# Unmet Expectations in the Comprehension of Relative Clauses in Japanese

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**Abstract**

In two self-paced reading experiments, subject relative clauses (e.g., 'the woman who saw the man') were read faster than object relative clauses ('the woman who the man saw') in Japanese. Previous formulations of working-memory factors do not predict the patterns observed. A preference to complete fragments as object relative clauses indicates that ambiguity and expectation are unlikely to explain the reading-time data. The results support the proposal that accessibility of the position relativized affects how natural the relative clause is as a statement about the modified noun.

**Keywords:** relative clauses, Japanese, subject, object

## Introduction

An *accessibility hierarchy* of grammatical roles has been shown to constrain the grammaticality of relative clauses in 49 typologically distinct languages (Keenan & Comrie, 1977; also Comrie, 2007, for a recent summary). Subjects are ranked higher than objects to reflect the observation that more languages allow subject relative clauses than object relative clauses. *Postnominal* relative clauses as in (1) follow the modified noun *woman* (brackets mark the boundaries of the embedded clause; the extraction site or *gap* is coindexed with the modified noun, or *filler*).

(1) a. Subject relative clause (postnominal)
the woman$_i$ [that $gap_i$ saw the man]

b. Object relative clause (postnominal)
the woman$_j$ [that the man saw $gap_j$]

In languages that allow both alternatives, subject relatives are predicted to be easier to understand, that is, comprehension is facilitated when *woman* is interpreted as the subject of the embedded verb *saw* as in (1a). The subject advantage is well-documented for constructions in which both nouns are animate (*man* and *woman* in (1); Dutch: Mak, Vonk & Schriefers, 2002; English: Traxler, Moris & Seely, 2002; *inter alia*). We report evidence supporting accessibility as a factor in the comprehension of relative clauses in Japanese.

Japanese is an SOV (subject-object-verb order) language and relative clauses are *prenominal* as they precede the modified noun as in (2).

(2) a. Subject relative clause (prenominal)
[$gap_i$ dansei-o mita] josei$_i$
man-acc saw woman
'the woman that saw the man'

b. Object relative clause (prenominal)
[dansei-ga $gap_j$ mita] josei$_j$
man-nom saw woman
'the woman that the man saw'

The words and their order are exactly the same except for the case marker on the *coargument*, 'man' (i.e., the argument inside the embedded clause). When the coargument is an accusative object, extraction is from subject position; when it is a nominative subject, extraction is from object position. This similarity allows for a cleaner comparison between the constructions as it avoids comparing words with different parts of speech as is often the case in languages such as English.

As a universal constraint, the accessibility hierarchy predicts subject relatives to be easier to understand in Japanese. The prediction is supported by off-line judgments (e.g., difficulty ratings, Sheldon, 1976) and self-paced reading (Ishizuka, Nakatani & Gibson, 2003; Miyamoto & Nakamura, 2003; Ueno & Garnsey, 2008, Experiment 1, also Experiment 2, for *event related potential* data). But these studies fail to address alternative explanations, especially those related to ambiguity factors, which we discuss later in this introduction. Moreover, some aspects of the preference are better explained by a new type of accessibility.

### The object before subject preference

Although often described as taking two arguments, transitive verbs are more closely associated with their direct objects than their subjects (Marantz, 1984; the *verb-object bonding principle*, Tomlin, 1986). A transitive verb can thus be represented as a function that takes the direct object as its only argument to yield a one-place predicate, which in turn takes the subject as its argument. Hence, the semantic role of the object is assigned by the verb, and the role of the subject is assigned by the verb-object compound (Marantz, 1984).

This subject-object asymmetry leads to a processing preference to assign the role of the object more locally than the role of the subject (the *object before subject bias* or ObS). Locality is assumed to be determined by clause structure. Relative clauses are statements about the modified noun, that is, they are functions that are applied onto the modified noun. Intuitively, we must understand what the statement means (e.g., determine the semantic roles of the coargument) to apply the statement to the modified noun.

In subject relative clauses, the object is in the same clause as the verb and receives its semantic role first. Next, the

object-verb complex assigns a semantic role to the subject (see the left-hand side of Figure 1). Therefore, the semantic role assigned to the modified noun is congruent with the statement that the relative clause makes about this noun.

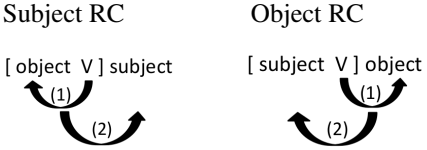


Figure 1: Order of semantic-role assignment in Japanese

In object relative clauses, the verb assigns a semantic role to the modified noun (its object) and only then the object-verb as a unit assigns a role to the coargument inside the relative clause (the subject; see Figure 1). The statement that the relative clause makes about the modified noun is complex in that it is partly based on the modified noun itself and it does not match the order in which roles are assigned by the verb.

The ObS maintains the intuition from traditional accessibility that extraction position affects the naturalness of the relative clause as a statement about the modified noun. But in traditional accessibility the hierarchy is fixed (Keenan & Comrie, 1977) and it incorrectly predicts that subject extraction is always favored (Nakamura & Miyamoto, 2013).

## Ambiguity in relative clauses in Japanese

There are no markers in Japanese that differentiate relative clauses from *simple clauses* (i.e., clauses without extractions such as adjunct, matrix or complement clauses). The relative clauses in (2) can be initially interpreted as simple clauses with an argument left implicit or *dropped*. Subject extraction is less likely to be affected by this type of ambiguity because the relative clause may be detected as soon as the coargument is read for the following reasons. First, the object coargument is an early indicator that there is no subject in the clause (although possible, a subject rarely follows an object; e.g., less than 2% of accusative objects are followed by a subject in a newspaper corpus, Miyamoto & Nakamura, 2005). Second, in a null context, the missing subject lacks a referent, therefore the relative-clause interpretation has been claimed to be favored so that a referent can be provided (Ishizuka, 2005).

In object relative clauses, the subject coargument provides little information about an upcoming object NP. It is only at the predicate (e.g., 'saw' in (2b)) that it is clear that the object is missing. In short, subject relatives may be detected as soon as the coargument NP is read, while object relatives may not be noticed until past the embedded predicate.

## Alternative explanations

One line of research has articulated a compelling alternative to accessibility models by proposing that *working-memory factors* such as decay and interference increase the difficulty in creating the dependency between the modified noun and the extraction position. In English, more material intervenes from the modified noun to the object position than to the subject position, therefore these proposals correctly predict more difficulty in object relative clauses such as (1b).[1] The following is a summary of working-memory factors proposed in the literature and their predictions for Japanese.

a. Object relative clause: man-nom saw woman$_i$

b. Subject relative clause: man-acc saw woman$_i$

Figure 2: Linear decay in Japanese (horizontal lines mark the material that contributes to decay; vertical arrows indicate from where in the sentence retrieval occurs)

**A. Linear-span decay** is based on the material in the sentence intervening between the modified noun and the extraction position (metrics based on number of words, King & Just, 1991; new discourse referents, Gibson, 1998). For Japanese, greater difficulty is predicted for subject relatives than for object relatives (see Figure 2).

**B. Temporal-span decay** measures the material processed from the moment in time an element was inserted in the representation until the time it is retrieved (Lewis, Vasishth, & van Dyke, 2006). A missing object is only detectable when the transitive verb is read, thus an empty object position is created after the verb is read and this is the point in time that is relevant for object relatives (Figure 3a). Figure 3b illustrates the observation that a sentence-initial object can indicate that the subject is missing from its canonical position, therefore an empty subject position may be created when the object is read and decay will start from that point in time.

Predictions may change depending on reactivation.

**C. Reactivation** of a constituent can reverse decay, facilitating retrieval (Lewis, Vasishth, & van Dyke, 2006). Therefore, when a constituent was last reactivated, as opposed to when it was first inserted in the representation, may be a better indicator of temporal decay. In relative clauses in Japanese, both the extraction position and the coargument are reactivated at the embedded verb, but predictions depend on reactivation order.

**C1. Simultaneous reactivation** of the two positions will lead

a. Object relative: man-nom saw woman$_i$

b. Subject relative: man-acc saw woman$_i$
(no reactivation at *saw*)

Figure 3: Temporal decay in Japanese (horizontal lines mark the material that contributes to decay; vertical arrows indicate the point in time the empty position is retrieved from)

[1] If relative clauses and modified nouns are directly associated without the mediation of gaps (Pickering & Barry, 1991), working-memory factors predict no extraction advantage in languages with verb-final embedded clauses such as Dutch, German, Japanese.

them to have similar activation levels when the modified noun is read, therefore subject and object relatives are predicted to be equally easy to process (Kwon, Lee, Gordon, Kluender & Polinsky, 2010). But reactivation at the verb is linguistically motivated (as arguments are linked to the verb), and linguistic constraints may affect reactivation order as in the following two alternatives.

**C2. Canonical reactivation** requires arguments to be reactivated in the canonical, most common, order of the language (i.e., subject and then object). Hence, the object position should have an advantage as the last one to be reactivated and object relatives should be easier than subject relatives.

**C3. ObS-based reactivation** assumes that the ObS is implemented as a constraint on reactivation. The object is reactivated first to be associated with the verb, then the O-V compound is applied onto the subject, which is thus reactivated last. Hence, subject relatives should be easier to process.

**D. Interference** from similarity is another factor related to working memory that has been discussed in the literature. Interference should occur when the case marker on the coargument and the modified noun are the same, increasing confusability (Kwon et al, 2010; also Gordon, Hendrick & Johnson, 2001, for other types of similarity-related difficulty).

The predictions by working memory and accessibility may be obscured by other factors, especially ambiguity.

**E. Expectation-based models** predict that an interpretation is easier to understand if it is more likely to be generated during production (as measured by, for example, fragment completions). Results in English suggest that object relatives are less predictable because they allow more alternative interpretations as the sentence unfolds, thus requiring longer reading times to zero in on the intended interpretation (Gennari & MacDonald, 2008; *inter alia*). But expectation may fail to predict the exact point of greatest difficulty in English (Grodner & Gibson, 2005) and, in some formulations, expectation is not relevant in long-distance dependencies (Levy, 2008).

Supporting contexts may reduce ambiguity and allow working-memory effects to be measured more clearly. In one such study in Japanese, subject relatives were found to be harder to process than object relatives (Ishizuka, Nakatani & Gibson, 2006; but see Kwon, Lee, Gordon, Kluender & Polinsky, 2010, footnote 12, for communication from Edward Gibson reporting failure to replicate and retracting the result; see also Roland, Mauner, O'Meara & Yun, 2012, for context-related factors facilitating object relatives in English, and Sato, 2011, who failed to replicate such effects in Japanese).

We report two self-paced reading experiments confirming the subject advantage for relative clauses in Japanese. The advantage is not explained by previous formulations of working-memory factors (Gibson, 1998; Gordon, Hendrick & Johnson, 2001; King & Just, 1991; Lewis, Vasishth, & van Dyke, 2006; *inter alia*). Expectation-based models (Gennari & MacDonald, 2008) are unlikely to be relevant either given the results of two fragment-completion questionnaires.

# Experiment 1

## Method

**Participants** Thirty native Japanese speakers undergraduates at the University of Tsukuba were paid to participate.

**Materials** Twelve pairs of items (see (3) for an example) were distributed into two lists according to a Latin Square design so that each sentence in a pair appeared in one list.

(3) a. Subject relative clause
Daikigyo-no keesya-o maekara utagatteita
company's manager-acc a while distrusting-was
kanryo-wa totemo mukutida.
bureaucrat-top very quiet-is

'The bureaucrat who has distrusted the company manager for a while is very quiet.'

b. Object relative clause
Daikigyo-no keesya-ga maekara utagatteita
company's manager-nom a while distrusting-was
kanryo-wa totemo mukutida.
bureaucrat-top very quiet-is

'The bureaucrat who the company manager has distrusted for a while is very quiet.'

Each sentence was shown one region at a time on a single line in a non-cumulative fashion using double-byte characters with the uniform-width Japanese font MS Mincho. The segmentation used is indicated with spaces in (3).

**Norming 1** The predictions by expectation-based models (Gennari & MacDonald, 2008) depend on production preferences. Therefore, 42 native Japanese speakers who did not participate in the reading-time study, were shown fragments ending at the embedded verb (e.g., 'distrusting-was' in (3)) and were asked to write completions for them. There were more object relatives than subject relatives (*Median* of the difference $= 1$; two-tailed Exact Wilcoxon Signed Rank, function *wilcoxsign_test* in the package *coin*, R Development Core Team, 2009; Wilcoxon, for short: $Z_1 = 3.47$, $P < .001$; $Z_2 = 2.86$, $P < .01$; see Ueno & Garnsey, 2008, for similar results). Contrary to previous reports, the object advantage held even when the comparison was restricted to relative clauses with animate modified nouns, which are the most similar to the items in the reading experiment ($Median = 1$; Wilcoxon: $Z_1 = 2.41, P < .05$; $Z_2 = 2.59, P < .05$), probably because we chose embedded verbs that were biased towards animate objects. Therefore, expectation-based models should predict an object advantage in the reading time data.

**Norming 2** To ensure that the two types of relative clauses are equally plausible, simple transitive sentences were created by placing the modified noun in the intended extraction position in the embedded clause. Thirty-two native Japanese speakers, who did not participate in any of the other studies, rated each sentence on a 5-point scale (1 as natural and 5 as

strange). No difference was detected (subject: 1.74; object: 1.66; Wilcoxon: $Z$s $< 1$).

### Results and discussion

In the crucial region, the modified noun 'bureaucrat', subject relatives were marginally faster than object relatives ($F_1(1,28) = 2.96$, $MSe = 92{,}790$, $P = .096$; $F_2(1,10) = 4.94$, $MSe = 15{,}300$, $P = .051$). A spillover was observed in the following region, which contained the same words across the two conditions, and the difference was reliable at this point ($F_1(1,28) = 11.19$, $MSe = 12{,}933$, $P < .01$; $F_2(1,10) = 6.63$, $MSe = 10{,}210$, $P < .05$).

The results suggest that subject relative clauses are easier to process than object relative clauses, replicating previous results (Ishizuka, Nakatani & Gibson, 2003; Miyamoto & Nakamura, 2003; Sheldon, 1976; Ueno & Garnsey, 2008). This is compatible with accessibility and the ObS in particular, but not with previous formulations of working-memory factors (e.g., Gibson, 1998; King & Just, 1991).

Temporal-span models (Lewis, Vasishth, & van Dyke, 2006) can account for the results if reactivation at the embedded predicate obeys the ObS. To date, we know of no other formulation of working-memory factors that has the potential to provide an explanation for the subject preference in the Japanese constructions discussed in this paper. However, even ObS-based reactivation fails to account for other types of relative clauses in Japanese, such as those with the coargument dropped (Nakamura & Miyamoto, 2013).

Difficulty in object relatives was observed even though they were more expected according to Norming 1 (contra Gennari & MacDonald, 2008).

## Experiment 2

The role of the modified noun in the outer clause (usually the matrix clause) has also been implicated in the comprehension of relative clauses. *Parallelism* predicts facilitation when the extraction site and the modified noun share properties such as grammatical role (Sheldon, 1976). Alternatively, facilitation occurs when the two positions share the same case marker (Sauerland & Gibson, 1998). This type of case-marking *attraction* is grammaticalized in some languages so that the case marker on the modified noun can affect the marker on the relative pronoun or vice-versa (e.g., Ancient Greek, Persian; see Keenan, 1981, for examples). We controlled for these factors in this experiment.

### Method

**Participants** Thirty-two native speakers of Japanese at the Future University Hakodate, who had not participated in the other studies, were paid to participate in the experiment.

**Materials** Twelve pairs of items were used with the same procedure as in the first experiment. The following is an example pair.

(4) a. Subject relative clause

| | | | |
|---|---|---|---|
| Kinjono | obaasan-o | basutei-made | miokutta |
| neighbor-gen | woman-acc | bus-stop-to | accompanied |
| onnanoko-ni-wa | sanpochuuno | inu-ga | jareteita. |
| girl-dat-top | walk | dog-nom | frolicking-was |

'As for the girl who accompanied the woman from the neighborhood to the bus stop, a dog taken for a walk was frolicking around (her).'

b. Object relative clause

| | | | |
|---|---|---|---|
| Kinjono | obaasan-ga | basutei-made | miokutta |
| neighbor-gen | woman-nom | bus-stop-to | accompanied |
| onnanoko-ni-wa | sanpochuuno | inu-ga | jareteita. |
| girl-dat-top | walk | dog-nom | frolicking-was |

'As for the girl who the woman from the neighborhood accompanied to the bus stop, a dog taken for a walk was frolicking around (her).'

Following previous studies (Ishizuka, Nakatani & Gibson, 2003; Ueno & Garnsey, 2008), the modified noun ('girl' in (4)) was marked with the dative marker *ni* and the topic marker *wa*. The two combined particles are not shared with either of the extraction positions (the nominative-subject or the accusative-object positions), therefore there should be no interference from attraction (Keenan, 1981; Sauerland & Gibson, 1998). A sentence-initial animate noun marked with *ni* is usually interpreted as an indirect object, therefore a strict interpretation of parallelism (requiring the exact same grammatical role for the extraction position in the relative clause and for the modified noun in the matrix clause; Sheldon, 1976) would also predict no difference between the two types of relative clauses. But to the extent that *ni*-marked objects are more similar to direct objects than to subjects,[2] a looser version of parallelism may favor object relative clauses.

Perspective shift elaborates on parallelism by considering whose point of view is adopted as the representation for the event is built. According to work on Hungarian (MacWhinney & Pleh, 1988), perspective depends on whether the language is *subject-prominent* (SP; i.e., languages in which sentences are based on the relation between subject and predicate; e.g., Indo-European languages) or *topic-prominent* (TP; in which sentences are based on the relation between topic and comment; e.g., Chinese; Li & Thompson, 1976). In TP languages like Hungarian, parallelism is claimed to hold for topics. In particular, a sentence-initial object is the topic in Hungarian, therefore its perspective is adopted, and because of parallelism, there is a preference for relative clauses to be object extracted when they modify a topicalized object (MacWhinney & Pleh, 1988).

The test sentences in (4) are TP constructions because the dative object 'girl' is topicalized with the marker *wa*; there-

[2]For example, the object of verbs such as *au* 'meet', *intabyusuru* 'interview', *denwasuru* 'call/phone' is a direct object in English, but it is marked with the dative *ni* in Japanese.

fore, similar to Hungarian, perspective shift should favor object extraction.[3]

**Norming 3** A new group of 46 native speakers of Japanese participated. As in Norming 1, there were more object relative-clause completions (66.3%) than subject relative clauses (52.45%; Wilcoxon: $Z_1 = 3.04$, $P < .01$; $Z_2 = 2.36$, $P < .05$). The same trends were observed when counts were restricted to relative clauses with head nouns depicting humans (object relatives: 61.7%; subject relatives: 51.1%; Wilcoxon: $Z_1 = 2.73$, $P < .01$; $Z_2 = 2.05$, $P < .05$).

**Norming 4** As in Norming 2, no plausibility difference between the subject condition (1.9) and the object condition (1.73; where 1 was natural and 5 was strange; Wilcoxon: $P$s $> .2$) according to 16 native Japanese speakers, who had not participated in any of the other studies reported.

### Results and discussion

In the critical region ('girl' in (4)), there was a numerical advantage for subject relatives. The difference was reliable in the following region, which contained the same words across the two conditions ($P < .05$; function *lmer* in the package *lme4*, R Development Core Team, 2009). Moreover, the coargument in five items was a proper name while in the remaining seven items it was a common noun. Because the modified noun was always a common noun, proper names should decrease confusability and facilitate comprehension, but there was no interaction when type of noun was included in the analysis ($P > .8$; contra Gordon, Hendrick & Johnson, 2001).

The results replicated the advantage for subject relatives over object relatives. Because the modified noun was marked dative-topic, factors such as parallelism (Sheldon, 1976), attraction (Keenan, 1981; Sauerland & Gibson, 1998) and perspective shift (MacWhinney & Pleh, 1988; Mitsugi, MacWhinney & Shirai, 2010) incorrectly predict an object preference or no preference between the two types of relative clauses. The subject advantage is not compatible with expectation-based models either (Gennari & MacDonald, 2008) given that there was an advantage for object relatives in the completion results of Norming 3.

## General discussion

We can classify languages into four types according to the positions of the relative clause (prenominal or postnominal) and the object (OV or VO) as follows: postnominal/SVO (e.g., English, French), postnominal/SOV (Dutch, German), prenominal/SVO (Chinese), and prenominal/SOV (Japanese, Korean, Turkish). Previous discussions of working-memory factors correctly predict the subject advantage in both types of postnominal languages as well as the object advantage in prenominal/SVO languages (Hsiao & Gibson, 2003; Lin & Garnsey, 2011; *inter alia*). The exception is prenominal/SOV languages, for which working-memory factors predict no difference or an object advantage. The results reported confirm the exceptional status of these languages even when ambiguity and expectation are taken into consideration.

We raised the possibility that ObS-based reactivation may explain the subject advantage in Japanese. It is also possible that simultaneous reactivation at the embedded verb cancels out any working-memory difference (Kwon et al, 2010), therefore only accessibility has an effect in Japanese. But there are at least two other alternatives that will also need future research. The first alternative is that the working-memory load difference is small in Japanese-type languages because linear decay involves only one NP (see Figures 2ab). If so, working memory may not be enough to explain the subject advantage in Dutch and German, for which the difference between subject and object extraction is also of one NP only. This would reinforce the need for another factor such as the ObS to complement working-memory factors in order to explain the subject advantage in these languages.

Another possibility is that *closure* may be relevant because it flushes out verbatim material out of working memory. Memory load is likely to decrease after closure is performed on a phrase. Moreover, the load may vary across languages depending on the timing of closure. In Japanese, a consistently head-final language, closure is likely to be performed immediately at the end of the phrase (for example at the verb of an embedded clause). In contrast, head-initial languages do not have a marker to indicate the end of the phrase; consequently, closure may be delayed and memory load linger in languages such as English. Mixed languages such as Chinese may also fail to generate closure consistently at phrase end especially if the marker is a short functional word (e.g., *de* for relative clauses) that can be easily skipped during reading.

In sum, a second factor apart from working-memory constraints is needed to explain the subject advantage in prenominal/SOV relative clauses. This may provide an opportunity to better understand how memory use is affected by processes such as closure during language comprehension.

[3] Before the topicalized noun is read, the sentences may be mistaken for SP constructions. It has been argued that perspective in SP relatives may remain unspecified after an accusative NP is read, therefore no shift occurs and subject extraction may be relatively easy (Mitsugi, MacWhinney & Shirai, 2010). However, it is unclear what exactly an unspecified perspective entails for the kind of representation assumed in perspective shift. Even the "neutral" point of view of an uninvolved spectator or the speaker would still require a shift when the perspective of the modified noun is adopted.

## References


Comrie, B. (2007). The acquisition of relative clauses in relation to language typology. *Studies in Second Language Acquisition*, *29*, 301-309.

Gennari, S. P., & MacDonald, M. C. (2008). Semantic indeterminacy in object relative clauses. *Journal of Memory and Language*, *58*, 161-187.

Gibson, E. (1998). Linguistic complexity: locality of syntactic dependencies. *Cognition*, *68*, 1-76.

Gordon, P. C., Hendrick, R., & Johnson, M. (2001). Memory interference during language processing. *Journal of Experimental Psychology: Learning, Memory and Cogni-*

*tion*, *27*, 1411-1423.

Grodner, D. J., & Gibson, E. A. F. (2005). Consequences of the serial nature of linguistic input for sentential complexity. *Cognitive Science*, *29*, 261-291.

Hsiao, F., & Gibson, E. (2003). Processing relative clauses in Chinese. *Cognition*, *90*, 3-27.

Ishizuka, T. (2005). Processing relative clauses in Japanese. In Okabe and Nielsen (Eds.), *Working Papers in Psycholinguistics*, *2* (pp. 135-157), UCLA Working Papers in Linguistics 13.

Ishizuka, T., Nakatani, K., & Gibson, E. (2003). Relative clause extraction complexity in Japanese. Poster presented at the 16th Annual CUNY Conference on Human Sentence Processing, Boston, March 2003.

Ishizuka, T., Nakatani, K., & Gibson, E. (2006). Processing Japanese relative clauses in context. Paper presented at the 19th Annual CUNY Conference on Human Sentence Processing, NY, March 2006.

Keenan, E. L. (1981). Relative clauses. In B. Comrie (Ed.), *Language Universals and Linguistic Typology* (pp. 138-164). Oxford: Basil Blackwell.

Keenan, E. L., & Comrie, B. (1977). Noun phrase accessibility and Universal Grammar. *Linguistic Inquiry*, *8*, 63-99.

King, J., & Just, M. A. (1991). Individual differences in syntactic processing: The role of working memory. *Journal of Memory and Language*, *30*, 580-602.

Kwon, N., Lee, Y., Gordon, P. C., Kluender, R., & Polinsky, M. (2010). Cognitive and linguistic factors affecting subject/object asymmetry: An eye-tracking study of prenominal relative clauses in Korean. *Language*, *86*, 546-582.

Levy, R. (2008). Expectation-based syntactic comprehension. *Cognition*, *106*, 1126-1177.

Lewis, R. L., Vasishth, S., & Van Dyke, J. A. (2006). Computational principles of working memory in sentence comprehension. *Trends in Cognitive Science*, *10*, 447-454.

Li, C. N., & Thompson, S. A. (1976). Subject and topic: a new typology of language. In C. N. Li (Ed.), *Subject and Topic* (pp. 457-61). London/New York: Academic Press.

Lin, Y., & Garnsey, S. (2011). Animacy and the resolution of temporary ambiguity in relative clause comprehension in Mandarin. In H. Yamashita, Y. Hirose, & J. L. Packard (Eds.), *Processing and Producing Head-final Structures* (pp. 241-275). Dordrecht: Springer.

MacWhinney, B., & Pleh, C. (1988). The processing of restrictive relative clauses in Hungarian. *Cognition*, *29*, 95-141.

Mak, W. M., Vonk, W., & Schriefers, H. (2002). The influence of animacy on relative clause processing. *Journal of Memory and Language*, *47*, 50-68.

Marantz, A. (1984). *On the Nature of Grammatical Relations*. Cambridge, Mass.: MIT Press.

Mitsugi, S., MacWhinney, B., & Shirai, Y. (2010). Cue-Based Processing of Relative Clauses in L2 Japanese. In M. T. Prior, Y. Watanabe, and S.-K. Lee (Eds.), *Selected Proceedings of the 2008 Second Language Research Forum: Exploring SLA Perspectives, Positions, and Practices* (pp. 123-138). Somerville, Mass.: Cascadilla Proceedings Project,

Miyamoto, E. T., & Nakamura, M. (2003). Subject/object asymmetries in the processing of relative clauses in Japanese. In G. Garding & M. Tsujimura (Eds.), *Proceedings of the 22nd West Coast Conference on Formal Linguistics* (pp. 342-355). Somerville, MA: Cascadilla Press.

Miyamoto, E. T., & Nakamura, M. (2005). Unscrambling some misconceptions: a comment on Koizumi and Tamaoka (2004). *Gengo Kenkyu*, *128*, 113-129.

Nakamura, M. & Miyamoto, E. T. (2013). The object before subject bias and the processing of double-gap relative clauses in Japanese. *Language and Cognitive Processes*, *28*, 303-334.

Pickering, M., & Barry, G. (1991). Sentence processing without empty categories. *Language and Cognitive Processes*, *6*, 229-259.

R development core team. (2009). *R: A Language and Environment for Statistical Computing*. Vienna: R Foundation for Statistical Computing, http://www.R-project.org.

Roland, D., Mauner, G., O Meara, C., & Yun, H. (2012). Discourse expectations and relative clause processing. *Journal of Memory and Language*, *66*, 479-508.

Sato, A. (2011). *Nihongo kankeisetuno syori fukao ketteisuru yoinno kento - koopasuni okeru siyo hindono eikyoo chuusinni (An Investigation of Factors that Determine Processing Load in Japanese Relative Clauses - With a Focus on Frequency Use in Corpora)* (In Japanese). Unpublished doctoral dissertation, Hiroshima University, Higashi Hiroshima, Japan.

Sauerland, U., & Gibson, E. (1998). Case matching in relative clause attachment. Paper presented at the 11th Annual CUNY Sentence Processing Conference, Rutgers University, New Brunswick, NJ, March 1998.

Schriefers H., Friederici A. D., & Kuhn K. (1995). The processing of locally ambiguous relative clauses in German. *Journal of Memory and Language*, *34*, 499-520.

Sheldon, A. (1976). Speaker's intuition about the complexity of relative clauses in Japanese and English. In S. S. Mufwene, C. A. Walker and S. B. Sanford (Eds.), *Papers from the Twelfth Regional Meeting of the Chicago Linguistic Society* (pp. 558-567). Chicago: Department of Linguistics: University of Chicago.

Sheldon, A. (1977). On strategies for processing relative clauses: A comparison of children and adults. *Journal of Psycholinguistic Research*, *6*, 305-318.

Tomlin, R. S. (1986). *Basic Word Order — Function Principles*. London: Croom Helm.

Traxler, M. J., Morris, R. K., & Seely, R. E. (2002). Processing subject and object relative clauses: evidence from eye movements. *Journal of Memory and Language*, *47*, 69-90.

Ueno, M. & Garnsey, S.M. (2008). An ERP study of the processing of subject and object relative clauses in Japanese. *Language and Cognitive Processes*, *23*, *646-688*.