ASYMMETRY IN LINGUISTIC DEPENDENCY: LINGUISTIC AND PSYCHOPHYSIOLOGICAL STUDIES OF JAPANESE RIGHT DISLOCATION

TAKAHIRO SOSHI and HIROKO HAGIWARA
Tokyo Metropolitan University

On the basis of the notion of the argument/adjunct asymmetry in syntactic derivation, it will be argued that Japanese right dislocation constructions should be divided into two types, based on the argument/adjunct distinction of the dislocated element. This argument is also examined through an event-related brain potential (ERP) study. We will report that dislocated arguments elicit the left dominant positivity. On the basis of previous ERP studies of language processing, it will be argued that this left dominant positivity effect reflects a syntactic integration, and that this result supports our asymmetrical analysis of Japanese right dislocation constructions.*

Keywords: right dislocation, argument and adjunct asymmetry, ERP, P600

1. Introduction

The first half of this paper investigates the syntactic structure of the Japanese right dislocation construction (JRDC), as exemplified below in (1). The latter half presents a psychophysiological study of the JRDC, utilizing event-related brain potentials (ERPs), namely, brain electrical activities time-locked to human cognitive processes, recorded from the

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scalp.

(1) a. **konsato-de Hanako-ga hiku-yo, cero-o.**
concert-in Hanako-Nom play-P(article) cello-Acc
‘Hanako plays the cello in a concert.’
b. **Hanako-ga chero-o hiku-yo, konsato-de.**
Hanako-Nom cello-Acc play-P concert-in
‘Hanako plays the cello in a concert.’

Previous structural analyses of the JRDC can be divided into two types. One is a movement analysis, subdivided into a rightward movement analysis (for example, Endo (1989), Murayama (1999)) and a leftward movement analysis (Abe (1999), Tanaka (2001)). Another is a base-generation analysis (Inoue (1978), Kuno (1978)). While our standpoint belongs to the base-generation group, our analysis goes beyond their analysis, arguing that (1a) and (1b) have distinct underlying representations, depending on the differentiation between the dislocated categories. On the assumption that arguments and adjuncts show asymmetry in syntactic operations, (see Lebeaux (1988), Hasegawa (1996), among others), it will be claimed that sentence (1a) must involve an empty category, assumed to be pro, corresponding with the dislocated NP chero-o ‘cello-Acc’ in the complement position of the verb hiku ‘play.’ On the other hand, sentence (1b) will not be required to have a pro co-indexed with the PP konsato-de ‘in a concert.’ Consequently, (1a) and (1b) will have different syntactic representations, and will be interpreted by distinct processes. Although our analysis introduces a dissociation of the syntactic structures of the JRDCs, the distinction remains grounded in the prevalent theoretical assumptions of argument/adjunct asymmetry.

1 Although Inoue (1978) and Kuno (1978) assume that JRDCs are not derived by movement, they do not propose structural analyses of JRDCs. Inoue (1978) notes that the JRDC permits adjuncts to be dislocated to the right, while not arguing that the JRDC of an adjunct has a syntactic structure different from that of an argument. Kuno (1978), on the other hand, claims that the non-dislocated part of the JRDC involves a deletion process, but does not mention whether or not a deleted constituent is structurally represented. Therefore, it is difficult to claim that they do not distinguish between JRDCs of arguments and adjuncts.
The ERP study of the JRDC in the latter half of this paper is also devoted to verifying the theoretical claim mentioned above.

One of main interests in recent ERP studies for human language processing is a late positive component called the P600, which reaches its peak about 600ms after the onset of the stimuli. This ERP component is assumed to reflect several linguistic processes, in which there is an integration process of a filler-gap dependency between a dislocated element and a gap or an empty category (Kaan et al. (2000)). The notion of the filler-gap dependency includes not only a relation between a linguistically moved element and a trace, but also one between a base-generated overt element and its corresponding covert constituent such as pro (Clifton and Frazier (1989)). Given that our theoretical analysis contains filler-gap dependencies in right dislocation of arguments, but not of adjuncts, an ERP investigation of JRDCs would add a significant argument to ERP research on the P600. Although P600s are reported to be mainly distributed in centro-parietal scalp areas, recent studies of this component argue that they are modulated by distinct linguistic processes, and are distributed in different scalp areas (Friederici et al. (2002), Kaan and Swabb (2003)). If two types of dislocated categories in JRDCs elicit distinct ERP components or P600s with different scalp distributions, our study would provide support for the possibility that P600s are not monolithic components, but consist of several distinct components (Friederici et al. (2001)). Additionally, the theoretical analysis of the JRDC will also be supported by an ERP study.

This paper attempts to explore a correspondence between linguistic analysis and ERP studies, being organized as follows: in the former part, from section 2 to 3, a linguistic theoretical analysis of the JRDC is first developed, and the latter part, from section 4 to 8, is devoted to the ERP investigation of JRDCs. Section 9 provides a general conclusion to this paper.

2. A Linguistic Study of the Japanese Right Dislocation Construction

2.1. Previous Analyses and Their Problems

In this section, two movement analyses of the JRDC are reviewed, and problematic examples for them are critically examined.


Endo (1989) claims that JRDCs are derived by rightward movement,
as shown in (2):²

(2) \[ S' [S' \ldots \ldots \cdot t_1 \ldots \ldots \cdot] [XP_1]]

Endo (1989) assumes that the right dislocated phrase XP is first base-generated inside \( S' \), and is successive-cyclically moved to the right peripheral position, adjoined to \( S' \).

The theoretical and empirical foundation of her analysis is that JRDCs obey the Subjacency condition, as exemplified in (3): (henceforth, dislocated constituents will be italicized.)

(3) a. soko-ni \([NP_1 t_1 \text{ wain}}]-\text{ga aru-yo, } [S_1 [NP_2 [S_2 there-in wine-Nom exist-P}
  \text{tonari-ni hikkoshiteki-ta} \text{ isha]-ga motteki-ta}_i]
next door-in move-Past doctor-Nom bring-Past
‘There is wine (which) the doctor (who) moved in next door brought.’

b. *soko-ni \([NP_1 [S_1 [NP_2 t_1 \text{ isha}-\text{ga motte-ki-ta}] \text{ wain}}]-\text{ga aru-yo,} [S_2 tonari-ni hikkoshi-te-ki-ta}_i]
‘There is wine (which) the doctor (who) moved in next door brought.’

c. *\([NP_S \text{ Ken-ga } t_i \text{ hanashite-ta }] \text{ eiga]-o mi-ta-yo,}
Ken-Nom was talking-Past movie-Acc see-Past-P
\text{Mari-to}_i.
Mari-with
‘(I) saw the movie Ken was talking (about) with Mari.’

d. *\([NP_S [S t_i \text{ Mari-ga hiku}] \text{ kyoku]-o shi-tte-ru,}
Mari-Nom play piece-Acc know-P
\text{ashita}_i?
tomorrow
‘Do (you) know the piece Mari’s going to play tomorrow?’ (Endo (1989: 112–121))

Based on the assumption that \( NP \) and \( S' \) are bounding nodes for Japanese, Endo claims that the acceptability of the sentences in (3) can

² Endo (1989) does not use the term ‘dislocation,’ but ‘postposing.’ She also assumes that JRDCs are subdivided into several distinct types, and that one of them belongs to the Japanese postposing construction. In this paper, we use the term ‘dislocation,’ and not ‘postposing.’ On the other hand, traditional notations, e.g. \( S \) and \( S' \), are conveniently used, keeping to Endo’s. Since the aim of this paper is to argue that two types of JRDCs as in (1) have distinct syntactic representations, it could be said that the use of traditional notations has no significant effect on our claim.
be explained by the Subjacency condition. In sentence (3a), the entire embedded S’ is right-dislocated from the position inside NP1 to the sentence final position. This movement does not violate the Subjacency condition, because the right-dislocated S’1 only crosses one bounding node, NP1. In sentence (3b), on the contrary, the second embedded S’, base-generated inside NP2, moves across three bounding nodes, NP1, S’1 and NP2, violating the Subjacency condition. Sentences (3c) and (3d) also involve a violation of the Subjacency condition: both the NP Mari-to ‘with Mari’ and the nominal adverb ashita ‘tomorrow’ move from positions inside the relative clause, crossing the two bounding nodes. Both sentences, therefore, become unacceptable.

Observing such examples, it would seem appropriate to believe that the Subjacency condition is a crucial factor for the acceptability of the sentences in (3), and that JRDCs truly involve movement. However, let us examine the following examples.

(4) a. tomodachi-wa [S’ otoosan-ga [NP t_i sofuto]-o friend-Top father-Nom software-Acc ka-tte-kure-ta-to] i-tta-yo, Windouzu-no_i buy-Benefit-Past-Comp say-Past-P Windows-Gen(itive)
‘A friend said that his father bought Windows software for him.’

b. [NP [S’ [S Ken-ga t_i hanashi-te-iru]-no]-o mi-ta-yo, Ken-Nom is-speaking-Comp-Acc see-Past-P Mari-to_i Mari-with
‘(I) saw that Ken was speaking with Mari.’

(Endo (1989: 121))

c. soko-ni [NP1 [NP2 t_i isha]-ga sunde-ita there-in doctor-Nom used to live-Past ie]-ga aru-yo, kono-aida taiho-sare-ta_i house-Nom exist-P recently is-arrested-Past
‘There is the house where the doctor who was recently arrested used to live.’

d. minato-ni [NP1 [NP2 t_i daitoryo]-ga aiyou-shite-ita harbor-at president-Nom use-habitually-Past yotto]-ga arunda-yo, senjitsu ansatsu-sare-ta_i sailboat-ga exist-P the other day is-assassinated-Past
‘At the harbor, there is a sailboat (which) the president (who) was assassinated the other day used habitually.’
e. \([NP [S [S_t_i \text{Mari-ga hiku}] \text{kyoku-o shi-tte-ru}, \text{Mari-Nom play piece-Acc know-P} \text{ashita-no konsato-dei?} \text{tomorrow-Gen concert-in} \] \text{‘Do (you) know the piece Mari’s going to play in tomorrow’s concert?’}]

f. \(t_i \text{ima isogashii-nda, } [t_j \text{kyaku-ga kuru-kara}], \text{now busy-Copula visitor-Nom come-because ashita_j.} \text{tomorrow} \text{‘(I) am busy now because a visitor is coming tomorrow.’} \) (Endo (1989: 145))

g. \(\text{Taro-ga } t_i \text{itte-ta-yo, } [\text{Mari-ga } t_j \text{sagashi-teru-tte}], \text{Taro-Nom say-Past-P Mari-Nom is-looking for-Comp anata-no-koto-o_j. you-Acc} \text{‘Taro said that Mari was looking for you.’} \)

In (4a), the prenominal modifier \(\text{Windouzu-no ‘Windows’} \) moves from the position inside the NP to the sentence final position, crossing two bounding nodes. This movement violates the Subjacency condition, which should result in the unacceptability. The facts, however, are contrary to the prediction. Sentence (4b) also involves a violation of the Subjacency condition, because the phrase \(\text{Mari-to ‘with Mari’} \) crosses two bounding nodes, while being acceptable. Endo claims that the non-lexical complementizer \(\text{no ‘that’} \) is inserted later in the derivation, and that at the level of representation at which the Subjacency condition applies, the node \(S’ \) is invisible to this condition. Although we admit that non-lexical complementizers without strong semantic content do not block the linking between right-dislocated elements and empty categories, it is unclear whether or not a non-lexical complementizer undergoes late insertion. It is obvious that a non-lexical complementizer selects \(S \), and therefore, is required to be obligatorily merged with \(S \) in the derivation. A complementizer or the projection \(S’ \) certainly appears at the stage where rightward movement takes place, which would induce the violation of the Subjacency condition.

Sentences (4c) and (4d) are examples comparable with Endo’s (3b). Although both dislocated relative clauses in (4c) and (4d) also move from inside complex NPs, (4c) and (4d), in contrast to (3b), sound more natural. It is suspected that the recovery of acceptability in both
(4c) and (4d) comes from the properties of the predicates placed inside the upper non-dislocated relative clauses. Both *sunde-ita* ‘used to live’ and *aiyou-shite-ita* ‘use habitually’ express a customary state, and provide a habitual property to the NPs modified by the relative clauses which include them, i.e., the two NPs are characterized by the relative clauses. It will be described in section 3 how this functional factor operates in the modification of adjunct relative clauses.

The example (4e) shares the same syntactic structure as (3d), but it seems to be quite acceptable. The difference between (3d) and (4e) lies in the distinct properties of the dislocated adverbials. In (3d), where the time adverbial is dislocated, it can modify the embedded verb *hiku*, and is also semantically consistent with the verb *shi-tte-ru* ‘know’ with the particle *te-iru* denoting a stative reading. Consequently, the matrix verb *shi-tte-ru* is the closest modifiee of the dislocated adverbial, blocking a modification relation between the embedded verb *hiku* and the dislocated adverbial. In (4e), on the other hand, the matrix verb *shi-tte-ru* cannot be modified by the dislocated locative adverbial *ashita-no konsato-de* ‘tomorrow’s concert,’ and does not prevent the verb *hiku* from being modified by *ashita-no konsato-de*. If the matrix verb *shi-tte-ru* is replaced with the verb *shi-tta* ‘knew,’ denoting a change-of-state, the locative adverbial *konsato-de* can modify the matrix verb, which induces the unacceptability, as seen in (5):

(5) *[NP [S' [S ti Mari-ga hiku]] kyoku]-o shi-tta-no, konsato-dei? konsato-dei?
Mari-Nom play piece-Acc know-Past-Q
concert-in
‘Did (you) know the piece Mari’s going to play in the concert?’

As will be argued in section 3, we will assume that a fundamental factor in the unacceptability of the right dislocation of adjuncts results from a blocking effect of a closer modifiee.

The last two examples (4f) and (4g) involve the operation of multiple right dislocation. In (4f), the adverbial clause *kyaku-ga kuru kara* ‘because a visitor is coming’ is firstly right-dislocated and adjoined to the matrix clause, and secondly, the adverbial *ashita ‘tomorrow’* is moved from inside the dislocated clause to the sentence final position. If JRDCs are considered to be derived by rightward movement, it is necessary to assume that (4f) includes two such steps of rightward movement to positions adjoined to the matrix clause, because JRDCs do
not permit dislocation inside an embedded clause, as confirmed by the evidence for the root phenomenon in (6):

(6) *[kyaku-ga kuru kara, ashita] ima isogashii-nda.
    visitor-Nom come because tomorrow now busy-Copula
    ‘(I) am busy now because a visitor is coming tomorrow.’

The argument immediately above also applies to (4g). Although the derivations in (4f) and (4g) do not involve a violation of the Subjacency condition, the second movement would violate the Frozen Structure Constraint (Ross (1986: 173)). This constraint claims that any element cannot move out of an extraposed clause. As long as this traditional constraint for movement is adequate as a descriptive generalization, (4f) and (4g) would be considered to be problematic examples for the rightward movement analysis.


Abe (1999) and Tanaka (2001) present similar analyses for JRDCs. They assume that JRDCs are not derived by rightward movement. Under their analyses, a sentence is represented repeatedly, as shown in (7b), and the NP Mary-o ‘Mary-Acc’ in the second sentence in (7b) moves leftward. The rest of the second sentence is then deleted.

(7) a. John-wa hihan-shi-ta, Mary-o.
    John-Top criticize-Past Mary-Acc
    ‘John criticized Mary.’

b. [John-wa pro; hihan-shi-ta] [Mary-o [John-wa ti hihan-
   shi-ta]]
   (Abe (1999: 6))

The advantage of this analysis is that movement phenomena can be taken to be uniformly leftward, and that the Island sensitivity of JRDCs are also explained. However, their analyses, as well as the rightward movement analysis, suffer from some empirical problems hard to solve. Let us examine the following examples.

(8) a. Taro-wa [Yankiisu-de pro; ichiban-da-to]
    Taro-Top Yankees-in best player-Copula-Comp
    omo-tte-iru-yo, Matsui-gai.
    think-P Matsui-Nom

3 Another advantage of the leftward movement analysis is that the value of the head parameter in Japanese is preserved (Abe (1999: 2)). Under our analysis, this theoretical problem remains unsolved because base generation of dislocated elements in post-head positions is inevitable, violating the head parameter value.
‘Taro thinks that Matsui is the best player in Yankees.’

b. Taro-wa Hanako-ni koukana tokei-o age-ta-yo,
   Taro-Top Hanako-Dat expensive watch-Acc give-Past-P
   Doitsu-sei-no.
   German-made-Gen

‘Taro gave Mary an expensive German-made watch.’

Although Tanaka (2001) claims that long-distance scrambling of a subject is not permitted in the JRDC as in (9a), our examples (9b) and (9c) as well as (8a) seem to be acceptable.

(9)  a. ?*Mary-ga oishii-to i-tta-yo, sono-okashi-ga.
   Mary-Nom good-Comp say-Past-P the-sweet-Nom
   ‘Mary said that the sweet is good.’ (Tanaka (2001: 571))
   a'. [S'1 Mary-ga proi oishii-to i-tta-yo], [S'2 sono-okashi-ga
       [Mary-ga ti oishii-to i-tta-yo]]
   b. Mary-ga [tabemono-no-nakade proi ichiban oishii-to]
      Mary-Nom food-P-among best-Comp
      itte-ta-yo, Uonuma-san-no okome-ga,
      say-Past-P Uonuma-made rice-Nom
      ‘Mary said that the Uonuma-made rice is the best
      among all types of food.’
   c. kantoku-ga [kondo-no-shiai-wa zettai-ni proi katsu-to]
      manager-Nom next-game-Top absolutely win-Comp
      itte-ta-yo, Nihon-ga,
      say-Past-P Japan-Nom
      ‘The manager said that in the next game Japan would
      absolutely win.’

Tanaka claims that the unacceptability of (9a) comes from the deviancy of the sentence in (9a'). It is generally accepted that long-distance leftward scrambling of a subject is barred in Japanese. The second sentence in (9a') involves long-distance scrambling of the embedded subject sono-okashi-ga ‘the sweet-Nom,’ which is assumed to induce the unacceptability of the entire sentence. Let us now turn to our examples (9b) and (9c). The derivations of (9b) and (9c) are considered to involve (10a) and (10b) as their second sentence.

(10)  a. *Uonumsan-no okome-ga, Mary-ga [tabemono-no-nakade ti
      ichiban oishii-to] i-tte-ta-yo.
   b. *Nihon-ga, kantoku-ga [kondo-no-shiai-wa ti zettai-ni
      katsu-to] i-tte-ta-yo.

The unacceptability of the sentences in (10) is caused by long-distance
leftward scrambling of embedded subjects. If (9b) and (9c) were assumed to be derived by the non-preferred leftward scrambling as in (10a) and (10b), the acceptable status of (9b) and (9c) could not be easily explained under the leftward movement analysis.

The argument above also applies to (8b), reproduced in (11) for the sake of convenience:

(11) Taro-wa Hanako-ni koukana tokei-o age-ta-yo, Doitsu-sei-no.
The derivation of (11) is assumed to be as follows:

(12) \[ S'1 \text{Taro-wa Hanako-ni [NP koukana pro, tokei]-o age-ta-yo}, \]
\[ S'2 [Doitsu-sei-no], \text{Taro-wa Hanako-ni [NP koukana t, tokei]} \]
\[-o age-ta-yo] \]

The putative second sentence S’2 in (12) is deviant, whereas the entire sentence in (11) is perfectly acceptable. This discrepancy suggests that (11) is not derived by leftward movement in the second clause in (12).

Another problem is whether the matrix clause in (11) includes a pro corresponding to the prenominal modifier Doitsu-sei-no ‘German-made-Gen.’ The noun tokei ‘watch,’ contrary to a deverbal nominal, e.g. hakai ‘destruction,’ is not a θ-role assigner. If a noun head assigns a θ-role to a genitive phrase, pro seems to be generated inside the NP as seen in the following discourse context.

(13) A: daitoryo-ga [NP Tokyo-no hakai]-o
  president-Nom Tokyo-Gen destruction-Acc
  meiji-ta-rashii-ne?
  order-Past-seem-Q
  ‘Didn’t the president seem to have ordered Tokyo’s destruction?’

B: sou-nanda, tsuini [pro hakai]-o meiji-ta-nda.
  yes-Copula, finally destruction-Acc order-Past-P.
  ‘Yes, (the president) finally ordered the destruction.’

Although the NP hakai-o in (13B) does not contain an overt prenominal modifier, the interpretation, on the basis of the preceding utterance (13A), could be equal to Tokyo-no hakai ‘Tokyo’s destruction.’ We would claim that existence of pro makes such an interpretation possible. To further examine this argument, let us observe the following example in which a prenominal modifier is not assigned a θ-role.

(14) A: Taro-ni [NP Doitsu-sei-no tokei]-o
  Taro-from German-made-Gen watch-Acc
mora-tta-natte?
receive-Past-Q
‘Did (you) receive a German-made watch from Taro?’
B: *sou-nanda, [NP tokei]-o mora-tta-nda.
yes-copula watch-Acc receive-Past-P
‘Yes, (I) received a watch (from Taro).’

From a functional point of view, it could be claimed that the unacceptability of (14B) is attributed to the deletion of the modifier Doitsu-sei-no denoting more important information (Kuno (1978)). From a structural point of view, (14B) has two possible syntactic representations: one is a structure with pro corresponding to the modifier Doitsu-sei-no, and another is one without pro. On the assumption that pro was presented in (14B), and had the discourse referent of Doitsu-sei-no, it would be predicted that (14B) is as acceptable as (13B). If we assume, on the other hand, that pro is not represented in (14B), the NP tokei cannot be interpreted as Doitsu-sei-no tokei-o. This amounts to a violation of Kuno’s functional constraint, i.e. deletion of more important information. These arguments show that a prenominal modifier which is not assigned a θ-role has not its corresponding pro.

3. An Alternative Analysis and an Explanation

In section 2.1, it was pointed out that both rightward and the leftward movement analyses have several empirical problems which are not easy to solve. In this section, we will propose an alternative analysis. Our analysis assumes different structure for two types of JRDCs. Section 3.1 presents the conceptual grounds for our analysis, followed by a proposed condition on JRDCs involving arguments and adjuncts in section 3.2. Section 3.3 attempts to explain the empirical problems that the two movement analyses could not account for.

3.1. The Conceptual Grounds

As was mentioned in section 1, two types of representations have been posited for JRDCs, as shown in (15):

(15) a. Right Dislocation of an Argument
[[s′ . . . proi . . . ] [XP_i]]
b. Right Dislocation of an Adjunct
[[s′ . . . . . . . . . ] [XP]]

Although right-dislocated arguments and adjuncts indicated by XPs in
(15) are similarly base-adjoined to sentence final positions, the JRDC of an argument involves a pro co-indexed with a right dislocated argument, as in (15a). On the other hand, the counterpart of an adjunct does not have a pro inside the matrix clause. This analysis is based on the notion of the argument/adjunct asymmetry in syntactic derivations.

Lebeaux (1988) develops a theory of argument/adjunct asymmetry in phrase structure building. He distinguishes two licensing conditions of linguistic elements, as in (16):

(16) a. If $\alpha$ is licensed by theta theory, it must be so licensed at all levels of representation.

b. If $\alpha$ is not licensed by theta theory, it need not be licensed at all levels of representation.

(Lebeaux (1988: 137))

The former condition is taken to be a natural consequence of the Projection Principle (PP): selectional information of a head must hold at all syntactic levels. The latter condition, on the other hand, only claims that linguistic elements may be licensed at some stage of the derivation. The distinction between the two conditions in (16) affects derivational operations of arguments and adjuncts. Arguments are

4 One of the problems of the base generation analysis as well as the rightward movement analysis concerns the position where the dislocated element is placed. If a dislocated element is adjoined to the matrix clause, it c-commands a constituent inside the matrix clause. Therefore, under binding theory, the unacceptability of the example in (i) cannot be explained because (i), in which a dislocated phrase is outside the c-command domain of a co-referenced pronoun, is unacceptable.

(i) *Karei-wa [anata-ga John-ni kaita tegami]-o Mary-ni miseta.

he-Top Mary-Dat showed you-Nom John-Dat wrote letter-Acc

'He showed Mary the letter you wrote to John.'

(Abe (1999: 25))

It is obvious that the c-command requirement in condition C is a necessary condition, as can be understood by comparison between (iia) and (iib).


b. [anata-ga John-ni kaita tegami]-o karei-wa Mary-ni miseta.

However, let us observe the following examples in (iii):

(iii) a. ??[pro John-ni kaita tegami]-o karei-wa Mary-ni miseta.

b. *[John-eno tegami]-o karei-wa Mary-ni miseta.

Although the constituents involving the R-expression John is outside the c-command domain of the pronoun kare, the sentences in (iii) are unacceptable. This fact shows that the c-command requirement is not a necessary and sufficient condition. Consequently, the unacceptability of (i) does not necessarily support the argument that the dislocated element is within the c-command domain of the pronoun in the matrix clause, but not is adjoined to the matrix clause.
selected by heads, and therefore, are obligatorily inserted at an early stage of the derivation. On the other hand, adjuncts are not selected by any head, and thus need not be obligatorily inserted into phrase structure.

Ishii (1998) reexamines the notion of argument/adjunct asymmetry in syntactic derivation in the minimalist framework, and proposes the following restriction.

(17) *Derivational Selectional Restriction (DSR)*

Satisfy selectional restrictions as early as possible

(Ishii (1998: 31))

According to restriction (17), an argument, selected by a selector, must be merged with it, whereas an adjunct, not selected by any head, is inserted into phrase structure after all selectional restrictions are derivationally satisfied by Merger. Consequently, the restriction in (17) implies that Merger of an adjunct must be post-cyclic.\(^5\)

Ishii’s theory provides motivation for our analysis. Let us first examine the derivation of arguments of JRDCs. If pro were merged with its selector at some later stage of the derivation where the selector has already become a part of a large structure, such a derivation would violate the DSR. Therefore, pro needs to be cyclically inserted into a local position of a selector, showing that JRDCs of arguments do in fact involve pro inside the matrix clause. With regard to the adjuncts of JRDCs, on the other hand, the assumption that dislocated adjuncts have a corresponding pro invites a theoretical problem. Let us suppose some derivational stage where a dislocated overt adjunct and pro remain

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\(^5\) Stepanov (1999) also presents a strong version of the argument/adjunct asymmetry in structure building. Stepanov, on the basis of the argument in Chomsky (2000), posits a basic condition on structure building, defined in (i):

(i) *Least Tampering*

Given a choice of operations applying to a syntactic object labeled \( \alpha \), select one that does not change \( @(\alpha) \).

\( @(X) \) - a set of c-command relations in a syntactic object labeled X.

(Stepanov (1999: 7))

Presupposing the definition of c-command as the notion of the first branching node in Reinhart (1976), he claims that from the condition in (i), Merger at the root is selected, rather than merger inside a phrase marker or post-cyclic adjunction. The reason lies in that Merger inside a phrase marker changes the existing c-command relation, violating condition (i), and that if Merger is further applied to structures built by cyclic adjunction, a new c-command relation of an adjunct category and a segment category are added to the existent set of structural relations.
unmerged, while all other selectional restrictions have been satisfied by cyclic Merger. Although the overt adjunct and pro must be inserted into some position in the phrase structure, there is no reason that the former, but not the latter, is necessarily required to be adjoined to the right peripheral or ‘dislocated’ position. There are other possibilities, for instance, that the overt adjunct and pro are both base-adjoined to the matrix clause, and stay in that position, or that they are both slotted into some projection inside the matrix clause. That is, the next stage of the derivation has four options, as shown in (18), which could not be determined in an unambiguous way.

\[
\begin{align*}
18 & \\
& a. \ [s' [s' [proi] \ [XPi]]] \\
& b. \ [s' [s' [XPi] \ [proi]]] \\
& c. \ [s' [s' \ [proi] \ [XPi]]] \\
& d. \ [s' \ [proi] \ [XPi]]
\end{align*}
\]

On the other hand, with the assumption that JRDCs of adjuncts do not include pro, and that dislocated adjuncts are not post-cyclically hooked up to some position inside the matrix clause, the derivation of JRDCs of adjuncts is determined in an unambiguous way; a desirable consequence which supports our argument that pro is not included in JRDCs of adjuncts.

3.2. The Unambiguous Modification Condition

In the previous subsection, it was argued that on the basis of theoretical claims about argument/adjunct asymmetry in structure building, JRDCs of arguments and those of adjuncts had distinct syntactic representations. Now, the question arises about how exactly dislocated arguments and adjuncts are licensed or interpreted. It will be argued, in particular, that dislocated adjuncts are licensed by modification which is constrained by the Unambiguous Modification Condition (UMC), the properties of which are described below, followed by its definition in (20).

Let us first observe the following paradigm for the purpose of outline-
ing the basic properties of the UMC.\footnote{We are indebted to Heizo Nakajima for the paradigm in (19), and to Hiroshi Hasegawa for indispensable comments on the UMC.}

(19) a. \([\text{NP \[shushou-ga Hanako-ni a-tta-toiu\]}\]

prime minister-Nom Hanako-with meet-Past-Comp
uwasa]-wa tashika-da-yo,
rumor-Top certain-Copula-P
Shinbashi-no ryoutei-de.

Shinbashi-Gen Japanese-style restaurant-at
‘The rumor that the prime minister met with Hanako at a Japanese-style restaurant in Shinbashi is certain.’

b. \([\text{NP \[shushou-ga kinou attei-ta] josei]-o\}

prime minister-Nom yesterday meet-Past woman-Acc
shi-tte-ru-yo, Shinbashi-no ryoutei-de.
know-P Shinbashi-Gen Japanese-style restaurant-at
‘(I) know the woman (whom) the prime minister met with at a Japanese-style restaurant in Shinbashi yesterday.’

c. *\([\text{NP \[shushou-ga kinou a-tta] josei]-o\}

prime minister-Nom yesterday meet-Past woman-Acc
mi-tanda-yo, Shinbashi-no ryoutei-de.
see-Past-P Shinbashi-Gen Japanese-style restaurant-at
‘(I) saw the woman (whom) the prime minister met with at a Japanese-style restaurant in Shinbashi yesterday.’

The three sentences in (19) are examples in which the dislocated locative adverbials modify embedded verbs in complex NPs. As was mentioned in our argument concerning (4e) in section 2.1, the difference of acceptability between both (19a) and (19b) and (19c) seems to come from the distinct properties of the predicates in the matrix clause. In (19a), the locative adverbial Shinbashi-no ryoutei-de ‘at a Japanese-style restaurant in Shinbashi’ is not consistent with the epistemic modal adjective tashika ‘certain,’ so the adverbial can ‘skip’ the adjective tashika and modify the embedded verb a-tta ‘met.’ The same argument also applies to the example (19b). In (19c), on the other hand, the locative adverbial can modify not only the verb in the embedded clause, but also the one in the matrix clause. The intervention of the matrix
verb blocks modification of the embedded verb by the dislocated adver-
bial. It can be claimed from this observation that the difference of
acceptability among the three examples in (19) depends on which ele-
ment the closest possible modifiee is. Therefore, a condition on JRDCs
of adjuncts is defined as follows:

(20) The Unambiguous Modification Condition (UMC)
Modify the closest ‘possible’ modifiee

This condition seems to inevitably operate in the establishment of a
modification relation between a dislocated adjunct and its host, even
when being provided with a discourse context, as shown in the follow-
ing examples in which the unacceptability of (19c) is not improved.

(21) A: [[shusho-ga kinou Shinbashi-no ryoutei-de a-tta] josei]-o
mi-tanda-tte?
B: *sounanda, [[shusho-ga kinou a-tta] josei-o mi-tanda-yo,
Shinbashi-no ryoutei-de].

Syntactic co-indexation in JRDCs of arguments, on the other hand, is
not affected by the factor of closeness which is imposed on JRDCs of
adjuncts, as demonstrated in the following example.

(22) [pro\textsubscript{i} kaze-o hii-ta-node] pro\textsubscript{i} gakko-o
cold-Acc catch-Past-because school-Acc
yasumi-da-yo, Taro-wa\textsubscript{i}
absent-Copula-P Taro-Top

‘Because (Taro) caught a cold, (Taro) is absent from school.’

The dislocated argument Taro ‘Taro’ in (22) needs to be simultaneously
co-indexed with each pro. In other words, the dislocated argument
does not need to be unambiguously co-indexed with the closest pro.
This example shows that JRDCs of arguments are free from the restric-
tion imposed on the counterparts of adjuncts. Let us observe other
examples to further examine the properties of JRDCs of arguments.

(23) A: kimii-ga Taro-ni hanronsuru-no-wa naze?
you-Top Taro-to object-Comp-Top why
‘Why do you object to Taro?’
B: [pro\textsubscript{i} sugu monku-o iu-kara] pro
often complaint-Acc say-because
hanronsurunda-yo, Taro-ga\textsubscript{i}
object-P Taro-Nom
‘Because Taro often complains, (I) object (to Taro).’

(24) A: Taro-ga boku-ni hanronsuru-no-wa naze?
Taro-Now me-to object-Comp-Top why
‘Why does Taro object to me?’
B: \[pro \text{sugu monku-o} \text{iu-kara} \] pro;
  \text{often complaint-Acc say-because}
  \text{hanronsurunda-yo, Taro-ga};
  \text{object-P Taro-Nom}
  ‘Because you often complain, (Taro) objects (to you).’

The utterances in (23B) and (24B) share the same surface form, but the argument Taro in each utterance can be co-indexed with a distinct pro. This suggests that on the basis of the preceding discourse context, syntactic co-indexation can chose a pro associated with the dislocated argument. These examples indicate that the ambiguity factor defined in the UMC is concerned solely with JRDCs of adjuncts.

Observing the paradigm in (19), we can easily understand the basic notion of ‘possible’ in the UMC. The following examples in (25), however, make the notion obscure.

\[(25)\]
\[a. \text{soko-ni} [\text{NP1} [S' [\text{NP2 isha-ga motte-ki-ta} \text{wain-ga aru-yo, tonari-ni hikkoshi-te-ki-ta}}] (=3b)]
\[b. \text{soko-ni} [\text{NP1} [S' [\text{NP2 isha-ga sunde-ita} \text{ie-ga aru-yo, kono-aida taiho-sare-ta.}}] (=4c)]
\[c. \text{minato-ni} [\text{NP1} [S' [\text{NP2 daitoryo-ga aiyou-shite-ita} \text{yotto-ga arunda-yo, senjitsu ansatsu-sare-ta.}}] (=4d)]

Since the dislocated relative clauses in (25) are adjuncts, they are considered not to have a corresponding pro. All of the NP2s in (25) are the closest hosts for the dislocated clauses, but there is difference of acceptability among the examples in (25). As was argued in section 2.1.1, the embedded verbs in (25b) and (25c), contrary to that of (25a), possess a habitual reading, and the embedded relative clauses S’ with the verbs in (25b) and (25c) can provide a habitual characterization to the modified NPs (see Takami (1995)). This characterization of the embedded relative clauses S’ in both (25b) and (25c) would make the host NP2 visible to the dislocated relative clauses.\(^8\) It could be said that the factor of characterization affects the transparency of modification, and that this functional factor is relevant to the notion of ‘possible’ in the UMC.

\(^8\) Although we claim that the habitual property of an embedded verb can establish characterization, information from the dislocated relative clause could also be considered to take part in a habitual characterization, as seen in (i):
This factor, on the other hand, would not operate in JRDCs of arguments, as observed below.

(26)  
   a. soko-ni [NP1 [S pro; motte-ki-ta] wain]-ga aru-yo, tonari-ni hikkoshi-te-ki-ta isha-ga_i,  
   b. soko-ni [NP1 [S pro; sunde-ita] ie]-ga aru-yo, kono-aida taiho-sare-ta isha-ga_i,  
   c. minato-ni [NP1 [S pro; aiyou-shite-ita] yotto]-ga arunda-yo, senjitsu ansatsu-sare-ta daitoryo-ga_i.

In the examples in (26), embedded subjects are dislocated, and have the corresponding pro inside the embedded relative clauses. The predicates in the embedded relative clauses are the same as those in (25), having the same properties of habitual characterization. Nevertheless, there is no difference in acceptability among the sentences in (26). It could be said that the functional factor of habitual characterization effectively operates in the satisfaction of the UMC in JRDCs of adjuncts, but not in the establishment of syntactic dependency between dislocated arguments and pro.

There is a factor which seems similar to the factor of closeness in the UMC, but should be distinguished from it. Let us observe the following example.

(27) *[Taro-ga matte-ru-kara] [yotei-o kae-te] iku-yo,  
     Taro-Nom wait-P-because schedule-Acc change-P go-P  
     gakko-de.  
     school-at  
     ‘Because Taro waits for (me) at school, (I) will change (my) schedule and go (to school).’

Both the clause yotei-o kae-te ‘(I) change (my) schedule’ and the verb iku ‘go’ cannot be modified by the dislocated adjunct gakko-de ‘at school.’ The verb matte-ru ‘wait for’ is the closest host of the dislocated adjunct gakko-de ‘at school,’ but (27) is unacceptable, which is outside our prediction. To solve this problem, let us examine the following example.

(28) [Taro-ga matte-ru-kara] iku-yo, gakko-de.

(i) Soko-ni [NP1 [S [NP2 isha]-ga mo-tte-ki-ta] wain]-ga aru-yo, senjitsu  
    the other day  
    nakuna-tta  
    die-Past
Example (28) sounds more acceptable than (27). The difference between (27) and (28) lies in the fact that (27), not (28), involves the additional constituent *yotei-o kae-te*. It is, therefore, suspected that the intervening constituent *yotei-o kae-te* induces the unacceptability of (27). When you have a connection between a dislocated element and a host, the latter must be held in working memory until the former appears. Retention of the host for a long duration would cause a parsing difficulty. The processing of example (27), therefore, requires more working memory resources since the host of the dislocated element is placed in a more remote position.

This parsing factor of distance should be distinguished from the notion of closeness in the UMC. The factor of closeness in the UMC is a notion specific to JRDCs of adjuncts. This factor is linguistically determined, and selectively functions for dislocated adjuncts. Let us observe example (29a), which has two interpretations presented in (29b) and (29c).

(29) a. Ken-ga Hanako-to yatteki-ta-no-o
     Ken-Nom Hanako-wity come-Past-Comp-Acc
tsutae-ta-yo, sensei-no-motoni.
report-Past-P teacher-Gen-to
b. ‘(I) reported to (my) teacher that Ken came with Hanako.’
c. ‘(I) reported (to someone) that Ken came with Hanako to (his) teacher.’

The dislocated element in (29) has an ambiguous status because it is an adjunct for the embedded verb *yatteki-ta ‘came,’* and on the other hand, is an argument for the matrix verb *tsutae-ta ‘reported.’* If the UMC indiscriminately operated for (29a), the interpretation in (29c) would not be available, because the matrix verb *tsutae-ta* is the closest host of the ambiguous dislocated element. However, the fact is the opposite. The availability of the interpretation in (29c), therefore, shows that the UMC selectively operates for the dislocated adjunct.

The parsing factor of distance, on the other hand, is taken as a general condition, since it is determined by working memory resources, and also operates in JRDCs of arguments, as shown in (30).

(30) a. [anata-ga *pro_1* shinjiru-koto]-ga hitsuyou-desu-yo,
     you-Nom believe-Comp-Nom necessary-Polite-P
sensei-o_i
     teacher-Acc
‘It is necessary that you believe in the teacher.’


‘It is necessary for improvement of the relationship that you believe in the teacher.’

Compared to (30a), (30b), both of which are examples of JRDCs of arguments, has an additional constituent kankei-o yokusuru-tameniwa ‘for improvement of the relationship,’ which requires the retention of the sentential subject for a longer duration. This parsing difficulty seems to decrease the acceptability of (30b).

From the argument above, it could be concluded that, although the parsing factor of distance is a seemingly similar notion to that of closeness in the UMC, the parsing factor of distance possesses a general property, which JRDCs of arguments and adjuncts are both constrained by, and that the UMC is a specific condition for JRDCs of adjuncts, as summarized in Table 1.

<table>
<thead>
<tr>
<th>Type</th>
<th>UMC</th>
<th>parsing (distance)</th>
</tr>
</thead>
<tbody>
<tr>
<td>JRDC of argument</td>
<td>×</td>
<td>○</td>
</tr>
<tr>
<td>JRDC of adjunct</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

3.3. An Explanation for the Remaining Examples

Before ending the theoretical part of this paper, we will provide an explanation for the remainder of the counterexamples for the two movement analyses in section 2.1, repeated below, with our analysis.9

(31) a. tomodachi-wa [s’ otoosan-ga [NP sofuto]-o ka-tte-kure-ta-to] i-tta-yo, Windouzu-no. (=4a))

b. [ima isogashii-nda], [kyaku-ga kuru-kara], ashita (=4f))

9 In connection with the examples in (31), we should examine the example in (3c), as repeated in (i).

(i) *[s [NP [s Ken-ga ti proj hanashi-te-ta] eigai]-o mi-ta-yo], Mari-toj. (=3c)

Example (31a) is not derived by a movement operation, being free from movement constraints. The dislocated modifier Windouzu-no in (31a) is an adjunct, having no corresponding pro inside the object NP. The acceptability of (31a), therefore, is determined by the UMC. A host modified by the dislocated modifier is confined to the NP sofuto. Therefore, the NP sofuto is the closest possible modifiee, which satisfies the UMC. The example (31a), therefore, is acceptable.

Example (31b) is one of multiple right dislocation. Under our analysis, it is predicted that (31b) is not relevant to movement constraints, e.g. the Frozen Structure Constraint, because it is not assumed to be derived by rightward or leftward movement. The acceptability of (31b), on the other hand, is considered to be determined by the UMC, since the two dislocated constituents are adjuncts. The host of the time adverbial ashita is the immediate preceding dislocated clause kyaku-ga kuru-kara, which is the closest modifiee. Consequently, (31b) is acceptable. This explanation is also confirmed by the following example.

(32) *[S [kyaku-ga kuru kara] ima isogashii-nda], ashita

(Endo (1989: 145))

Endo (1989) claims that the difference of acceptability between (31b) and (32) stems from the distance, i.e. a parsing factor, between the dislocated adverbial ashita and the host clause kyaku-ga kuru-kara.

This example is not a counterexample for movement analyses, since (3c) violates the Subjacency condition, which is correctly predicted to be unacceptable. Under our analysis, on the other hand, this example is explained in the following way: The parser does not necessarily posit pro inside the embedded relative clause in (i). The structure below (iia) is more likely because the embedded relative clause S’ is not assumed to involve pro denoting an unspecified person, which is likely to be optional. This claim is confirmed by the example (iib), in which the verb hanashi-te-ta cooccurs with hitori-de ‘by oneself.’

(ii) a. *[S [NP [S Ken-ga ti hanashi-te-ta] eiga]-o mi-ta-yo], Mari-to
    b. [[Ken-ga ti hitori-de hanashi-te-ta] eiga]-o mi-ta-yo, Mari-to.

If Mari-to needs to be associated with the verb hanashi-te-ta in (iia), the parser would be required to reanalyze the structure of the embedded relative clause. Since this reanalysis process induces the parsing difficulty, the example in (iia) would become unacceptable.
Under our analysis, the parsing factor of distance is distinguished from the notion of closeness in the UMC. The matrix predicate *isogashii* can be modified by the adverbial *ashita*, and is the closest modificiee blocking the modification relation between the embedded verb *kuru* and *ashita*. The unacceptability of (32), therefore, is determined by the UMC. This argument is also supported by the following example, which has the same distance between the dislocated adverbial and its host as that in (32).

(33)  
\[
\text{[s' [kyaku-ga kuru kara] totemo ureshii-nda], ashita} \\
glad-P \\
\]

'(I) am very glad because a visitor is coming tomorrow.'

Since the adjective *ureshii* 'glad' cannot be modified by *ashita*, it does not count as the closest host. Consequently, (33), which satisfies the UMC, is the acceptable.

In (31c), the dislocated element *Matsui-ga* 'Matsui-Nom' is an argument, and *pro* is involved inside the embedded *S*. The acceptability of (31c) is governed by the parsing factor of distance. The two constituents, i.e. *ichiban-da-to* 'best-Copula-Comp' and *omotteiru-yo* 'think-P', intervene between the dislocated argument and *pro* in (31c). These two predicates are necessary in (31c) since they are θ-role assigners. Therefore, it can be claimed that the distance between the dislocated argument and *pro* in (31c) is minimal, not yielding unacceptability.

To summarize the first part of this paper, JRDCs of arguments contain a *pro* co-indexed with the dislocated arguments, and the establishment of their co-indexation is also constrained by parsing factors. The counterparts of adjuncts, on the other hand, do not have a *pro* corresponding with the dislocated adjuncts. The licensing of the latter is constrained by the UMC as well as the parsing factor commonly applied to JRDCs of arguments.

In the following sections, the validity of the theoretical analyses will be verified physiologically, utilizing ERPs.

4. ERP Study of Japanese Right Dislocation Construction

A dependency relation between an antecedent (filler) and an empty category (gap), which is assumed to be characteristic of JRDCs of arguments, has been one of the main topics in recent ERP studies of human sentence processing. Two types of ERP components are reported to be
elicited by the processing of filler-gap dependencies. The first is a negativity distributed in the left anterior scalp sites. Since this negativity is elicited immediately after the appearance of the filler, continuing on to its associated gap position, it is called a sustained left anterior negativity (LAN) (Kluender and Kutas (1993), King and Kutas (1995), Fiebach et al. (2002), Ueno and Kluender (2003)). This sustained LAN effect is modulated by working memory span, interpreted to reflect the retaining of the filler in short-term working memory.

The second is a positive component, or a P600, elicited around a gap position, and is mainly distributed in the posterior sites at a latency after 500 ms post-stimulus. We will focus on this component in the present study. This ERP component, named by Osterhout and Holcomb (1992), is reported to be elicited by various linguistic tasks.10 It is generally claimed that linguistic processes related to a P600 are divided into three types (Friederici et al. (2002)). The first is a reanalysis or a revision process for an ambiguous grammatical sentence requiring an amendment from a preferred reading to a non-preferred one (e.g., *Die Frau hatte der Mann gesehen ‘the woman (ambiguous) had the man (subject) seen’; Frish et al. (2002)). The second is a repair process necessary when the parser encounters ungrammatical sentences (e.g., *what was a proof of criticized by the scientist?; Neville et al. (1991)). It is reported that these two processes elicit positivities with different scalp distributions (Friederici et al. (2002), cf. Kaan and Swab (2003)). A revision-related positivity has a frontal distribution, while a repair-related positivity is distributed in the centro-parietal region. Given that differences in topographic distribution suggest the involvement of different neural structures and thereby different functional processes (Rugg and Cole (1995)), this distributional difference is interpreted to show that P600s have distinct neurophysiological backgrounds.

10 P600s are reported to be elicited by several linguistic tasks or factors such as phrase structure violations (Neville et al. (1991)), agreement violations (Osterhout and Mobley (1995)), Subjacency violations (Kluender and Kutas (1993), McKinnon and Osterhout (1996), Neville et al. (1991)), ECP violations (McKinnon and Osterhout (1996)), ambiguous sentence-initial words (Frish et al. (2002)), garden-path sentences (Friederici et al. (1998), Frish et al. (2002)), syntactic revisions (Friederici et al. (2002)), thematic hierarchy revisions (Bornkessel et al. (2002)), and word meaning judgment tasks vs. sentential-fitting judgment tasks (Posner and Pavese (1998)).
reflecting differentiated linguistic functions.

The third process, which is closely related to our study, is integrating an additional input word into a current syntactic structure (Gibson (1998)). Kaan et al. (2000) conduct an experiment for the purpose of confirming that a P600 does in fact reflect an integration difficulty, using sentences exemplified in (34):

(34) a. Emily wondered who the performer in the concert had imitated for the audience’s amusement.

b. Emily wondered whether the performer in the concert had imitated a pop star for the audience’s amusement.

(Kaan et al. (2000: 164))

Since the Wh-phrase ‘who’ in (34a) needs to be assigned a θ-role, the parser predicts that a θ-role assigner such as a predicate will appear. This prediction is satisfied with the occurrence of the verb ‘imitated,’ and ‘who’ can be integrated into the current phrase structure. In the processing of sentence (34b), on the other hand, such expectation of a predicate is not necessary because ‘whether’ is not an element requiring a thematic role. On the basis of this notion, Kaan et al. (2000) compare the embedded verb ‘imitated’ in (34a) and (34b), and observe that the verb ‘imitated’ in (34a) elicits the P600 at posterior sites in the latency from 500 to 700 ms.

Accepting the interpretation in Kaan et al. (2000), Fiebach et al. (2002) also compares German sentences with an embedded object Wh-questions with those with embedded Whether-questions. They replicated the P600 at the pre-gap position in the Wh-questions. They conclude that a P600 reflects the syntactic integration cost whereby a filler is linked with a gap, and is integrated into a current phrase structure.

However, there is an experiment indicating that the P600 cannot be easily interpreted as an ERP index of a syntactic integration process. Haarmann et al. (2003) compare object Wh-question sentences involving semantically-related noun phrases, like in (35a), to those with semantically-unrelated noun phrases, as in (35b).

(35) a. What box did the pilot that entered the airport forget in the plane?

b. What box did the actor that entered the airport forget in the shop? (Haarmann (2003: 180))

The comparison between the main verbs in the related and unrelated conditions reveals that the positivity (in their terms, reduced negativity) for the unrelated condition in (35b) appears at bilateral posterior sites
from an early time window. In an electroencephalogram (EEG) coherence (the synchronization of neural activity) analysis of the same experimental data, Haarmann et al. (2002) also show that there is a significant coherence change in the 15.6 to 17.7 Hz band at the main verb 'forget' in the semantically-unrelated condition. They conclude that the filler-gap integration process strongly makes use of semantic working memory, consequently interpreted as semantic integration.

Although it is widely reported that a P600 in general is related to a syntactic process, there is a discrepancy in the interpretation of the integration process eliciting a P600, as reviewed above, i.e. a syntactic integration vs. a semantic integration. This discrepancy could partly result from the properties of the sentences used in the experiments. A comparison of matrix verbs as in (34) is surely a way to examine ERPs for processing syntactic filler-gap dependencies, but syntactic integration of the dislocated Wh-element 'who' in (34a) is also accompanied by semantic integration, i.e. the construction of a core propositional meaning, consisting of an argument and a predicate. Since the integration process taking place in (34a) is considered to involve both syntactic and semantic properties, it is likely that the manipulation of the semantic factor, as seen in (35), also modulates a P600. To examine the nature of P600 as an index of integration in more restricted way, it is necessary to differentiate syntactic and semantic factors as rigidly as possible. The two types of JRDCs examined thoroughly in the previous sections are an optimal way to control these two factors and investigate the sub-properties of a P600 component. Since JRDCs of arguments and adjuncts involve dislocated constituents connected with preceding hosts, it can be said that both require integration process. However, the difference lies in the fact that in JRDCs of arguments, integration is established through a syntactic co-indexation between a dislocated argument and its corresponding pro, whereas in JRDCs of adjuncts, integration is performed by the formation of a modification relation between the dislocated adjunct and its host, constrained by the UMC. Utilizing these two types of JRDCs, it may be possible to extract distinct positive components. Accordingly, we performed an ERP experiment on JRDCs, using a multichannel EEG system (NeuroScan, ESI128).

5. The Present Study

For the purpose of distinguishing a syntactic integration from a
semantic one, two types of JRDCs, schematically represented in (36), were compared.

(36)  

a. **Right Dislocation of an Argument (RD of AR)**

\[ S' [S' [YP \text{pro}_i Y]] XP_i \]

b. **Right Dislocation of an Adjunct (RD of AD)**

\[ S' [S' [YP Y]] XP \]

In (36a), a dislocated argument indicated by XP is integrated at gap (pro) positions inside a projection YP, headed by a \( \theta \)-role assigner Y, through syntactic co-indexation. In (36b), on the other hand, a dislocated adjunct is integrated by the semantic modification of the projection with the head Y which is not restricted to a \( \theta \)-role assigner. Both types of right dislocations, therefore, include distinct integration processes on the basis of different syntactic representations of the matrix clauses \( S' \).

Our predictions concerning the ERPs for the two types of dislocated phrases are: i) both types of dislocated categories, which are concerned with integration, will elicit P600s, and ii) on the basis of our theoretical analysis, they will be integrated by linguistically distinct processes, which will in turn elicit postivities with different scalp distributions.

6. Method

6.1. Participants

Thirteen right-handed university students (six females) between the ages of 18 to 24 (Mean=20.38, SD=2.06) participated in the experiment. Hand preference was tested on the basis of a revised version of the Edinburgh Handedness Inventory (Oldfield (1971), Negishi et al. (1990)). All were monolingual native speakers of Japanese, had normal or corrected-to-normal vision. Subjects gave written informed consent before the experiment. They were paid for their participation.

6.2. Materials

The two types of JRDCs used in the experiment are exemplified below.

(37) a. **RD of AR**

\[ \text{ane-wa} [\text{michibata-de guzen-ni mi-ta-to}] \]

sister-Top in the street accidentally see-Past-COMP

\[ \text{i-tta-yo}, \text{ tomodachi-ga haiyu-o.} \]

say-Past-P, friend-Nom actor-Acc

\[ \text{tomodachi-ga haiyu-o.} \]

say-Past-P, friend-Nom actor-Acc
(My) elder sister said that (her) friend accidentally saw an actor in the street.

b. RD of AD
[ane-wa [tomodachi-ga haiyu-o mi-ta-to] i-tta-yo], michibata-de guzenni.
‘(My) elder sister said that (her) friend accidentally saw an actor in the street.’

Both types of sentences as in (37) had seven words, consisted of a matrix clause and a subordinate clause, and shared the same propositional content. In (37a), two arguments of the embedded verb mi-ta ‘saw’ were dislocated into the sentence final position. In (37b), two adjunct phrases were dislocated, modifying the embedded verb backwardly.

One hundred experimental sentences were constructed for each type of construction. They were equally divided into two lists so that subjects did not see the same proposition twice. Furthermore, 135 filler sentences were added to both lists. The participants were randomly presented with either of the two lists, and viewed a total of 235 stimulus sentences. Each list was divided into 5 blocks, in which the stimuli were pseudo-randomly distributed so that the same type of experimental sentences did not successively appear three times.

For each stimulus sentence, an interrogative sentence partly restating it (e.g., ane-wa haiyu-o mi-ta? ‘Did (your) elder sister see an actor?’) was constructed for the purpose of monitoring whether or not participants correctly understood the content of the sentence. This interrogative sentence contained not only an argument, but also an adjunct for both elements to be paid equal attention to. The number of correct and incorrect questions was counterbalanced across all stimulus sentences.

6.3. Procedure
Each trial started with the presentation of a white box in the center of the screen for 2000 ms. This white box served as a fixation. Each word of the stimulus sentences was presented for 600 ms, and was separated by an interstimulus interval (ISI) of 300 ms. At the end of each sentence, punctuation marks separately appeared for 400 ms, followed by a blank screen for 1000 ms. In the sentence comprehension task, immediately following the blank screen, a question sentence was visuo-centrally presented in one frame until the participants responded by
pressing a button indicating yes or no.

6.4. Data Acquisition

The EEG was recorded from 123 Ag/AgCl scalp electrodes mounted on an elastic cap, referenced to linked mastoids. Eye movements and blink artifacts were monitored with 4 electrodes placed below and above each eye. An additional electrode was placed on the tip of the nose for the purpose of a supplementary reference, if required. The high-pass filter of the recording system was set to DC (time constant 0), and the low-pass filter was set to 70 Hz. The impedances of all the electrodes were kept below 5 kΩ through all of the trials. The EEG of each trial was continuously converted with a rate of 250 points/sec.

6.5. Data Analysis

ERPs of correct trials were computed for each subject and each experimental condition, starting 200 ms before and lasting 900 ms after the onset of the word. As shown in (38), eight critical phrases, indicated by tracery, were chosen to investigate the effects of the two types of right dislocation. The right dislocated arguments (AR2 and AR3) in (38a) were compared to the corresponding non-dislocated phrases in (38b), and the right dislocated adjuncts (AD1 and AD2) to the corresponding phrases in (38a). Individual averaged ERPs were computed by combining dislocated phrases (AR2 and AR3 in (38a) together, and AD1 and AD2 in (38b)) and non-dislocated ones (AR2 and AR3 in (38b), and AD1 and AD2 in (38a)). A comparison of the grand averaged ERP waveforms between the two types of phrases and a subtraction of the non-dislocated ERPs from their dislocated counterparts were performed to investigate the two types of right dislocation effects, as shown in Table 2.

(38) a. [AR1 [AD1 AD2 V1] V2] AR2 AR3 (RD of AR)  
    b. [AR1 [AR2 AR3 V1] V2] AD1 AD2 (RD of AD)
Before computing the averaged ERPs, a filtering process (band-pass: 0.3 to 40 Hz) was applied to the EEG epochs. The epochs contaminated with ocular and other artifacts were excluded from the averaging on the basis of voltage values ranging from -50 to 50 μV. Baseline corrections to the averaged ERPs were conducted on the basis of the mean amplitude of the time range from -200 to 0 ms.

For the purpose of investigating scalp distributions of ERP effects for the two types of right dislocation, voltage values of the subtraction waveforms of the two comparisons (see Table 2) were mapped on to a two dimensional scalp model every 100 ms. Ninety seven electrodes which fell under the area defined by the international 10/20 system (Klem et al. (1999)) were specified by measuring the head size of all subjects.

Repeated-measures analysis of variance (ANOVA) was carried out on the mean amplitudes for each comparison. ANOVAs were separately performed for the midline and lateral sites, determined on the basis of

<table>
<thead>
<tr>
<th>effect</th>
<th>waveform comparison</th>
<th>subtraction</th>
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<tbody>
<tr>
<td>RD of AR</td>
<td>2 vs. 3</td>
<td>2−3</td>
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<tr>
<td>RD of AD</td>
<td>4 vs. 1</td>
<td>4−1</td>
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</table>

The ERP comparison in this study is different from those of previous studies which investigated the integration process of the filler-gap relation. This comes from the property of the Japanese language and JRDCs. Japanese is a head-final language, and all constituents precede a verbal head in a canonical word order. Consequently, it is impossible to compare right dislocated elements with non-dislocated elements in the same linear position. Additionally, it is risky to compare dislocated arguments with dislocated adjuncts in the same linear position. Since arguments, unlike adjuncts, are assigned a Case-marker belonging to a closed-class category, they could be differently processed in the brain, whether or not they are dislocated (see Kutas and Hillyard (1983)). The comparisons, therefore, obeyed the following criteria: i) no lexical differences between the non-dislocated and dislocated elements, and ii) the same interval between the non-dislocated and dislocated words (the two verbs). Keeping to these criteria, the ERP difference between the two types of right dislocation could not be attributed to either a lexical factor or to linear distance between the non-dislocated and dislocated word.
the topographical division of Takazawa et al. (2002), as can be seen in Figure 1.

![Figure 1. Topographical division within the international 10/20 scalp area. Lateral sites are divided into eight areas: LF: left frontal, LT: left temporal, LP: left parietal, LO: left occipital, RF: right frontal, RT: right temporal, RP: right parietal, RO: right occipital. The Midline site is divided into anterior part (AM) and posterior part (PM).](image)

The relevant factors in the ANOVAs for the lateral site were dislocation (dislocation, non-dislocation), hemisphere (left, right) and area (frontal, temporal, parietal, occipital). Two factors, i.e. dislocation and anteriority (anterior, posterior), were posited for the midline site. When there was a significant interaction between dislocation and a topographical factor, additional ANOVAs were performed for each hemisphere or area to further explore the topographical features of the ERP effects. Time windows of statistical analyses were determined by visual inspection of the voltage maps of the subtraction waveforms. Degrees of freedom were modified using the Huynh and Feldt correction whenever necessary.

7. Results

7.1. Behavioral Performance

The results of the behavioral task are presented in Table 3. The reaction times of the two types of JRDCs were almost equal. The ANOVA within the subjects supported this view \[F(1,12)=.072, p=.79\]. Descriptively, the correct response rates were slightly higher for the dislocation of arguments than for that of adjuncts. However, there was no significant difference between the two types of constructions \[F(1,12)=2.679, p=.128\].
7.2. Event-related Brain Potentials

7.2.1. Non-dislocated Arguments vs. Dislocated Arguments

When comparing the ERPs for the two types of arguments, the dislocated arguments elicited more positive ERPs than the non-dislocated arguments (see Figure 2A). Visual inspection of the ERP waveforms revealed that the positive-going ERPs for the dislocated arguments started at about 300 ms after the onset of words in the left hemisphere. In the time window from 400 to 500 ms, positive ERPs could also be observed in the midline site. This positivity peaked in the latency between 500 and 600 ms.

The voltage maps of the subtraction waveform (dislocated minus non-dislocated) also revealed that positive ERPs for the dislocated arguments were elicited at more posterior sites in the left hemisphere in the latency from 300 to 400 ms (see Figure 2B). In the next time window from 400 to 500 ms, this positivity was strongly observed in the left frontal, temporal regions, as well as in the parietal areas. The positivity was bilateral but left-dominantly distributed around the midline electrodes in the time range from 500 to 600 ms.

The ANOVAs confirmed this visual inspection. In the time window from 300 to 400 ms, a main effect of dislocation and an interaction between dislocation and hemisphere reached statistical significance [lateral: dislocation: $F(1,12)=18.247$, $p=.001$; dislocation $\times$ hemisphere: $F(1,12)=17.977$, $p=.001$; midline: dislocation: $F(1,12)=9.783$, $p=.009$]. The interaction in the lateral site was due to the difference between the non-dislocation and dislocation condition in the left hemisphere [left: $F(1,102)=18.108$, $p=.000$; right: $F(1,102)=3.321$, $p=.071$].

In the time window from 400 to 500 ms, significant interactions, as well as a main effect, were obtained for the lateral site [dislocation: $F(1,12)=19.801$, $p=.001$; dislocation $\times$ hemisphere: $F(1,12)=12.385$, $p=.004$; dislocation $\times$ area: $F(3,36)=3.135$, $p=.037$; dislocation $\times$ hemi-
sphere × area: \( F(3,36)=3.658, p=.021 \). In the midline site, a main effect of dislocation was also statistically significant [dislocation: \( F(1,12)=11.802, p=.005 \)]. Although an interaction for the left hemisphere did not reach significance [dislocation × area: \( F(3,36)=3.342, p=.053 \)], tests of main effects of dislocation for all areas were performed for the purpose of exploring a topographic feature in the left hemisphere. The results revealed that in three areas, except for the occipital area, significant main effects were observed [frontal: \( F(1,24)=6.832, p=.015 \); temporal: \( F(1,24)=13.729, p=.001 \); parietal: \( F(1,24)=10.282, p=.004 \); occipital: \( F(1,24)=3.937, p=.059 \)]. As for the right hemisphere, an interaction was significant [dislocation × area: \( F(3,36)=3.034, p=.042 \)], and this significant interaction was due to the difference in the parietal area [\( F(1,24)=4.918, p=.036 \)].

To verify the left dominant positivity effects of the dislocated arguments in this time window, tests of an interaction between hemisphere and area were performed for both types of conditions. As for the dislocation condition, an interaction reached significance [hemisphere: \( F(1,12)=41.348, p=.000 \); hemisphere × area: \( F(3,36)=3.518, p=.049 \)]. Significant main effects of hemisphere were also obtained for all areas [frontal: \( F(1,12)=9.051, p=.011 \); temporal: \( F(3,36)=38.212, p=.000 \); parietal: \( F(3,36)=30.797, p=.000 \); occipital: \( F(3,36)=10.565, p=.007 \)]. As for the non-dislocation condition, both a main effect of hemisphere and an interaction between hemisphere and area did not reach significance [hemisphere: \( F(1,12)=.374, p=.552 \); hemisphere × area: \( F(3,36)=.563, p=.546 \)]. As can be seen in Figure 3, the significant main effect of hemisphere in the dislocation condition was due to the enhancement of positive potentials in the four left areas (see the graph on the right side), confirming that the left dominant ERP effect was, in fact, due to the enhanced positivity for the dislocated arguments.

In the latency from 500 to 600 ms, an effect of dislocation and an interaction between dislocation and area statistically reached significance [dislocation: \( F(1,12)=15.546, p=.002 \); dislocation × area: \( F(3,36)=5.009, p=.005 \)]. Significant differences between the non-dislocation and the dislocation condition were found in three out of four areas, confirming the bilateral distributions of positivities for dislocated arguments [frontal: \( F(1,50)=8.664, p=.005 \); temporal: \( F(1,50)=12.044, p=.001 \); parietal: \( F(1,50)=13.594, p=.001 \); occipital: \( F(1,50)=4.016, p=.051 \)].
7.2.2. Non-dislocated Adjuncts vs. Dislocated Adjuncts

Dislocated adjuncts also produced more positive ERP effects than non-dislocated adjuncts in the same time range from 300 to 600 ms. Contrary to the case of arguments, however, this effect was dominant in the right hemisphere (see Figure 4A). From the visual inspection of the ERP waveforms for the two types of adjuncts, positivity effects of dislocated adjuncts in the early time range were observed mainly in the fronto-central areas, and had more right dominant distributions. In the time range from 400 to 500 ms, this positivity effect reached peak voltage, and was widely distributed more in the right posterior areas. In the next time range, this positivity effect remained in the posterior area, particularly in the right hemisphere.

Visual inspection of the voltage maps in Figure 4B confirmed the observation above. In the time range from 300 to 400 ms, the positivity effect of the dislocated adjuncts spread into the fronto-central area, reaching the right parietal area. This positivity effect, in the next time range from 400 to 500 ms, came to be widely recognized in the right hemisphere, and also appeared in the left parietal area. From 500 to 600 ms, the effect tended to decrease, but was still observed bilaterally.
around the parietal areas.

An ANOVA was performed for each time range. In the time range from 300 to 400 ms, two interactions in the lateral site reached statistical significance \[\text{dislocation} \times \text{hemisphere}: \frac{\text{df}=1}{\text{df}=12}=10.193, \ p=.008; \ \text{dislocation} \times \text{area}: \frac{\text{df}=3}{\text{df}=36}=3.905, \ p=.016\]. Tests of main effects of dislocation for the four areas showed that in the frontal and parietal, but not in the temporal and occipital areas, the main effects of dislocation were significant \[\text{frontal}: \frac{\text{df}=1}{\text{df}=50}=6.527, \ p=.014; \ \text{temporal}: \frac{\text{df}=1}{\text{df}=50}=2.042, \ p=.159; \ \text{parietal}: \frac{\text{df}=1}{\text{df}=50}=4.393, \ p=.041; \ \text{occipital}: \frac{\text{df}=1}{\text{df}=50}=0.953, \ p=.334\]. A difference between the dislocation types in each hemisphere was also investigated. It was revealed that the positivity effect was dominant in the right hemisphere \[\text{left}: \frac{\text{df}=1}{\text{df}=102}=2.320, \ p=.131; \ \text{right}: \frac{\text{df}=1}{\text{df}=102}=11.793, \ p=.001\], confirming that the effect in this time range was distributed in the fronto-central area, and was more dominant in the right hemisphere.

In the latency range from 400 to 500 ms, a main effect of dislocation and an interaction between dislocation and hemisphere reached significance \[\text{dislocation}: \frac{\text{df}=1}{\text{df}=12}=8.026, \ p=.015; \ \text{dislocation} \times \text{hemisphere}: \frac{\text{df}=1}{\text{df}=12}=18.209, \ p=.001; \ \text{midline}: \frac{\text{df}=1}{\text{df}=12}=5.896, \ p=.032\]. Since the interaction between dislocation, hemisphere and area tended to be significant \[\text{dislocation} \times \text{hemisphere} \times \text{area}: \frac{\text{df}=3}{\text{df}=36}=2.749, \ p=.085\], an interaction was tested for each hemisphere to further examine a topographic feature of the positivity effect. Although a significant interaction between dislocation and area was not obtained for the left hemisphere \[\text{dislocation} \times \text{area}: \frac{\text{df}=3}{\text{df}=36}=2.758, \ p=.056\], a main effect of dislocation for each area was tested for the purpose of exploring a scalp distribution. In only the parietal area did the main effect marginally reach significance \[\text{frontal}: \frac{\text{df}=1}{\text{df}=12}=2.265, \ p=.145; \ \text{temporal}: \frac{\text{df}=1}{\text{df}=12}=0.791, \ p=.383; \ \text{parietal}: \frac{\text{df}=1}{\text{df}=12}=3.082, \ p=.092; \ \text{occipital}: \frac{\text{df}=1}{\text{df}=12}=1.456, \ p=.239\]. In the right hemisphere, on the other hand, a strong main effect of dislocation was obtained \[\frac{\text{df}=1}{\text{df}=12}=14.171, \ p=.003\].

In the time range from 500 to 600 ms, a main effect of dislocation and two interactions were statistically significant \[\text{dislocation}: \frac{\text{df}=1}{\text{df}=12}=5.393, \ p=.039; \ \text{dislocation} \times \text{hemisphere}: \frac{\text{df}=1}{\text{df}=12}=14.276, \ p=.003; \ \text{dislocation} \times \text{type}: \frac{\text{df}=3}{\text{df}=36}=3.925, \ p=.016\]. In the midline site, a significant main effect of dislocation was also observed \[\frac{\text{df}=1}{\text{df}=12}=12.383, \ p=.004\]. Tests of a main effect strongly revealed that the positivity effect was distributed bilaterally in the more posterior
areas [left: \(F(1,102)=7.485, \ p=.007\), right: \(F(1,102)=22.668, \ p=.000\); frontal: \(F(1,50)=2.967, \ p=.091\); temporal: \(F(1,50)=6.948, \ p=.011\); parietal: \(F(1,50)=12.581, \ p=.001\); occipital: \(F(1,50)=7.347, \ p=.009\)].

To examine whether or not the right dominant effect observed in the time range from 400 to 500 ms was due to the increase in positive potentials for the dislocated adjuncts, an ANOVA was performed for each type of dislocation. As for the dislocated adjuncts, both a main effect of hemisphere and an interaction between hemisphere and area did not reach significance [hemisphere: \(F(1,12)=.011, \ p=.920\); hemisphere \times area: \(F(3,36)=.720, \ p=.495\)]. In the case of the non-dislocated adjuncts, both a main effect and an interaction were found to be significant [hemisphere: \(F(1,12)=8.847, \ p=.012\); hemisphere \times area: \(F(3,36)=3.630, \ p=.037\)]. Main effects of hemisphere in all areas were also observed, revealing that the interaction was a result of the significant difference in the temporal area [frontal: \(F(1,24)=.421, \ p=.523\); temporal: \(F(1,24)=5.015, \ p=.035\); parietal: \(F(1,24)=2.013, \ p=.169\); occipital: \(F(1,24)=1.079, \ p=.309\)]. This statistical result showed that the right dominant positivity effect of a dislocated adjunct was not due to the change in positivity for dislocated adjuncts in the right hemisphere, but to the increase of negative potentials for non-dislocated adjuncts in the right hemisphere. As can be observed in Figure 5, there is no difference in the mean voltage values of the dislocated adjuncts between the left and the right hemisphere (the graph on the right side). In the case of non-dislocated adjuncts (the graph on the left side), on the other hand, the increase in a negative potential can be clearly observed in each area. The positivity effect of a dislocated adjunct recognized by visual inspection of the voltage maps in Figure 4B would be the result of the right dominant negativity for a non-dislocated adjunct.
It could thus be concluded that the fluctuation of the baseline influenced the seemingly positive effect of the dislocated adjunct.

8. Discussion and Summary of the ERP Study of Japanese Right Dislocation

The goal of the ERP experiment was to examine our theoretical analysis that two types of JRDCs had differentiated syntactic representations, and would be asymmetrically processed according to the argument/adjunct distinction of the dislocated element. The present study partly supports our theoretical analysis. The dislocated argument elicited the P600 in the left frontal and temporal areas, suggesting that the dislocated argument which was integrated into gap positions through a syntactic co-indexation elicited the P600. On the other hand, such an ERP effect with the left dominancy was not observed for the dislocated adjunct. The distributional difference of the ERP effects between dislocated arguments and adjuncts supports our claim that the two types of JRDCs have different structural representations, and are processed differently in the brain. As for the effect of dislocated adjuncts, because
Figure 2. (A): Grand average waveforms (N=13) for non-dislocated (blue line) and dislocated (red line) arguments at nine scalp electrode sites. (B): Voltage maps of subtraction waveforms (dislocated minus non-dislocated) within the international 10/20 area. Negativity is plotted upwards.
Figure 4. (A): Grand average waveforms (N=13) for non-dislocated (blue line) and dislocated (red line) adjuncts at nine scalp electrode sites. (B): Voltage maps of subtraction waveforms (dislocated minus non-dislocated) within the international 10/20 area. Negativity is plotted upwards.
of the fluctuation of the baseline voltages of non-dislocated adjuncts in the critical time range from 400 to 500 ms, our study does not provide detailed information about scalp distributions of ERP effects of dislocated adjuncts.

The positivity effect for dislocated arguments started to appear from an early time window (from 300 to 400 ms), which is somewhat early to call this effect a P600. This latency is similar to that of a P3b, which is elicited by an unexpected event such as in odd-ball tasks, and is said to have a parietal distribution. The early positivity effect in this study, though being left dominant, was prominently observed in the posterior areas, which is partly similar to the distribution of the positivity reported to belong to the P3b in Coulson et al. (1998). Since the JRDC is a construction with a distinct property in that a dislocated element is placed after a matrix predicate, it might be said that dislocated elements are recognized as rare stimuli, and elicit the P3b. However, this possibility is unlikely. Since the dislocated arguments and adjuncts were presented to the participants under the same experimental condition, it is not plausible that the factor of dislocation selectively operated as a variable of unexpectedness only in the case of the argument, but not in that of the adjunct.

A more likely possibility is that this positivity effect should be regarded as a P345 which reflects a reanalysis without any reconstruction of syntactic structure (Mecklinger et al. (1995), Frish et al. (2003)) or a 'diagnosis' (Friederici et al. (2001)), which will be discussed below. When the parser finishes processing the matrix clause of JRDCs of arguments as in (39), the first pro may be co-indexed with the NP ane-wa, and the second also may have an unspecified referent.

\[(39) \text{ane-wa [michibata-de guzen-ni pro1 pro2 mi-ta-to] i-tta-yo, ...} \]

(from (37a))

When dislocated arguments are presented, the parser needs to scan a given co-indexation of pro in (39), but is not required to reanalyze the syntactic structure itself. Such a scanning process without a structural reanalysis is reported to hasten the latency of the P600. Friederici et al. (2001) call such a process diagnosis, required before the revision of phrase structure, and report that a spatial factor, reflecting diagnosis, has an occipital-parietal distribution. The early positivity effect in our study was statistically significant in the left hemisphere, and in the next time range from 400 to 500 ms, this positivity effect became marginal in the occipital area. This decrease in the main effect of dislocation in
the occipital area would show that the diagnosis of co-indexation of *pro* expires within the time range from 300 to 400 ms, and that the parser switches to the next stage of processing. According to this idea, we could explain the reason why dislocated adjuncts do not elicit an early positivity. Dislocated adjuncts do not have a corresponding *pro*, and therefore, diagnosis is not required in the processing of dislocated adjuncts.

In the time range from 400 to 500 ms, significant positivity effects were prominently observed in the left frontal and temporal areas. It is suspected that this positivity reflects a syntactic integration process in which dislocated arguments are integrated into gap positions through co-indexation, and their syntactic features such as Case are checked. Studying the ERPs of Japanese Wh-interrogative sentences in syntactic violation paradigms, Nakagome et al. (2001) carried out a Scalp Current Density (SCD) analysis, i.e. spatial enhanced technique of a potential field, and found activated potential fields in the left anterior and temporal sites. They argue that the activation observed as a current sink in the left anterior and/or temporal areas is a reflection of syntactic processing. Although the SCD was not performed in our study, it seems likely that positivity effects in the left anterior and temporal sites reflect syntactic processing, specifically, a process of syntactic integration. Concerning this positivity in the left anterior and temporal sites, it should be noted that it was not observed in the comparison between the non-dislocated and dislocated adjuncts. This ERP asymmetry between dislocated arguments and adjuncts, on the basis of our theoretical claim, could be interpreted as showing that each type of JRDC has a distinct syntactic representation, and is treated by differentiated neurophysiological processes.

Comparing the dislocated and non-dislocated adjuncts, apparent positivity effects of the dislocated adjuncts were observed in the right hemisphere. As we mentioned in section 7.2.2, however, this positivity effect was due to a great increase in negative potentials in the right hemisphere for the non-dislocated adjuncts. We regard this negativity as the N400, a component related to semantic processing, on the basis of its scalp distribution, i.e. the centro-parietal areas with more right hemisphere dominance. From the viewpoint of sentence comprehension, it is quite likely that the parser tries to capture the propositional content of a sentence as early as possible. Encountering adjuncts without the processing of a predicate and its subcategorized arguments,
therefore, would cause the parser to have difficulty in constructing a propositional meaning. In the case of the non-dislocated adjuncts as in (37a), the parser would expect a context consistent with the adjuncts in advance, since a predicate and its arguments are not provided at the stage of processing of adjuncts. As for the dislocated adjuncts as in (37b), the parser can capture propositional information before the processing of them, and then, may only search for their modifiees. Consequently, it could be said that (37b) is more economical than (37a) in the processing of adjuncts. This difference in semantic processing may be the reason behind why we observe the N400 for adjuncts in non-dislocated positions in the right hemisphere.

To summarize this ERP study, the dislocated arguments, as predicted, elicited the positive component. In particular, the positivity in the time range from 400–500 ms was distributed in the frontal and the temporal areas of the left hemisphere, showing that dislocated arguments are processed through syntactic filler-gap dependencies. The right-dislocated adjuncts, on the other hand, did not exhibit the ERP effects of the same scalp distribution, i.e. the left dominant positivity. This result suggests that dislocated adjuncts are processed differently from dislocated arguments. A genuine distributional property reflecting the processing of dislocated adjuncts remains to be clarified in future research.

9. Conclusion

The theoretical analysis in this paper argued that JRDCs should be structurally divided based on the argument/adjunct distinction of dislocated elements. The JRDC of an argument was analyzed to contain a syntactic co-indexation between pro and the dislocated argument. The JRDC of an adjunct, on the other hand, was argued to have no such syntactic dependency, but instead to have semantic modification, constrained by the UMC. The ERP study confirmed this theoretical analysis. Dislocated arguments elicited the positivity in the left hemisphere in the latency from 300 to 600 ms. Although the P600 is generally reported to be widely distributed in the centro-parietal area, and the relation between the scalp distributions and linguistic functions has not been clearly determined yet, it was shown by combination of the theoretical analysis and the ERP study that a P600 was sensitive to a specific experimental variable of syntactic nature, and can be distributed in
a more restricted area.

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Department of English Language and Literature
Tokyo Metropolitan University
1–1 Minami Osawa
Hachioji, Tokyo 192–0397
e-mail: tksoshi@ybb.ne.jp
hirokohg@beige.plala.or.jp