship between the adverb classes and the canonicity of word order is summarized in (9).

(9)

Adverb classes	*Canonical word orders*	*Derived word orders*
VP adverbs:	SAOV and SOAV	ASOV
TP adverbs:	ASOV and SAOV	SOAV
MP adverbs:	ASOV	SAOV and SOAV

In the psycholinguistic literature, it is generally believed that, other things being equal, the human parser processes canonical word orders faster than derived word orders (see Assumption

1). Thus, the analysis summarized in (9) predicts that in sentences with VP adverbs, SAOV and SOAV are processed faster than ASOV; in sentences with TP adverbs, ASOV and SAOV are processed faster than SOAV; and in sentences with MP adverbs, ASOV is processed faster than SAOV and SOAV.

(10) *Predictions (*X $<$ Y *stands for 'X is processed faster than Y')*
  a. VP adverbs: {SAOV, SOAV} $<$ ASOV
  b. TP adverbs: {ASOV, SAOV} $<$ SOAV
  c. MP adverbs: ASOV $<$ {SAOV, SOAV}

In an earlier study (Koizumi and Tamaoka 2006), we tested these predictions by performing a reading experiment involving a sentence correctness judgment task (Chujo 1983, Tamaoka et al. 2005). In this experiment, transitive sentences with adverbs such as those in (6)–(8) as well as semantically anomalous filler sentences were visually presented to the participants in the center of a computer screen, in random order. The participants were instructed to respond as quickly and accurately as possible by deciding whether or not the sentences were correct. They registered their responses by pressing either the ''Yes'' or the ''No'' button. To determine whether or not a sentence was correct, the participants had to determine its syntactic structure as well as retrieve lexical information. The results of the experiment confirmed all of the predictions indicated in (10). In sentences with VP adverbs, the response times were reliably longer for ASOV than for either SAOV or SOAV, while the response times for the latter two did not differ significantly. In sentences with TP adverbs, the response times were longer for SOAV than for ASOV and SAOV, and the response times for the latter two were comparable. In sentences with MP adverbs, ASOV was processed faster than SAOV, which in turn was processed faster than SOAV. Taken together, these results support the analysis of adverb distribution represented in (2).

Given the discussion above, in this article we accept the two general assumptions shown in (1).

3 Competing Syntactic Analyses and Their Predictions

Traditionally, the subject was defined as an NP immediately dominated by an S node (Chomsky 1957). Thus, when Saito and Hoji (1983) argued that in Japanese, the object is base-generated within VP (11a) and that when it occurs to the left of the subject, it has undergone scrambling (11b), it was presumed that the subject occupies a position directly under the S node throughout the derivation (see also Hoji 1985, Saito 1985).

(11) a. $[_S\ S\ [_{VP}\ O\ V]]$
  b. $[_S\ O_i\ [_S\ S\ [_{VP}\ t_i\ V]]$

However, according to the ISH, the ''base'' or ''thematic'' position of the subject (i.e., the external argument), as well as that of the object (i.e., the internal argument), is within the VP, and when the subject is outside the VP, it has moved from its base position for some reason (e.g., the Extended Projection Principle). In Japanese, it is now a standard analysis that the subject in a canonically ordered SOV sentence moves from its thematic position, Spec,VP, to its derived position, Spec,TP, as shown in (12) (Miyagawa 1989, Kishimoto 2001).

(12) $[_{TP}\ S_i\ [_{VP}\ t_i\ OV]]$

The discussion in section 2 was also based on this assumption, although the presence of a subject trace within the VP was not explicitly mentioned because it was not relevant.

Regarding Japanese sentences with the OSV word order, there are at least two competing analyses with respect to the placement of the subject. One is that the subject in OSV sentences, like the subject in SOV sentences, obligatorily moves to Spec,TP, and the object moves to an even higher position, as shown in (13) (see, e.g., Saito 2003).

(13) *Analysis 1*
$[_{TP}\ O_j\ S_i\ [_{VP}\ t_i\ t_j\ V]]$

Although this structure contains a VP-internal subject trace, it is fairly similar to the traditional structure presented in (11b). Therefore, it can be considered an updated version of the traditional structure.

A more innovative analysis has been proposed by Miyagawa (2001), according to which it is possible that the subject stays in its base position within the VP and only the object moves to Spec,TP, as shown in (14).

(14) *Analysis 2*
$[_{TP}\ O_i\ [_{VP}\ t_i'\ S\ t_i\ V]]$
↑_____|↑___|

Note that the derivation of this structure involves two movements of the object: the first, in which the object moves to the edge of VP, which is necessary for locality reasons, and the second, in which the object moves to Spec,TP (Miyagawa 2001, Miyagawa and Arikawa 2007). Hence, the OSV word order has a more costly derivation than the SOV order.

Part of the evidence for the proposal that the subject may stay in the VP as in (14) comes from scope interpretation. Recall that constituents within a VP are c-commanded by the negation in short negation sentences; however, this is not the case with constituents that belong to a TP or an MP. Thus, if the universal quantifier *zen'in* 'all' occurs in the object position of an SOV sentence, it may be interpreted as being inside the scope of negation, thereby yielding a partial-negation reading (i.e., 'not all'). If *zen'in* occurs in the subject position, it is interpreted as being outside the scope of negation.

(15) a. Taroo-ga zen'in-o sikar-anakat-ta.
Taro-NOM all-ACC scold-NEG-PAST
'Taro did not scold all.' (not > all, all > not)
b. Zen'in-ga Taroo-o sikar-anakat-ta.
all-NOM Taro-ACC scold-NEG-PAST
'All did not scold Taro.' (??not > all, all > not)

Significantly, Miyagawa (2001) observes that if the object scrambles across the subject *zen'in*, partial negation becomes easier to obtain with appropriate prosody, as exemplified in (16) (see also Miyagawa 2006, Miyagawa and Arikawa 2007).

(16) Sono tesuto-o_i zen'in-ga t_i uke-nakat-ta (yo/to omou).
that test-ACC$_i$ all-NOM t_i take-NEG-PAST
'That test, all didn't take.'
(Miyagawa 2001:299)

Miyagawa argues that the partial negation interpretation of (16) is readily explained if we assume that its subject occupies a VP-internal position (as in (14)) that is c-commanded by the negation.

The two competing analyses in (13) and (14), together with the two assumptions summarized in (1), create different predictions for the processing of OSV sentences with VP adverbs in three different positions such as those in (17).

(17) a. *AOSV*
Yukkuri sinbun-o Taroo-ga yonda.
slowly newspaper-ACC Taro-NOM read
'Taro read a newspaper slowly.'
b. *OASV*
Sinbun-o yukkuri Taroo-ga yonda.
newspaper-ACC slowly Taro-NOM read
c. *OSAV*
Sinbun-o Taroo-ga yukkuri yonda.
newspaper-ACC Taro-NOM slowly read

Before discussing the predictions, however, we must make Assumption 2 more precise. We have shown that VP adverbs may be base-generated either to the left or to the right of the base position of the object within VP. It is not yet clear, though, whether they can be base-generated to the left of the base position of the subject within VP, as shown in (18a), or not, as shown in (18b).

(18) *Base positions of VP-adverbs: Two versions of Assumption 2*
a. Assumption 2a: [$_{VP}$ (A) S (A) O (A) V]
b. Assumption 2b: [$_{VP}$ S (A) O (A) V]

We will therefore take both possibilities into consideration in the following discussion.

Let us now turn to the predictions of Analysis 1 and Analysis 2 for the processing of OSV sentences with VP adverbs. In Analysis 1, with either Assumption 2a or Assumption 2b, the VP adverb *yukkuri* 'slowly' occupies its base position within the VP in the OSAV order (17c) and has undergone scrambling in the other two orders (17a–b). This is schematically represented in (19). (The traces of the arguments are omitted, and *(t_i')* stands for the intermediate traces of the adverb that would be left at the VP edge for locality reasons under Assumption 2b.)

(19) *Schematic structures of the sentences in (17) in Analysis 1 with either Assumption 2a or Assumption 2b*
a. [$_{TP}$ A_i O S [$_{VP}$ . . . (t_i') . . . t_i . . . V]]
b. [$_{TP}$ O A_i S [$_{VP}$ . . . (t_i') . . . t_i . . . V]]
c. [$_{TP}$ O S [$_{VP}$ . . . A . . . V]]

Thus, Analysis 1 predicts that AOSV and OASV are more difficult to process than OSAV.

Analysis 2 makes different predictions with Assumption 2a and with Assumption 2b. With Assumption 2a, both OASV (17b) and OSAV (17c) are canonical word orders with respect to adverb placement, and AOSV (17a) alone involves adverb scrambling, as shown in (20).

(20) *Schematic structures of the sentences in (17) in Analysis 2 with Assumption 2a*
a. $[_{TP}\ A_i\ O\ [_{VP}\ \ldots\ t_i\ S\ \ldots\ V]]$
b. $[_{TP}\ O\ [_{VP}\ \ldots\ A\ S\ \ldots\ V]]$
c. $[_{TP}\ O\ [_{VP}\ \ldots\ S\ A\ \ldots\ V]]$

It is then expected that AOSV is more difficult to process than both OASV and OSAV. In contrast, with Assumption 2b, AOSV (17a) involves two movements of the adverb: a movement to the edge of VP and a movement to Spec,TP from the VP edge. OASV (17b) involves a movement of the adverb across the subject within VP. OSAV (17c) is a canonical word order with respect to the adverb. This is schematically shown in (21), which predicts that AOSV is more difficult to process than OASV, which in turn is more demanding than OSAV.

(21) *Schematic structures of the sentences in (17) in Analysis 2 with Assumption 2b*
a. $[_{TP}\ A_i\ O\ [_{VP}\ t_i'\ \ldots\ S\ t_i\ \ldots\ V]]$
b. $[_{TP}\ O\ [_{VP}\ \ldots\ A_i\ S\ t_i\ \ldots\ V]]$
c. $[_{TP}\ O\ [_{VP}\ \ldots\ S\ A\ \ldots\ V]]$

The predictions regarding the cognitive load associated with the processing of sentences like (17a–c) are summarized in (22).

(22) *Predicted processing load*
a. Analysis 1 with Assumption 2a or 2b: AOSV = OASV > OSAV
b. Analysis 2 with Assumption 2a: AOSV > OASV = OSAV
c. Analysis 2 with Assumption 2b: AOSV > OASV > OSAV

4 Experiment

4.1 Rationales for Sentence Correctness Decisions

We tested the predictions in (22) by conducting a psycholinguistic experiment with a sentence plausibility judgment task that involved whole sentence reading (see Chujo 1983, Tamaoka et al. 2005).

The study measured efficiency of sentence processing by examining accuracy and speed. Since the study used only simple sentences, accuracy—correct ''yes'' responses to grammatically and semantically acceptable sentences—was expected to be very high. (In fact, the error rates in the study were all lower than 3%, as shown below.) Thus, the critical measure was reading time (or processing time), rather than accuracy. In the experimental condition of the study, participants were asked to decide as quickly and accurately as possible whether or not a visually presented sentence was correct. Before the trial sentences, the experimenter instructed the participants to process each sentence as fast as possible without making a mistake. Processing time is crucial

in the reaction time paradigm that has been used for over 40 years in experimental psychology. Because of syntactic manipulations (i.e., resolving filler-gap dependencies), sentences with a scrambled order are expected to require longer processing times than the same sentences with a canonical order (see Assumption 1).

The sentence plausibility task with whole sentence reading measures overall reading time. This task has been criticized for not being sensitive enough to investigate the details of phrasal processing (Miyamoto and Nakamura 2005). In order to measure phrasal processing, the self-paced reading method is often used. Self-paced reading requires participants to read one part (often a single phrase) of a sentence at a time and press a button (usually the space bar on a keyboard) to see the next part. The length of time between button presses is interpreted as the reading time for each part of a sentence. The idea that self-paced reading can measure the reaction times required for reading each part of a sentence seems appropriate for the investigation of sentence processing, especially from the syntactic perspective. However, this method has seldom detected scrambling effects in simple sentences (Nakayama 1995, Yamashita 1997, Tamaoka et al. 2003). Upon further consideration, then, what initially appears to be an ideal method turns out to face inherent problems, especially when one is investigating the processing of grammatically and semantically simple sentences.

First, this tendency becomes extreme in a simple active sentence with a transitive verb (for details, see Tamaoka and Koizumi 2006). Since this type of sentence is read by pressing the space bar three times, participants are likely to repeat a three-beat rhythm for NP-*ga*, NP-*o*, and VP. Likewise, a four-beat rhythm is used for active sentences with ditransitive verbs such as NP-*ga*, NP-*ni*, NP-*o*, and VP. Since the target stimulus sentences used for the present experiment were constructed using four phrases, participants could finish reading a sentence by pressing the space bar four times. With this repetitious behavior, reaction times varied little between phrases. Second, in the case of long and complex sentences, self-paced reading locks participants' reading at a certain region, so participants are not allowed to read backward to check phrases they have already read. As a result, self-paced reading entails heavy memory loads to remember previously read phrases, which is often reflected by longer reading times of over 1,000 milliseconds for each phrase—an extremely tedious pace of reading. Third, a spillover tendency is also occasionally observed in which the phrase that follows the target phrase shows a significantly longer reading time.

A recent eye-tracking study (Tamaoka et al. 2009) used the sentence correctness decision task to investigate the processing of simple canonical-order and scrambled-order active sentences with ditransitive verbs.

1. Canonical order: $[_{S}$ NP-ga $[_{VP}$ NP-ni $[_{V'}$ NP-o V]]]
2. Single-scrambled order: $[_{S}$ NP-ga $[_{VP}$ NP-o_1 $[_{VP}$ NP-ni $[_{V'}$ gap_1 V]]]]
3. Double-scrambled order: $[_{S}$ NP-ni_1 $[_{S}$ NP-o_2 $[_{S}$ NP-ga $[_{VP}$ gap_1 $[_{V'}$ gap_2 V]]]]]

That study showed that prehead (before seeing a verb) reading times were delayed for the third noun phrase in both single- and double-scrambled sentences, each compared with canonical sentences. This result implies that native Japanese speakers construct phrasal syntactic structures

prior to encountering the head verb. However, while the posthead reading times (i.e., regression) did not differ between canonical and single-scrambled sentences, double-scrambled sentences showed posthead reading times that were significantly longer for all three noun phrases than they were in the other two sentential conditions. Thus, single-scrambled sentences that contain a single filler-gap dependency can be mostly resolved through prehead parsing in the third noun phrase whereas double-scrambled sentences containing two filler-gap dependencies require heavy post-head parsing. Using the eye-tracking method, Tamaoka et al. (2009) revealed the involvement of scrambling effects in the processing of grammatically and semantically simple sentences consisting of only four phrases. On the basis of their eye-tracking study, we assumed that the sentence correctness decision task measures all of these forward and backward readings for scrambled-order sentences that cannot be measured by the self-paced reading method. The present study used simple sentences constructed of four phrases, the same number of phrases per sentence as in the eye-tracking study of Tamaoka et al. (2009). Since all the nouns in the minimal-paired four-phrase sentences are the same, it can be assumed that the delay in processing speed found with scrambled sentences compared with canonical sentences is caused by differences in word order. Therefore, the sentence correctness decision task with whole sentence reading can be considered a reasonable method for measuring scrambling effects in simple sentences.[3]

4.2 Method

4.2.1 Participants Participants were 33 native speakers of Japanese (21 females and 12 males). Their ages ranged from 18 years and 11 months to 32 years and 8 months (average age 21 years and 10 months on the day of testing).

4.2.2 Materials Test items were 48 semantically plausible triplets such as those in (17), constructed using 48 VP adverbs (24 manner adverbs and 24 resultative adverbs). All the test items had the same format as the examples in (17). Using a Latin square design, they were distributed into three lists, each of which was then combined with 110 semantically plausible and implausible fillers, yielding three lists of 158 sentences each. Each list was presented to 11 participants, and each participant saw exactly one list.

4.2.3 Procedure The stimuli were presented to the participants in random order in the center of a computer screen. The participants were instructed to respond as quickly and accurately as possible in deciding whether or not the sentences made sense. They registered their responses by pressing either a ''Yes'' or a ''No'' button. The length of time between the appearance of a sentence on the screen and the pressing of a button was recorded as the response time.

4.2.4 Data Analysis The extremes among sentence correctness decision times (less than 400 and longer than 5,000 milliseconds) were recorded as missing values. Before the analysis was

[3] Although the details of phrasal processing for simple sentences were shown by the eye-tracking method using the sentence correctness decision task with whole sentence reading (Tamaoka et al. 2009), the present study used only the sentence correctness decision task, without measuring eye movements. The present study still has to make the assumption that overall reaction times for the task reflect the syntactic phrasal processing of filler-gap dependencies.

performed, reaction times outside of 2.5 standard deviations at both the high and low ranges were replaced by boundaries indicated at 2.5 standard deviations from the individual means of participants in each category. The statistical tests that follow analyze both subject (F_1) and item (F_2) variability. Only the stimulus items that evoked correct responses were used in the analyses of reaction times.

4.3 Results

The means of correct ''Yes'' reaction times and the error rates for sentence correctness decisions are presented in table 1. A series of one-way analyses of variance (ANOVAs) with repeated measures in the three different word orders were conducted on reaction times (milliseconds) and error rates (percentages) for sentences with VP adverbs (resultative adverbs and manner adverbs) by using subject (F_1) and item (F_2) variabilities. The experiment revealed significant main effects of word order on reaction times [$F_1(2, 64) = 13.911$, $p < .001$; $F_2(2, 94) = 4.280$, $p < .05$], but not on error rates [$F_1(2, 64) = 0.103$, $p = .902$; $F_2(2, 94) = 1.444$, $p = .241$]. When sentences with resultative adverbs and those with manner adverbs were analyzed separately, the same trends were found. Subsequent simple paired contrasts indicated that sentences with VP adverbs took longer to process in AOSV order than they did in OASV order [$F_1(1, 32) = 27.324$, $p < .001$; $F_2(1, 47) = 8.187$, $p < .01$] or in OSAV order [$F_1(1, 32) = 20.456$, $p < .01$; $F_2(1, 47) = 4.207$, $p < .05$]. The response latencies for OASV and OSAV orders did not differ significantly from each other [$F_1(1, 32) = 1.439$, $p = .239$; $F_2(1, 47) = 0.001$, $p = .970$] (figure 1).

Overall, transitive sentences in which the object precedes the subject took longer to process in the AOSV word order than they did in the OASV and OSAV orders, and the processing times for the latter two were comparable, as indicated in (23).

(23) *Overall reaction times*
AOSV > OASV = OSAV

5 Discussion

There are two major competing syntactic analyses of the subject position in Japanese transitive sentences in which the subject is preceded by the object. Analysis 1 claims that the subject obligatorily moves to Spec,TP, as shown in (13) and (19), thereby predicting that sentences with

Table 1
Reaction times and error rates for OSV sentences with VP adverbs

Positions of adverbs	Reaction times (ms)		Error rates (%)	
	M	SD	M	SD
AOSV	1,695	259	2.55	3.92
OASV	1,550	253	2.92	4.26
OSAV	1,590	222	2.92	5.06

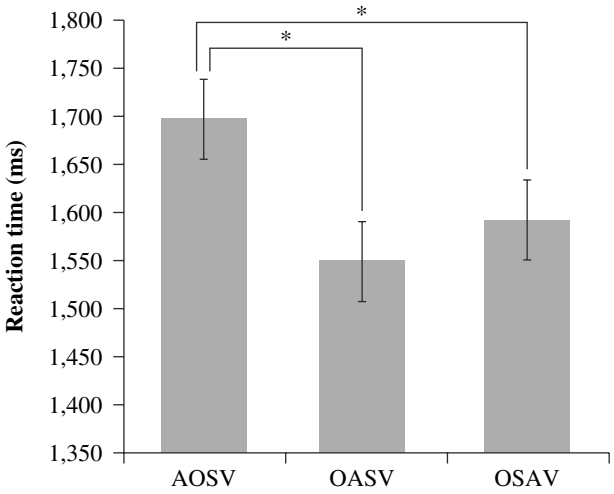

Figure 1
Histograms for the reaction times of the sentences with the AOSV, OASV, and OSAV word orders. The error bars indicate the standard error of the mean, and the asterisks denote $p < .05$.

VP adverbs take longer to process in AOSV and OASV word orders than in OSAV order. Analysis 2, in contrast, holds that the subject may stay in situ within the VP, as shown in (14), (20), and (21), leading to the expectation that AOSV is more difficult to process than OASV and OSAV, and that OASV is either as easy as OSAV (with Assumption 2a) or more difficult than OSAV (with Assumption 2b).

The overall results of the present experiment summarized in (23) are consistent with the prediction of Analysis 2 with Assumption 2a (i.e., (22b)) but not with the prediction of Analysis 2 with Assumption 2b (22c) or the prediction of Analysis 1 (22a). Most importantly, the OASV word order was significantly less difficult to process than the AOSV word order, contrary to the prediction of Analysis 1. This suggests that the subject of a Japanese transitive sentence may stay in the VP when it follows the object, as has been argued and defended in a series of papers by Miyagawa (e.g., Miyagawa 2001, 2003).[4] This, in turn, supports the central premise of the ISH, namely, that the base position of the external argument is within the VP rather than being outside the VP to begin with. Furthermore, the comparable reaction times for OASV and OSAV are

[4] One might object to this conclusion by pointing out that the observed heavier cost for AOSV compared with OASV could also be consistent with Analysis 1 if the distance factor in chain formation were taken into account: the adverb crosses O and S in AOSV, whereas in OASV, it crosses only S. This move, however, would lead to the incorrect prediction that OASV takes longer to process than OSAV, because in Analysis 1 the adverb crosses S in the former but crosses nothing in the latter.

consistent with Assumption 2a but not with Assumption 2b, indicating that VP adverbs can be initially merged to the left of the base position of the subject within the VP.

Thus far, it is evident that the subject of a transitive verb may stay in situ within the VP when it is preceded by the object, as schematically represented in (14). However, this by no means entails that the structure in (13), in which the subject as well as the object has moved out of the VP, is impossible to attain. On the contrary, there is good reason to believe that Japanese grammar allows not only the structure in (14) but also the structure in (13). Consider the following example:

(24) Kabin-o Taroo-ga [$_{T'}$ kinoo kowasita].
vase-ACC Taro-NOM yesterday broke
'Taro broke a vase yesterday.'

The subject in (24) occurs to the left of the TP adverb *kinoo* 'yesterday'. Assuming that TP adverbs occur in TP, this example suggests that the subject may move to TP (or a higher position) even if it is preceded by the object. Furthermore, the subject appears to be able to move even to MP, as suggested by (25), in which the subject precedes the MP adverb *zannennagara* 'unfortunately', which by hypothesis occurs in MP.

(25) Syoosin-o Taroo-ga [$_{M'}$ zannennagara zitaisita].
promotion-ACC Taro-NOM unfortunately refused
'Unfortunately Taro refused (an offer of) promotion.'

The analysis that the subject in sentences like (24) and (25) is located outside the VP is further supported by the fact that the subject *zen'in* 'all' cannot be inside the scope of negation when it occurs to the left of an MP or a TP adverb, as pointed out by Miyagawa (2001).

(26) Kono ronbun-o$_i$ zen'in-ga kinoo t_i yom-anakat-ta (yo/to omou).
this article-ACC$_i$ all-NOM yesterday t_i read-NEG-PAST
'This article, all did not read yesterday.' (??not > all, all > not)

(27) Kono ronbun-o$_i$ zen'in-ga saiwaini t_i yom-anakat-ta (yo/to omou).
this article-ACC$_i$ all-NOM fortunately t_i read-NEG-PAST
'This article, all did not fortunately read.' (*not > all, all > not)
(Miyagawa 2001:301)

In contrast, if an MP or a TP adverb is substituted for a VP adverb, the sentence becomes ambiguous between the partial negation reading and the total negation reading, as shown in (28).

(28) Kono ronbun-o$_i$ zen'in-ga yorokonde(wa) t_i yom-anakat-ta (yo/to omou).
this article-ACC$_i$ all-NOM happily t_i read-NEG-PAST
'This article, all didn't read happily.' (not > all, all > not)
(Miyagawa 2001:302)

This example is semantically ambiguous because it can be parsed either as in (29a), in which the subject has moved to Spec,TP (i.e., Analysis 1 in (13)), or as in (29b), in which the subject stays in the VP (i.e., Analysis 2 in (14)).

(29) a. $[_{TP}\ O_j\ S_i\ [[_{VP}\ t_i\ VP\text{-}A\ t_j\ V]\ Neg]\ T]$
b. $[_{TP}\ O_i\ [[_{VP}\ S\ VP\text{-}A\ t_i\ V]\ Neg]\ T]$

The structures in (29a) and (29b) are associated with the total negation reading and the partial negation reading, respectively. Similarly, the example provided in (16) is semantically ambiguous. On the basis of these examples, Miyagawa (2001) concludes that with respect to grammar, the subject in Japanese may or may not stay in the VP when it follows the object.

If the discussion in the previous paragraph is on the right path, the experimental materials, such as those in (17), must be structurally ambiguous as well. This implies that the sentences in (17) may be parsed either as in (19) or as in (20). For the sake of convenience, (17), (19), and (20) are repeated here, with some modifications, as (30), (31), and (32), respectively.

(30) a. *AOSV*
Yukkuri sinbun-o Taroo-ga yonda.
slowly newspaper-ACC Taro-NOM read
'Taro read a newspaper slowly.'
b. *OASV*
Sinbun-o yukkuri Taroo-ga yonda.
newspaper-ACC slowly Taro-NOM read
c. *OSAV*
Sinbun-o Taroo-ga yukkuri yonda.
newspaper-ACC Taro-NOM slowly read

(31) *Schematic structures of the sentences in (17) (= (30)) in Analysis 1 with Assumption 2a*
a. $[_{TP}\ A_i\ O\ S\ [_{VP}\ \ldots\ t_i\ \ldots\ V]]$
b. $[_{TP}\ O\ A_i\ S\ [_{VP}\ \ldots\ t_i\ \ldots\ V]]$
c. $[_{TP}\ O\ S\ [_{VP}\ \ldots\ A\ \ldots\ V]$

(32) *Schematic structures of the sentences in (17) (= (30)) in Analysis 2 with Assumption 2a*
a. $[_{TP}\ A_i\ O\ [_{VP}\ \ldots\ t_i\ S\ \ldots\ V]]$
b. $[_{TP}\ O\ [_{VP}\ \ldots\ A\ S\ \ldots\ V]]$
c. $[_{TP}\ O\ [_{VP}\ \ldots\ S\ A\ \ldots\ V]]$

We assume that the structures in (31a) and (32a) are both grammatically possible structures for the sentence in (30a) (and likewise for the (b) and (c) items), and we refer to this analysis as Analysis 2′. Analysis 2′ makes the same predictions as Analysis 2 with respect to the reaction times to sentences like those in (17) (= (30)) (i.e., AOSV > OASV = OSAV). This is because (31a–c) are structurally more complex than (32a–c), respectively, and because it is widely assumed in the sentence-processing literature that the human parser preferentially constructs simpler syntactic structures (e.g., (32a)) when the input (e.g., (30a)) and the grammar allow for multiple possibilities (e.g., (31a) and (32a)) (see, e.g., Frazier and Fodor 1978, Pritchett and Whitman 1995, Frazier and Clifton 1996, Gibson 1998, Hawkins 2004, Marantz 2005). This implies that although (31)

and (32) are both grammatically possible analyses of (30), the human parser is likely to construct the structures in (32) rather than those in (31) in the present experiment, in which the stimuli contain no explicit cues to the contrary. Thus, if we adopt Analysis 2′ instead of Analysis 2, the main conclusion remains the same—namely, that in Japanese, the subject may stay in the VP when it occurs to the right of the object.[5]

Thus far, we have been assuming that the subject always moves to Spec,TP in canonically ordered SOV sentences. However, there exists a differing view. In some versions of the ISH, the subject in Japanese stays within the VP throughout the derivation, regardless of whether it precedes or follows the object (Fukui 1986, Kuroda 1988). Although this proposal is not very widely accepted in the current literature, for the sake of completeness, we will consider whether or not it can account for the experimental results reported here. With respect to this particular version of the ISH, the discussion in section 2 needs to be reinterpreted in such a way that VP adverbs initially occur in ''the lower part of VP'' and TP adverbs, in ''the higher part of VP,'' as shown in (33).

(33) $[_{VP}$ (TP-A) S (TP-A) $[_{V'}$ (VP-A) O (VP-A) V]]

When the object undergoes scrambling as shown in (34), the subject stays in the same position as the subject in (33).

(34) O_i S $[_{V'}$ (VP-A) t_i (VP-A) V]

We will refer to this analysis as Analysis 3. In Analysis 3, the VP adverb occupies its canonical position in sentences with the OSAV word order, such as (17c), and the adverb has undergone scrambling in sentences with the AOSV order, such as (17a), and those with the OASV order, such as (17b), as indicated in (35). (The trace of the object is not represented.)

(35) *Schematic structures of the sentences in (17) in Analysis 3*
a. A_i O S $[_{V'} \ldots t_i \ldots$ V]
b. O A_i S $[_{V'} \ldots t_i \ldots$ V]
c. O S $[_{V'} \ldots$ A $\ldots$ V]

Since (35a) and (35b) involve scrambling and are therefore syntactically more complex than (35c), it is predicted that sentences with a VP adverb should be more difficult to process in the AOSV order and the OASV order than in the OSAV order.

(36) *Predicted processing load*
Analysis 3: AOSV = OASV > OSAV

[5] To put it the other way around, as pointed out by a reviewer, in constructions where the structures in (31) are forced or favored over those in (32), we would expect that the processing prediction of Analysis 1 (i.e., AOSV = OASV > OSAV) should be borne out. For example, in Miyagawa's (2001) approach, if the object is an anaphor, and the antecedent is the subject, the object would be in an Ā-position and the subject in Spec,TP, as in (31). Testing this prediction will be an important topic for future research.

The prediction of Analysis 3 shown in (36) is the same as the prediction of Analysis 1 shown in (22a), and it is crucially incompatible with the results of the experiment, reported in section 4. Therefore, Analysis 3 cannot account for the distribution of Japanese adverbs and their processing data. In other words, the subject of a transitive sentence in Japanese must move to Spec,TP when it precedes the object.

6 Conclusion

In this article, we have presented processing evidence for the hypothesis that the subject, or the external argument, of a transitive verb in Japanese overtly moves to Spec,TP when it precedes the object, but it may stay in situ within the VP when it follows the object. This, in turn, supports the central premise of the ISH, which states that the base position of the external argument is within the VP. A broader implication of this study is that sentence processing constitutes an important testing ground for the evaluation of competing linguistic hypotheses. Finally, the technique used in this study to investigate the syntactic positions of subjects and other sentential constituents in Japanese may be applicable to many free word order languages other than Japanese. This will hopefully contribute to the development of experimental syntax in nonconfigurational languages.

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(Koizumi)
Department of Linguistics
Graduate School of Arts and Letters
Tohoku University
27-1 Kawauchi Aoba-ku, Sendai
980-8576 Japan

koizumi@sal.tohoku.ac.jp

(Tamaoka)
Graduate School of Languages and Cultures
Nagoya University
Furo-cho, Chikusa-ku, Nagoya
464-8601 Japan

ktamaoka@lang.nagoya-u.ac.jp