

On the Bi-clausality of the Productive Causative Construction in Japanese: Evidence from ERP Experiments *

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1. Introduction

The present paper argues, based on the results of two ERP experiments we conducted (Ito et al. 2009, Okabe et al. 2011), that the left anterior negativity (LAN) can be interpreted as reflecting the parser's detection of the necessity to construct a bi-clausal constituent structure. This provides a new piece of evidence for a bi-clausal analysis of the so-called productive causative construction (henceforth PCC) in Japanese.

This paper is organized as follows. Section 2 provides a review of two opposing syntactic analyses of the PCC in Japanese, namely, a bi-clausal analysis and a mono-clausal analysis. In Section 3, after a brief survey of Event-Related Potential (ERP) components relevant to language processing, the results of the two experiments will be discussed in light of the debate on syntactic analyses of the PCC. Section 4 provides brief discussion and concluding remarks.

2. Productive Causative Construction in Japanese: Bi-clausal or Mono-clausal?

Japanese has a causative suffix *-(s)ase*,¹ which is attached to a verb stem to express a directive causation:²

- (1) Hahaoya-wa musuko-o beddo-ni ne-sase-ta.
mother-TOP son-ACC bed-on lie-CAUSE-PAST

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¹ *-ase* and *-sase* are phonologically conditioned allomorphs: *-ase* is attached to a consonant-ending stem, while *-sase* is selected for a vowel-ending stem.

² The following abbreviations are used in the gloss. ACC: accusative, CAUS: causative, COMP: complementizer, DAT: dative, GEN: genitive, NEG: negation, NOM: nominative, PL: plural, PRES: present, TOP: topic, Vi: intransitive verb, Vt: transitive verb.

‘The mother made her son lie on the bed.’

The suffix *-(s)ase* is extremely productive in that it can be attached to any verb stem as far as a certain semantic constraint is observed,³ and hence the causative construction employing this suffix is often called productive causative construction (PCC).

Two opposing syntactic analyses have been proposed for the PCC in Japanese: a bi-clausal analysis and a mono-clausal analysis. Proponents of a bi-clausal analysis (Kuroda 1965, Shibatani 1976, among others) maintain that the PCC has embedded structure, roughly represented as in (2):

(2) [Hahaoya-wa musuko-o [PRO beddo-ni ne] -sase-ta]

The most convincing evidence for this structure is obtained from the behavior of a reflexive pronoun *zibun*, which is known to exhibit subject orientation and to allow long-distance binding. As shown in (3a), only the subject of a sentence can be the antecedent, and the accusative-marked object cannot be the antecedent. As shown in (3b), *zibun*, unlike English reflexive pronouns like *himself* or *herself*, allows long-distance binding where *zibun* in the embedded clause is bound by the matrix subject, leading to the ambiguity of (3b) in which either the mother or the son can be interpreted as the owner of the bed.

(3) a. Hahaoya_i-wa musuko_j-o zibun_{i/j}-no beddo-ni ire-ta.
 mother-TOP son-ACC self-GEN bed-in put-PAST

‘The mother put her son in her/*his own bed.’

b. [Hahaoya_i-wa [musuko_j-ga zibun_{i/j}-no beddo-ni ne-ta] to it-ta.
 mother-TOP son-NOM self-GEN bed-on lie-PAST COMP say-PAST

‘The mother said that her son lay on her/his own bed.’

Given these properties of *zibun*-binding, the ambiguity of (4) strongly suggests that the PCC has bi-clausal structure similar to (3b):

(4) Hahaoya_i-wa musuko_j-o zibun_{i/j}-no beddo-ni ne-sase-ta.
 mother-TOP son-ACC self-GEN bed-in lie-CAUSE-PAST

‘The mother made her son lie on her/his own bed.’

In (4), like in (3b), either *hahaoya* or *musuko* can be interpreted as the antecedent of *zibun*. Recall that in a typical mono-clausal structure (3a), the accusative-marked NP cannot bind *zibun*. The biclausal analysis of the PCC as shown in (2) provides a natural explanation for the ambiguity of (4): either the matrix subject (*hahaoya*) or the embedded subject (i.e., PRO controlled by *musuko*) can be the antecedent of *zibun*.

Similarly, the ambiguity of subject-oriented adverbs like *wazato* ‘intentionally’ gives support to the bi-clausal analysis.

(5) Kantoku-wa sensyu-o wazato korob-ase-ta.
 manager-TOP player-ACC intentionally fall-CAUSE-PAST

‘The manager intentionally made the player fall down.’

‘The manager made the player intentionally fall down.’

In (5), the adverb *wazato* can be interpreted as either the manager’s or the player’s intention. The second

³ See the discussion in 3.2 below.

reading, where the player's action was intentional, can be neatly explained if we assume the bi-clausal analysis like (2), where the accusative marked NP controls the embedded subject PRO.

On the other hand, the PCC exhibits some mono-clausal properties, which has led to mono-clausal analyses in various frameworks (Miyagawa 1980 and Kitagawa 1986 in the GB tradition, Matsumoto 1996 in LFG, and Manning et al. 1999 in HPSG). First, the so-called Double-O Constraint, which disallows two occurrences of accusative marker *o* in a single clause, applies to the PCC:

- (6) Hahaoya-wa musuko-ni/*-o hon-o yoma-ase-ta.
 mother-TOP son-DAT/*-ACC book-ACC read-CAUSE-PAST
 'The mother made her son read the book.'

When the causative suffix *-(s)ase* attaches to a transitive verb with an accusative-marked object, the causee argument cannot be marked with accusative and is marked with dative as shown in (6), which is due to the Double-O Constraint. Note that this constraint prohibits two occurrences of *o* within a single clause, so that one occurrence in the matrix clause and another in the embedded clause is allowed as in (7) (Miyagawa 1999):

- (7) Hahaoya-ga musuko-o [hon-o kai-ni] mise-ni ik-ase-ta.
 mother-NOM son-ACC book- ACC buy-to shop-to go-CAUS-PAST
 'The mother made her son go to the shop to buy a book.'

Hence the ill-formedness of (6) supports the mono-clausal analysis of the PCC.

Secondly, the behavior of the negative polarity item (NPI) *sika* 'except' provides support for the mono-clausal analysis. It is well-known that *sika* and its licensing negative element *nai* must be clause mates as in (8a), so that a matrix negative element cannot license *sika* within an embedded clause as shown in (8b):

- (8) a. Hahaoya-wa [musuko-ga manga-sika yoma-nai] to i-u.
 mother-TOP son-NOM comics-except read-NEG COMP say-PRES
 'The mother says that her son doesn't read anything other than comics.'
 b.*Hahaoya-wa [musuko-ga manga-sika yom-u] to iwa-na-i.
 mother-TOP son-NOM comics-except read-PRES COMP say-NEG-PRES
 'The mother doesn't say that her son reads anything other than comics.'

A PCC sentence with *sika-nai* as in (9) is well-formed, which strongly suggests that the PCC is mono-clausal:

- (9) Hahaoya-wa musuko-o beddo-ni-sika ne-sase-na-i.
 mother-TOP son-ACC bed-on-except lie-CAUSE-NEG-PRES
 'The mother doesn't make her son lie on anything other than the bed.'

In sum, both mono-clausal and bi-clausal analyses have supporting evidence. It is uncontroversial that the PCC exhibits some "bi-clausal" properties exemplified in (4) and (5), and the issue is: at what level should the "bi-clausality" be captured? The proponents of the bi-clausal analysis maintain that the PCC has the embedded constituent structure in syntax, while those arguing for the mono-clausal analysis claim that it should be captured at some other level: the "bi-clausal" properties of the PCC are dealt with, for

instance, at the level of argument structure by Manning et al. (1998) in the HPSG framework, at the level of functional structure by Matsumoto (1996) in the LFG framework, and at LF by Kitagawa (1986) in the GB tradition.⁴ In what follows, I will argue that the results of the two ERP experiments we conducted, when considered together, provide support to the syntactic status of the “bi-clausality” of the PCC.

3. ERP Experiments

3.1. ERP Components Relevant to Language Processing

ERPs are scalp-recorded changes in electrophysiological activity of the brain induced by motor, sensory, or cognitive events. ERP measurement is widely used for non-invasively obtaining millisecond-level information on brain functioning that can be reliably related to cognitive processes including language processing.

ERPs are multi-dimensional, varying in polarity (negative/positive), latency (msec), amplitude and scalp distribution, as shown in Figure 1. We compare two conditions A and B, plotted by the gray and the black line, respectively, and say that Condition B, when compared with Condition A, elicited a negative component at a certain latency, and then a positive component at a later latency. (Note that negativity is plotted upwards, and positivity downwards.) In addition to the polarity and latency, scalp distribution is significant in identifying ERP components, as will be surveyed shortly.

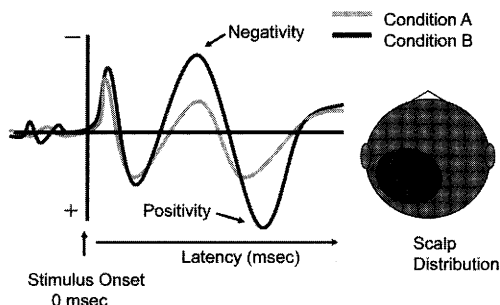


Figure 1. Factors relevant to identifying ERP components. (Cited from Ito et al. 2009)

Let us survey three ERP components known to be related to language processing.⁵ First, the N400 is a negativity which peaks at around 400 msec after the onset of stimuli, which shows a wide-spread scalp distribution often with a centro-posterior focus. This component has long been known to be elicited by a semantic/pragmatic anomaly: the seminal work of Kutas and Hillyard (1980) reported that reading an anomalous sentence like *he spread his warm bread with socks* elicited an N400 component at the critical word *socks*, when compared to reading the corresponding acceptable sentence *he spread his warm bread with butter*.

⁴ See Harley (2008), among others, for a review of syntactic analyses of the PCC in Japanese.

⁵ See Friederici (2002) and Kaan (2007), among others, for surveys of language-related ERPs.

Secondly, another negative component known as the LAN (left anterior negativity) is similar to the N400 in polarity (negative) and latency (observed at around 300-500 msec after the stimulus onset), but contrasts with the N400 in its distribution: unlike the N400, the LAN is limited to the left anterior region. This component is reported to be observed for detecting syntactic or morpho-syntactic anomalies like agreement errors or case violations, as in reading the critical word *he* in *he skinned he knee*, when compared with the well-formed *he skinned his knee* (Coulson et al. 1998).

The third component is the P600, a positive component peaking at around 600 msec after the stimulus onset. This component is interpreted to reflect the cost of reanalysis or reconstruction of syntactic structure after detecting some anomaly. This component is also known to reflect the complexity of syntactic structure in parsing well-formed sentences (Kaan 2007).

3.2. An ERP Experiment on the PCC: Ito et al. (2009)

Ito et al. (2009) report the results of an ERP experiment on the PCC conducted in the violation paradigm. They constructed sentences of the following four types, and examined the ERP responses to the violation in each unacceptable condition in comparison with its acceptable counterpart, the critical word being the sentence-final verb:

(10) a. Acceptable Transitive Condition:

Syehu-ga ryoori-o teeburu-ni narabe-ta.
 chef-NOM dish-ACC table-on align(Vt)-PAST
 ‘The chef arranged the dishes on the table.’

b. Unacceptable Transitive Condition:

*Sensyu-tati-ga kansei-o yakyuuzyoo-ni narabe-ta.
 player-pl-NOM cheer-ACC baseball.ground-on align(Vt)-PAST
 ‘The players arranged shouts of joy on the ground.’

(11) a. Acceptable Productive Causative Condition:

Kantoku-ga sensyu-o yakyuuzyoo-ni narab-ase-ta.
 manager-NOM player-ACC baseball.ground-on align-CAUS-PAST
 ‘The manager made players line up on the baseball ground.’

b. Unacceptable Productive Causative Condition:

*Syehu-ga ryoori-o teeburu-ni narab-ase-ta.
 chef-NOM dish-ACC table-on align-CAUSE-PAST
 ‘The chef made dishes line up on the table.’

They report that the Unacceptable Transitive Condition, when compared with the Acceptable Transitive Condition, elicited an N400 component with the latency of 300-400 msec, followed by a P600 component,⁶ as shown in Figure 2a, while the Unacceptable Productive Causative Condition in

⁶ We do not go into the question of why P600 was elicited in this condition, since it does not affect our argument. See Ito et al. (2009) for some discussion.

comparison to the Acceptable Productive Causative Condition elicited a LAN component at an early time window of 200-300 msec, followed by an N400 at the time window of 300-500 msec, as shown in Figure 2b.

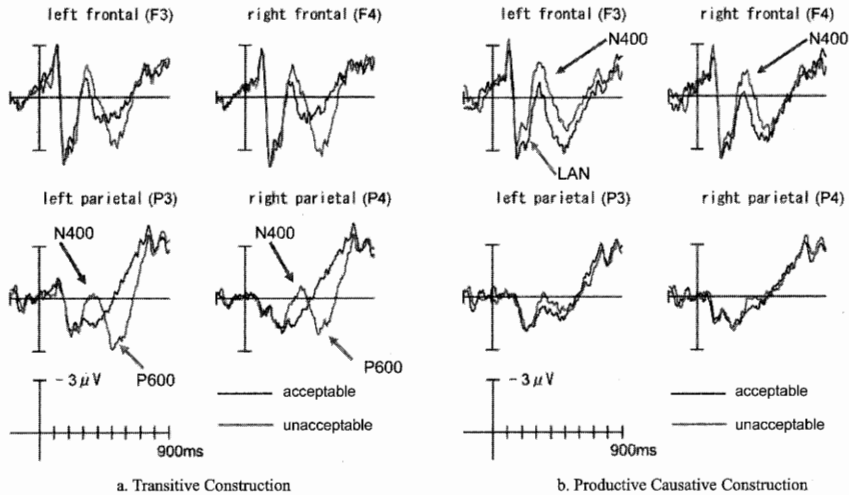


Figure 2. Grand average ERPs for the critical word (verb) in the four conditions in the four representative electrodes. Negativity is plotted upwards. (Ito et al. 2009)

They argue that the different ERP responses reflect the different nature of the two types of violation. The unacceptability of the Unacceptable Transitive Condition as exemplified in (10b) is due to a simple violation of semantic selection of the verb: the object of the verb *narabe* ‘align’, for instance, must denote a solid entity, a restriction which the noun *kansei* ‘shouts of joy’ does not satisfy. Hence the elicitation of an N400, which is robustly observed for sentences with semantic anomaly, conforms to their prediction.

The nature of unacceptability of the Unacceptable Productive Causative Condition is more complicated. (11b) does involve semantic anomaly, but it is a mismatch between the accusative-marked NP and the causative suffix *-sase*: there is no semantic mismatch between the noun *ryoori* ‘dish’ and the verb *narab* ‘align (Vi)’, as shown by the acceptability of the following sentence:

- (12) Ryoori-ga teeburu-ni naran-da.
 dishes-NOM table-on align(Vi)-PAST
 ‘Dishes were arranged on the table.’

The causative suffix *-sase* denotes directive causation, whereby the causer orders the causee to take some action denoted by the verb stem to which *-sase* is attached. Therefore, the verb stem must denote some willful action by an agent, and hence the accusative-marked NP, which denotes the causee, is required to be interpretable as an agent. Thus the ill-formedness of (11b) stems from the fact that the noun *ryoori* ‘dish’ denotes an inanimate entity, which cannot be interpreted as an agent. In this way, the detection of the semantic anomaly of (11b) can be claimed to involve some computation of *-sase* suffixation. Ito et al.

(2009) assume the biclausal structure for the PCC, and argue that the LAN component elicited by the Unacceptable Productive Causative Condition reflects the syntactic computation of biclausal structure (i.e., the detection of mismatch between the matrix predicate *-sase* and the embedded subject), while the N400 that followed the LAN is a reflection of the semantic anomaly.

Given the general consensus that the LAN component is related to syntactic violation of some kind, it is plausible to claim that some syntactic computation is involved in the detection of the anomaly of (11b). And yet, it is not obvious if the computation involved is related to bi-clausal structure at the syntactic (i.e., constituent structure) level: as reviewed in 2, the “bi-clausality” of the PCC could be captured in terms of lexical structure rather than syntactic constituent structure, and the results reported by Ito et al. (2009) alone may not be enough to tease apart these possibilities. Our second experiment reported as Okabe et al. (2011) provides support for the bi-clausality at the syntactic level.

3.3. An ERP Experiment on the Antecedent Selection of *Zibun*: Okabe et al. (2011)

The major aim of Okabe et al. (2011) was to elucidate the mechanism of antecedent selection for the reflexive pronoun *zibun*. As briefly reviewed in 2, the Japanese reflexive pronoun *zibun* exhibits two properties different from English reflexive pronouns: the subject orientation and the possibility of long-distance binding. The relevant examples are repeated below as (13): only subjects can be the antecedent of *zibun* as shown in (13a), and the matrix subject can be the antecedent of *zibun* in an embedded clause as in (13b):

- (13) a. Hahaoya_i-wa musuko_j-o zibun_{i/j}-no beddo-ni ire-ta.
 mother-TOP son-ACC self-GEN bed-in put-PAST
 ‘The mother put her son in her/*his own bed’
- b. [Hahaoya_i-wa [musuko_j-ga zibun_{i/j}-no beddo-ni ne-ta] to it-ta.
 mother-TOP son-NOM self-GEN bed-on lie-past COMP say-PAST
 ‘The mother said that her son lay on her/his own bed.’

Exploiting these properties of *zibun*, Okabe et al. (2011) tried to find out which NP is chosen as the antecedent of *zibun* when it has more than one possible antecedents. The stimuli included minimal pairs like the following:

- (14) a. Nom-Nom Condition
- | | | | |
|-------------|----------|----------|------------------------|
| Otto-ga | [tuma-ga | zibun-no | matanitii-doresu-o . . |
| husband-NOM | wife-NOM | self-GEN | maternity-wear-ACC |
- b. Nom-Dat Condition
- | | | | |
|-------------|----------|----------|------------------------|
| Otto-ga | tuma-ni | zibun-no | matanitii-doresu-o ... |
| husband-NOM | wife-DAT | self-GEN | maternity-wear-ACC |

(14a) has two nominative NPs, while (14b) has a nominative and a dative NP. The second nominative NP in (14a) is most likely interpreted as an embedded subject, and hence the clausal boundary as represented by a bracket in (14a) is posited when the parser receives the second nominative NP, as experimentally supported by Miyamoto (2002). In (14b), in contrast, when the parser encounters *zibun*, both mono-clausal

and bi-clausal analyses are possible: the dative NP can be interpretable as a goal argument of a three-place verb, for instance, as in the continuation (15a), or as an embedded subject (or, more precisely, as the controller of the embedded subject PRO) as in the continuation like (15b).

- (15) a. Otto-ga tuma-ni zibun-no matanitii-doresu-o watasi-ta.
 husband-NOM wife-DAT self-GEN maternity-wear-ACC hand-PAST
 ‘The husband handed his maternity wear to his wife.’
- b. Otto-ga tuma-ni, zibun-no matanitii-doresu-o
 husband-NOM wife-DAT self-GEN maternity-wear-ACC
 [PRO, arau-yooni tanon-da].
 wash-to request-PAST
 ‘The husband asked his wife to wash his/her maternity wear.’

Experimental results reported in Kanamaru et al. (2009), however, show that the mono-clausal analysis is preferred until the sentence is disambiguated in the verb region, in accordance with the Minimal Attachment Principle (Frazier 1979).

In sum, when reading (14a), the parser is likely to have assumed a bi-clausal structure when it encounters *zibun*, and hence both nominative-marked NPs are candidates for its antecedent. Since the embedded subject is structurally closer to *zibun*, it is likely to be preferred as the antecedent.⁷ In reading (14b), on the other hand, the parser is likely to have posited a mono-clausal structure when it encounters *zibun*, and hence is predicted to take the nominative-marked NP as its antecedent. The stimulus sentences were pragmatically manipulated so that taking the first NP as its antecedent will lead to an unnatural interpretation (i.e., ‘the husband’s maternity wear’). Therefore, it is predicted that (14b), but not (14a), will yield some anomaly response at the position of the pragmatically manipulated NP (*matanitii-doresu-o* ‘maternity wear’). Okabe et al. (2011) argue that their prediction was born out, reporting that the Nom-Dat condition (14b) elicited a LAN component when compared with the Nom-Nom condition (14a), as shown in Figure 3.

What is significant to us is that the observed anomaly response is judged to be a LAN component, given its limited distribution in the left anterior region. This can be interpreted as a reflection of the parser’s detection of the need to change the structural analysis from mono-clausal to bi-clausal. As discussed above, when reading sentences like (14b), the parser has assumed a mono-clausal analysis when it encounters *zibun*, and hence takes the first NP as its antecedent. Then, when the critical noun (accusative-marked NP) is encountered, the pragmatics tells the parser that the antecedent is likely to be the second NP (i.e., the dative-marked NP), which leads the parser to abandon its mono-clausal analysis and decide on a bi-clausal analysis. The cost of the change of structural analysis (or the detection of the need thereof), I contend, is

⁷ This is in fact one of the predictions Okabe et al. (2011) tested in their experiment. They compared the Nom-Nom Condition (14a) with a condition in which two nominative NPs were switched, and report that the latter condition elicited an N400. Based on this observation, they conclude that the embedded subject is preferred over the matrix subject as the antecedent of *zibun* in the embedded clause.

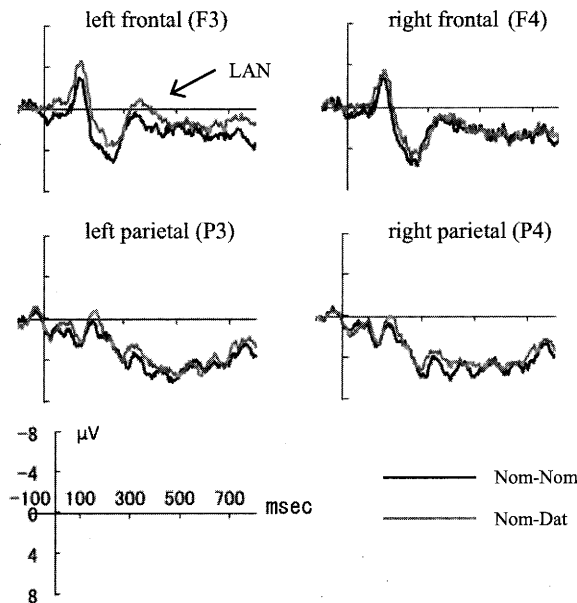


Figure 3. Grand average ERPs for the critical word (accusative NP) in the two conditions (Nom-Nom and Nom-Dat) in the four representative electrodes. Negativity is plotted upwards. (Okabe et al. 2011)

reflected in the LAN component observed.⁸

It is to be noted that the stimulus sentences used in this experiment involve bona fide syntactic embedding with two independent tensed verbs (matrix and embedded), unlike the PCC, where the verb stem and the suffix *-sase* forms a complex predicate. To be precise, since the parsing proceeds incrementally, the parser does not yet know the exact syntactic structure until it encounters the verb region. And yet, since the continuation like (15b) is the most likely candidate to accommodate the pragmatic requirement to take the dative-marked NP as the antecedent of *zibun*, it is plausible to assume that the LAN component elicited by (14b) reflects the cost relevant to “biclausality” at the syntactic (i.e., constituent structure) level.

4. Discussion and Concluding Remarks

The bi-clausal properties of the PCC can be captured either at the level of syntactic constituent structure or at some other, presumably lexical, structure, as surveyed in Section 2, and hence the controversy in theoretical linguistics. It seems difficult to decide on bi-clausal or mono-clausal analysis purely on the basis of theoretical considerations, partly because different frameworks are based on different

⁸ The parsing of (14a) also involves a bi-clausal structure, but since the parser has already decided on the bi-clausal structure at the point of the second nominative NP, the cost of building a bi-clausal structure is not reflected in the ERP at the critical noun. In contrast, in parsing (14b), the parser notices the need to build a bi-clausal structure when it encounters the critical noun, and hence the cost is reflected in the difference between the two conditions at the critical noun.

assumptions. For instance, HPSG generally deals with binding phenomena in terms of lexical argument structure, while the GB tradition regards binding as core syntactic phenomena, so that examples like (3) involving *zibun* binding has different implications in different frameworks. Such a situation sometimes renders it difficult to make the debate across frameworks fruitful and meaningful.

The present paper has attempted to provide a new piece of evidence from a different angle for taking the bi-clausality of the PPC at the syntactic level. The results of Okabe et al. (2011) suggest that the parser's detection of the need to construct a bi-clausal structure (or, to abandon a mono-clausal structure to switch to the bi-clausal analysis) is reflected in the LAN component. Here, the bi-clausality in question is undoubtedly syntactic (i.e., embedding in constituent structure). Therefore, the fact that a similar LAN component was observed in the parsing of Unacceptable PCC sentences (Ito et al. 2009) strongly suggests that the bi-clausality of the PCC in Japanese should be captured in terms of syntactic constituent structure: under the reasonable assumption that similar ERP components reflect similar cognitive processes, the results of the two experiments taken together suggest that the parsing of the PCC involves the same process of syntactic computation as the parsing of sentences with bona fide bi-clausal constituent structure, and hence it is plausible to deal with the bi-clausality of the PCC at the level of constituent structure.

The debate over the syntactic analyses of the PCC in Japanese has been unsettled for decades, and the present paper has attempted to provide a new kind of evidence for the bi-clausal analysis. I hope to have demonstrated the possibility that the results of neurocognitive experiments can shed new light on long-discussed issues in theoretical linguistics.

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