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**CENTER-EMBEDDING AND
NOMINATIVE REPETITION
IN JAPANESE SENTENCE PROCESSING**

by

KEIKO UEHARA

**A dissertation submitted to the Graduate Faculty in Linguistics
in partial fulfillment of the requirements for the degree of
Doctor of Philosophy, The City University of New York**

2003

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ABSTRACT

CENTER-EMBEDDING AND NOMINATIVE REPETITION IN JAPANESE SENTENCE PROCESSING

by

Keiko Uehara

Advisor: Professor Dianne C. Bradley

This research investigates the processing difficulty associated with double center-embedding in Japanese, and the effect of three consecutive subject NPs identically marked with the nominative particle *-ga* offers the means to explore the mechanisms underlying the problem. Three interrelated experiments focus on structural manipulations.

Psycholinguists argue that the human sentence processing system is highly efficient, but that its resources have limits. The observation that fully grammatical double-embeddings such as “The rat the cat the dog chased ate died” (Chomsky & Miller 1963: 286) are unprocessable — as two-level center-embeddings are claimed to be, in general — is therefore viewed as a realization of the competence-performance distinction. Many explanations have been proposed, but just why these structures are problematic remains unresolved after half a century. Exploiting structural characteristics of

Japanese, this study adds to the body of available information, previously drawn mainly from studies of English.

Experiment 1 utilized two off-line processability rating tasks. The results suggest that processability improves in both single- and double-embeddings, whenever a sequence of three consecutive NP-*ga*'s is reduced or interrupted by a structural manipulation.

Experiment 2 employed a self-paced reading method and an experimental design devised to isolate any cost engendered by three consecutive NP-*ga*'s. The results show that detectable costs exist only in double center-embedding, suggesting that the parser has difficulty making identical structural assignments, repeatedly, for surface-adjacent constituents. Identity and adjacency factors also explain English embeddings of varying kinds.

Experiment 3 used an off-line sentence completion task to explore the impact of an ambiguity associated with NP-*ga*, given its multiple syntactic functions: -*ga* case-marks single subjects, parallel subjects, nominative objects, and external possessors. While it is agreed that the English double center-embedding problem is unrelated to ambiguity, the situation is *a priori* less clear in Japanese. This study shows, for the first time, that NP-*ga* is interpreted with high probability as a single subject, suggesting that it is effectively unambiguous when encountered in Japanese double-embeddings. Detailed analyses of the sentence completion database illustrate the intersection of NP-*ga*'s syntactic roles and universal processing principles, lending support to the claim that the parser is not parameterized.

*To my parents, Takaaki & Mariko;
to my husband, Raymond;
to our good dog, Virgil,
and all our other furry family members*

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New York City

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LIST OF ABBREVIATIONS

ACC	Accusative
AOC	Accusative Object Construction
A-PSC	Adjacent Parallel Subject
DAT	Dative
EPC	External Possession Construction
GEN	Genitive
IPC	Internal Possession Construction
LOC	Locative
MA	Minimal Attachment
MCP	Minimal Chain Principle
ML	Minimal Lowering
MSC	Multiple Subject Construction
NOC	Nominative Object Construction
NOM	Nominative
N-PSC	Non-adjacent Parallel Subject
PM	Possessum
PoNP	Primary over Non-Primary
PR	Possessor
PSC	Parallel Subject Construction
SSC	Single Subject Construction
TIMC	Transparent Interpretation of Morphological Case
TOP	Topic

CHAPTER 1

INTRODUCTION

1.1 Center-Embedding and NP-ga Repetition

The human language comprehension mechanism is a rapid and reliable system, the final product of which is a mental representation of sentential meaning. The processes of structure building and meaning (re)construction draw on a domain-specific knowledge, necessarily, and the comprehension mechanism is therefore likely to have characteristics that are very different from other cognitive processes, such as recognizing figures or interpreting a series of numbers. It is usually assumed that, in computing a representation of sentential meaning, the mechanism begins to hypothesize the structure of an input as a string of words is encountered, i.e., incrementally.

The incremental assignment of a hypothesized structure, as inputs are received, implies that working memory resources must hold and manipulate partially processed products. While such partial products are less burdensome than wholly unstructured material (Miller 1957), there is nonetheless a limit on resources (Chomsky & Miller 1963; Frazier 1978; Frazier & Fodor 1978; Miller & Chomsky 1963). That limit is barely noticeable except in special circumstances, presumably because the way the comprehension mechanism functions is normally very efficient. However, a striking manifestation of the limit is seen in

the processing difficulty associated with the so-called double center-embedding construction (Chomsky 1959; Chomsky & Miller 1963; Miller & Chomsky 1963; Miller & Isard 1964). The phenomenon is illustrated by English sentences, such as (1.1):

(1.1) # The rat the cat the dog chased ate died.

(Chomsky & Miller 1963: 286)

As indicated by the symbol #, sentences of this kind are usually judged to be incomprehensible, even though they are grammatically well-formed.¹ Since the grammars of human languages are assumed to produce an infinite number of well-formed sentences, without any limit on recursion, the processing difficulty seen for doubly center-embedded structures such as (1.1) has been taken as a realization of the difference between competence, on the one hand, and performance, on the other (Bever 1970; Chomsky 1959; Chomsky & Miller 1963; Fodor et al. 1974; Miller & Chomsky 1963; Miller & Isard 1964):

The fact that an indefinite number of self-embeddings is grammatically acceptable, yet at the same time psychologically unacceptable would seem to imply that a clear distinction is necessary between our theory of the language and our theory of the language user.

(Miller & Isard 1964: 294)

¹ Some researchers have denied the grammaticality of such sentences, e.g., Marks (1968); Reich (1969). This issue is discussed in Section 1.2.

Although there have been a great many investigations of the mechanisms underlying the processing problem engendered by doubly center-embedded structures, the issue has yet to be definitively resolved, and it stands as a central problem in the field of psycholinguistics, for more than half a century.

The studies reported in this dissertation further explore the processing difficulty associated with doubly center-embedded constructions, and do so through an examination of the effect of repetitive use of nominatively marked NPs on the processing of Japanese center-embedding sentences. Three separate but interrelated experiments are reported, which focus on the processing effect of structural manipulations in double and single center-embeddings, and on the multiple syntactic functions of the nominative case-marker *-ga*.

The reason for using Japanese and NP-*ga* repetition to investigate the problem of double center-embedding problem is the following: Although there are many existing studies, the majority of these focus on English. Since a standard assumption in psycholinguistics is that the human language processing mechanism (hereafter, the parser) is universal — its fundamental characteristics do not vary across languages — studies of a different language offer different opportunities for elucidating that mechanism. In particular, the contrast between a language such as English (head- and complementizer-initial, with no overt case-markers²) and one such as Japanese (head- and complementizer-final, with overt case-markers) is likely to bring new insights.

² In English, abstract case is overtly realized in a very few instances, e.g., the Saxon possessive “-’s”, and pronouns such as “I”, “my”, and “me”.

Against with this briefly sketched background, we now turn to the two phenomena that initially motivate the current study: the phenomenology of double center-embedding, essentially comparable in English and Japanese; and the intuition that, in Japanese in particular, there is an isolable contribution to the difficulty of processing double-embeddings that arises from the presence of consecutive NPs marked with nominative *-ga*.

The phenomenal picture with center-embedded structures is that, while there is no large degrade in processability from a simple one-clause structure to one with a single level of embedding, there is a dramatic difference between one and two levels of center-embedding. This is illustrated for English by the relatively minor difference between examples (1.2a-b), on the one hand, and the marked difference between examples (1.2b-c), on the other.

- (1.2) a. [s The teacher danced.]
 b. [s The student [s the teacher taught] danced.]
 c. # [s The boy [s the student [s the teacher taught] met] danced.]

Despite the many structural differences between English and Japanese,³ the effect on processability of the number of levels of embedding is similar across these languages. That is, the contrast observed in English is replicated in Japanese, as illustrated in comparisons of examples (1.3a-b), and of examples (1.3b-c).

³ We discuss the structural differences between English and Japanese center-embeddings in Section 2.2.

- (1.3) a. [s sensei-ga odotta.]
 teacher-Nom danced
 "The teacher danced."
- b. [s gakusei-ga [s sensei-ga odotta]-to itta.]
 student-Nom teacher-Nom danced-that said
 "The student said that the teacher danced."
- c. # [s shoonen-ga [s gakusei-ga [s sensei-ga odotta]-to itta]-to
 boy-Nom student-Nom teacher-Nom danced-that said-that
 hanasita.]
 spoke
 "The boy stated that the student said that the teacher danced."

Note that, just as English (1.2c) is a sentence with three sentence-initial surface-adjacent subject phrases (*The boy the student the teacher*), so is Japanese (1.3c) (*shoonen-ga gakusei-ga sensei-ga*). But for Japanese, a simple device is available to reduce the number of consecutive NP-*ga*'s from three to two, without changing other aspects of the structure or basic meaning: For example, the first NP can be marked with the topic marker *-wa*. Native intuition suggests that processability clearly improves, as shown in (1.4).

- (1.4) #? [s shoonen-wa [s gakusei-ga [s sensei-ga odotta]-to itta]-to
 boy-Top student-Nom teacher-Nom danced-that said-that
 hanasita.]
 spoke
 "As for the boy, he stated that the student said that the teacher danced."

This observation suggests that not all double center-embeddings in Japanese are problematic for the parser, and that the processing difficulty noted for (1.3c), the closest parallel to English (1.2c), includes a contribution attributable to the repetitive use of NP-*ga* which is typical of this kind of center-embedding. Investigations of the effect of the NP-*ga* repetition on the processing of Japanese center-embedded sentences may, therefore, provide some clarification of the way in which the double center-embedding problem arises.

The first experiment to be reported was a preliminary examination that investigates the effect on processability of a sequence of three consecutive NP-*ga*'s (hereafter, 3*ga* sequence or string) in doubly center-embedded sentences.⁴ The primary purpose of this experiment was to confirm the intuition that there is a detectable contrast in processability between sentences with and without a 3*ga* sequence. For this exercise, participants were asked to perform two off-line tasks, these being variants of a judgment of processing difficulty. To create sentences without 3*ga* strings that were minimally different from those with 3*ga* strings, manipulations for materials construction were devised, involving particle substitutions and an adverb insertion. The findings of the experiment were entirely positive: A doubly center-embedded sentence was always judged more difficult to process when it contained a 3*ga* sequence, cf. its counterpart in which that sequence is either minimized or broken. This suggests that there is indeed a processing cost associated with a 3*ga* sequence, above and beyond

⁴ The experiment also included one instance testing the effect of 3*ga* in a single center-embedding.

the cost associated with the double center-embedding construction *per se*.

The second experiment investigated in detail whether the 3ga processing cost identical in the first experiment generalizes across double and single center-embedding contexts. In this experiment, designs to isolate any 3ga cost in doubly and singly center-embedded materials were created under parallel logic, and these were combined for presentation in one protocol. This allowed statistical analyses on each materials-set independently, as well as a comparison across the two sets. The protocol used a self-paced whole-sentence technique, and measured reading times for whole sentences. Arguably, the reading-time measure is less affected by extraneous factors than the off-line judgment tasks employed in the initial experiment.

The third experiment was a large-scale exploratory investigation of the parser's preferred interpretation of the nominative marker *-ga*. The nominative marker *-ga* has multiple syntactic functions, four of them being relevant in the current context: *-ga* can mark a single subject, a nominative object, an external possessor, and a parallel subject. While there is a consensus that the center-embedding problem in English is not attributable to any ambiguity in interpretation, there is no existing literature (to the author's knowledge) that provides information about whether an NP-*ga* encountered in input is ambiguous for the parser, or about whether any ambiguity arising from *-ga*'s multiple possible roles contributes to the center-embedding problem in Japanese. If *-ga* were ambiguous for the parser, the extent of that ambiguity would grow exponentially as one NP-*ga* after another was encountered. This might be a major source of

any isolable difficulty associated with 3ga sequences. An off-line sentence completion task was used to explore this issue.

The three experiments utilize structural characteristics that Japanese exhibits but English does not, and uncover important new facts not only about processing in the double center-embedding construction but also about interactions between the structural properties of Japanese and general processing principles that the language processing mechanism prefers to employ.

1.2 Theoretical Background

As its syntactic background, this study adopts the generative framework (Chomsky 1965, 1981, 1986a, b, 1993, 1995), and assumes that the structure of Japanese sentences is configurational (see Hoji 1985; Saito 1985; Tateishi 1991, among others). This study also follows common syntactic assumptions that abstract case in Japanese is morphologically realized in post-nominal positions by particles (Kuroda 1992; Kuno 1973b; Saito 1985, among others), and that particles are classified into two categories, case-markers and postpositions (Miyagawa 1989): The former themselves do not have semantic content and are the morphological realization of abstract case, e.g., *-ga* (Nom) and *-o* (Acc), while the latter do have semantic content, e.g., *-kara* ("from") and *-made* ("up to" or "until"). In the case of the *-ni* marker, this study assumes two roles: the dative case marker and a postpositional role (e.g., "in", locative). Finally, this study

follows the standard assumption that multiple center-embedding constructions are grammatical (e.g., Bever 1970; Chomsky & Miller 1963; Miller & Chomsky 1963, among others, cf. Marks 1968; Reich 1969).⁵

As its psycholinguistic background, this study follows several standard psycholinguistic assumptions that have been established on the basis of considerable empirical evidence. First, this study assumes that the human sentence processing mechanism is a universal system, i.e., a completely non-parameterized mechanism (e.g., Inoue & Fodor 1995,⁶ among others, cf. Hoover 1992;⁷ Mazuka & Lust 1990; Frazier & Rayner 1988). Second, it is assumed that the parser assigns structure to linguistic input on the basis of grammatical knowledge, in the first instance, and that the process of sentence

⁵ Some researchers (e.g., Marks 1968) consider double center-embedding structures to be ungrammatical, and a theory proposed by Reich (1969) limits grammatical center-embedding constructions to one level in any language. For details of debates on whether the doubly center-embedded structure is grammatical, see De Roeck et al. (1982), among others. Claims about the ungrammaticality of center-embedding often involve the infrequency of doubly center-embedded structure in daily life. In his discussion of the infrequency of the structure, Kuno (1974a) examines a variety of structures in a variety of languages and argues that "languages embody devices to minimize syntactic patterns that cause perceptual difficulties" (Kuno 1974: 122).

⁶ Inoue & Fodor (1995: 48) argue that the parser is fully universal and unparameterized, but that it sometimes *appears* to be parameterized because its principles and strategies interact with the structure of sentences of a given language.

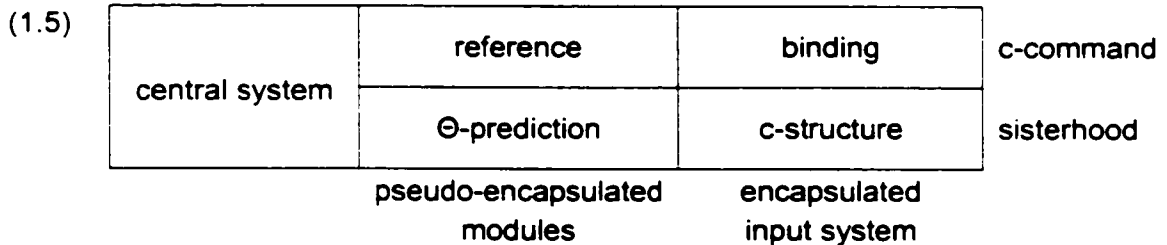
⁷ Hoover (1992) performed experiments examining, supposedly in parallel, how English (N=12) and Spanish (N=12) speakers process center-embedded sentences. The experiments presented the materials employing a self-paced reading paradigm, and measured comprehension in a post-sentence-reading task that asked participants to indicate whether a given S-V-O sequence was part of the sentence just read. Hoover argues that his findings offer strong evidence against a universal parsing model, the difference coming from the use of different strategies between the two languages. He reports that, compared to English speakers, Spanish speakers not only found doubly center-embedded sentences easier to understand but also experienced less "end of clause effects". It is unclear how these findings serve as evidence against a universal parsing model.

comprehension is incremental in the sense that the parser does not wait until the end of the sentence to begin hypothesizing an assigned structure (e.g., Frazier 1978; Frazier & Fodor 1978, Inoue & Fodor 1995, among others). Third, it is assumed that there are universal processing principles and strategies adopted by the parser (e.g., De Vincenzi 1991, 1994; Frazier 1978; Frazier & Fodor 1978; Inoue & Fodor 1995, among others).

Also, the current study assumes that the process of sentence comprehension is modular (Fodor 1983; see also Ferreira & Clifton 1986; Fodor 1988, 1990, 1995; Frazier 1985, 1987, 1990, 1999, among others). That is, the language comprehension mechanism is taken to consist of separate components. This study follows the proposal made by Fodor (1983) that the mind has systems of two distinct types, input modules and the central processor, and that the input modules are informationally encapsulated. In other words, each module corresponds to a level of linguistic analysis (such as phonological, lexical, and syntactic analyses) and is autonomous in the sense that it can process only the information stated in its own representational terms (Frazier 1985), being insensitive to information stated in other terms. At the final stage, the central system works on the output of the linguistic modules, and incorporates non-linguistic information such as world knowledge (and possibly discourse representations). A typical assumption in the psycholinguistic literature under the modular view is that the syntactic module is entirely independent of other modules, completes the first-pass stage without being influenced by semantic and pragmatic information, and feeds its product into the next module such as

the thematic processor (Frazier 1999). For a discussion of different approaches to this issue, see Fodor (1990).

The schematization in (1.5) is the model proposed by Frazier (1990, 1995, 1999), which focuses on post-lexical modules.



(Frazier 1999: 133)

Frazier's model assumes two encapsulated syntactic modules (i.e., the binding and c-structure modules) and two pseudo-encapsulated interpretive modules (i.e., the reference and Θ -prediction modules). The role of the syntactic modules is to construct a well-formed syntactic representation. To accomplish this, they use only the output of the phonological and lexical modules and relevant syntactic information. The role of the interpretive modules is to find the appropriate thematic representation (the Θ -prediction module) and the appropriate interpretation of DPs and scope (the reference module). Frazier assumes a pseudo-encapsulation of the interpretive modules (cf. Fodor 1983), which may communicate with the central processor to consult world knowledge (and discourse representations). However, at what stage and how semantic/pragmatic information is incorporated into the output of the syntactic modules and what role is played by lexical information have been matters of

intense debate in the field (see, e.g., Fodor 1988, 1990; Frazier 1990, among others).

Finally, this study considers the parsing mechanism to be serial (e.g., Ferreira & Clifton 1986; Frazier 1978; Frazier & Fodor 1978; Fodor & Inoue 1994; Inoue & Fodor 1995, among others). The assumption here is that the parser computes just one analysis under the guidance of general principles and strategies (even when alternative analyses are possible), in order to function as economically as possible. This implies that the structural choice initially made by the parser may turn out to be incorrect — incompatible with subsequent input or interpretively odd — requiring a reanalysis during so-called second-pass parsing (e.g., Ferreira & Clifton 1986; Frazier 1978; Frazier & Fodor 1978; Fodor & Inoue 1994; Inoue & Fodor 1995, among others).

This section now turns to a brief consideration of several general processing principles that the parser is assumed to prefer in structure-building. Overall, the priority guiding the parser's choices has been dubbed **Minimal Everything** (Inoue & Fodor 1995: 35), and under this rubric the principles given in (1.6) and (1.7) below are included.⁸

⁸ Besides the principles given in the above text, **Minimal Everything** also covers the following (Inoue & Fodor 1995: 49): **Right Association** (the preference for low right attachment), **Late Closure** (the preference to keep processing the most recently postulated phrase as far as possible), and **Local Attachment** (the preference for a close relation between adjacent items in input). According to Inoue & Fodor (1995: 50-51), Right Association and Late Closure are not applicable in Japanese because every constituent ends with its head and phrases cannot generally be extended to the right; Local Attachment does apply to Japanese, but cannot be distinguished from Minimal Attachment because non-local attachment in Japanese would always disobey Minimal Attachment at the same time.

(1.6) Minimal Attachment:

Attach incoming material into the phrase marker being constructed using the fewest nodes consistent with the well-formedness rules of the language under analysis.

(Frazier 1978; Frazier & Fodor 1978)

(1.7) Minimal Chain Principle:

Avoid postulating unnecessary chain members at S-structure, but do not delay required chain members.

(De Vincenzi 1991: 13)

Minimal Attachment is highly relevant to this study, particularly with respect to the tradeoff between different syntactic interpretations of NP-*ga* and the number of resulting phrasal nodes. That is, when each of more than one overt NP-*ga* is interpreted as the single subject of its own clause, the sentence must have (at least) the same number of clauses as there are overt NP-*ga*'s.⁹ As we will see in Chapters 3 and 6, the fact that -*ga* has more than one syntactic role means that the number of clauses in a sentence varies for different readings of NP-*ga*: For example, with no null subjects and the second NP-*ga* of an [NP-*ga* NP-*ga*] sequence taken as a nominative object, the sentence has just one clause, whereas if both NP-*ga*'s are taken as single subjects, it has two clauses.

The Minimal Chain Principle is relevant to our later discussions in the following sense: The syntactic functions of -*ga* and other particles utilized in the current study may or may not be analyzed as involving movement, depending on

⁹ Since Japanese allows *pro*-drop, null subjects are possible; thus the number of clauses can exceed the number of overt subjects.

the function.¹⁰ Thus, when a construction is assumed to involve movement, a processing cost is predicted, and the parser presumably avoids hypothesizing constructions involving movement, all else being equal. For example, if scrambling involves movement (see e.g., Saito 1985, among others), the Minimal Chain Principle predicts that the parser prefers a null element, which is associated with a singleton chain (i.e., just one member), over scrambling, which involves multi chain members, at a particular point of incremental processing. A fewer chain members are more economical and thus preferred in the parser's ranking of structural hypotheses, all else being equal.¹¹

While the above principles state the general preference for Minimal Everything in terms of the overt syntax, the preference is also assumed with respect to the interpretation of the overt copy of lexical item at LF, as in (1.8).

(1.8) Minimal Lowering:

Lower only when necessary (e.g., interpret a DP in its surface position if possible.)

(Frazier 1999: 119)

Frazier (1999) proposes that Minimal Lowering applies within the reference module in (1.5), which determines the non-thematic interpretation of DPs and

¹⁰ As we will see in Chapters 3 and 6, existing syntactic analyses can vary in terms of whether *-ga*'s roles (and those of other particles used in this study) involve movement, and at what stage movement is involved.

¹¹ The sentence completion data presented in Chapter 7 include many instances of null subjects and scrambling.

their scope.¹² That is, the overt copy of a lexical item must be interpreted non-thematically (e.g., quantificationally, existentially, and so forth) at LF, and this is also subject to a preference for economy, i.e., early interpretation of a DP. Minimal Lowering is relevant to this study, particularly with respect to the focused reading of NP-*ga* that results from an interaction between the stativity of the verb in a nominative object construction and the interpretation of subject NP-*ga* in the same clause (see Chapters 3 and 7).

Another principle that will be relevant in our discussion is one that can be stated as in (1.9):

(1.9) Primary over Non-Primary:

If an element is ambiguous between an argument and an adjunct, interpret it as an argument.

(Frazier & Clifton 1996: 3;
see also Abney 1989; Gibson 1991; Pritchett 1988, 1992)

Arguments and adjuncts are referred to as primary and non-primary, respectively, in the terms of Frazier & Clifton's (1996) proposal.¹³ The preference for primary

¹² Frazier (1999) assumes that LF is the interface between syntax and non-thematic aspects of interpretation, and that the position of an overt copy of a lexical phrase determines its referential (non-thematic) interpretation.

¹³ Frazier & Clifton (1996) propose the Construal Principle given in (i) below to explain the means by which an adjunct is processed, when the possibility of its being an argument as been ruled out.

over non-primary is relevant to this study with respect to the interpretation of NP-*ni*. As mentioned above, the *-ni* particle functions as the marker of dative case or as a locative postposition. As the dative marker, it marks not only indirect objects but also experiencer subjects. That is, NP-*ni* can be either an argument (indirect object, experiencer subject) or an adjunct.

As we proceed through the report of the current study, it will emerge that the data are broadly compatible both with the general picture of the human sentence processing mechanism as sketched in this section, and with particular processing principles already proposed to guide the parser's structure-building choices (see (1.6) through (1.9), above).

However, it will also emerge that more may need to be said than is currently proposed in the field. In particular, it has been standard to propose that syntactically unstructured material is burdensome, given a limit on the resources available to the parser (Miller 1957; Inoue & Fodor 1995, among others); likewise, semantically uninterpreted material (Frazier 1999, among others). Consideration of a head- and complementizer-final language in which case-markers are overt, like Japanese, may motivate our adoption of additional principles, such as the following:

(i) Construal Principle:

- i. Associate a phrase XP that cannot be analyzed as instantiating a primary relation into the current thematic processing domain.
- ii. Interpret XP within that domain using structural and non-structural (interpretive) principles.

(Frazier & Clifton 1996: 41-42)

Frazier & Clifton (1996: 42) define "the current thematic processing domain" as "the extended maximal projection of the last theta assigner".

(1.10) Transparent Interpretation of Morphological Case:

Interpret morphological case transparently, i.e., as attesting its prototypical role.

A principle of this kind permits an incremental parser to make *early* structural choices on the basis of information provided by morphologically realized case (see, e.g., Inoue 1991; Miyamoto 2002; Uehara 1997b, c, d; Yang 1999). An important issue here, and one considered in detail in Chapters 7 and 8, is whether such a principle requires independent statement or instead falls out of the principles already in hand. Details here may depend crucially on the syntactic analyses adopted of the different abstract cases instantiated by the same overt case-marker.

1.3 Overview

Evidence arising in the three experiments reported in this dissertation contributes to the psycholinguistic field in several ways: First, contrary to an earlier suggestion (e.g., Babyonyshev & Gibson 1995; see also Kimball 1975; Lewis 1996) that Japanese speakers may experience less difficulty than English speakers with doubly center-embedded sentences, it is shown that such sentences induce severe processing difficulty when the three subjects are adjacent and identically marked with the nominative case-marker *-ga*. Second, it is argued that the “problem” with double center-embedding cannot be attributed

to incomplete application of phrase structure rules, incomplete case-assignment relations of the same kind, incomplete thematic relations, or similarity-based interference effects of potential X-bar relations. Rather, the evidence will demonstrate that the human sentence processing mechanism is sensitive to the repetition of structural relations of the same *actual* kind, when their incorporation into a complete syntactic structure is necessarily defined. Third, an NP-*ga* encountered as input is not, by and large, treated as ambiguous by the parser; instead, it is preferentially interpreted transparently as its prototypical syntactic role, that of subject in its own clause. That is, we conclude that any processing problem with Japanese doubly center-embedded sentences turning on the presence of a 3*ga* sequence is not specifically created by the multiple syntactic functions of the nominative case-marker -*ga*. Finally, in the course of processing Japanese sentences, the parser deploys universal principles which are ultimately sourced in considerations of economy.

The remaining chapters of this dissertation are organized as follows: Chapter 2 reviews the structural characteristics of the Japanese center-embedding construction, and discusses earlier research on the processing of center-embeddings. In the course of that discussion, we summarize language-general characteristics of the processing problem, and review earlier findings on the processing of Japanese center-embedded sentences, specifically. We then sketch existing explanations, which attribute the processing problem to incomplete dependencies or to similarity-based interference effects; here, the discussion of similarity-based interference includes

syntactic, semantic, and phonological similarity. (Although the current study focuses on syntactic factors, effects based on semantic and phonological similarity also seem possible).

Three experiments (Experiments 1, 2, and 3) are reported in Chapters 4, 5, and 7, respectively. Four of *-ga*'s syntactic functions are relevant to this study, and these are summarized in two separate chapters: Chapter 3 discusses those two of *-ga*'s properties that are relevant to Experiments 1 and 2, and Chapter 6 reviews the remaining properties that are relevant only to Experiment 3.

Chapter 3, discussing the functions of *-ga* relevant to Experiments 1 and 2, considers *-ga* as the marker of single subjects, its prototypical role, and *-ga* as the marker of nominative objects. The purpose of this chapter is to provide background information about some syntactic and interpretive characteristics of *-ga*, and to prepare the way for the syntactic manipulations exploited in Experiments 1 and 2. In the materials of these experiments, doubly center-embedded structures are constructed to create environments in which the processability of sentences with and without a *3ga* sequence can be compared, while maintaining the level of embedding and basic sentential meaning. To construct such environments, a *3ga* sequence is minimized by replacing a *-ga* marker in the sequence with a different particle, variously *-wa* (Top), *-no* (Gen), or *-o* (Acc); alternatively (Experiment 1) and/or additionally (Experiment 2), that *3ga* sequence is broken up via insertion of an adverbial phrase within the sequence. To illustrate the basic idea underlying these manipulations, sections of Chapter 3 briefly sketch them and set out the characteristics of the three replacing particles,

and describe their relationships with *-ga*.

Chapter 4 reports the preliminary investigation of the effect of NP-*ga* repetition on the processing of Japanese center-embedded sentences. Employing two kinds (absolute, relative) of processability judgments in off-line tasks, Experiment 1 provides evidence for the existence of a processing cost associated with a 3*ga* sequence in center-embedding: The data of absolute processability ratings in Experiment 1A show that a doubly center-embedded sentence with a 3*ga* sequence is always significantly more difficult to process than its 2*ga* counterpart, indicating the existence of a special processing cost associated with a 3*ga* sequence above and beyond the cost associated with the double center-embedding construction *per se*; the data of the relative processability ratings in Experiment 1B replicated this outcome. Experiment 1B included one instance comparing a *single* center-embedded sentence with a 3*ga* sequence with its 2*ga* counterpart, and the off-line data here raise the possibility that a 3*ga* cost may be quite general.

Chapter 5 reports on an experiment investigating whether the 3*ga* cost found in Experiment 1 is indeed general to double and single center-embedded contexts. Since Experiment 1 used off-line tasks, the measures it collected may well include contributions from very late stages of processing, and are open to contamination from, e.g., stylistic conventions. To obtain cleaner data, Experiment 2 was run on a larger and more closely controlled materials set, and employed a self-paced reading technique collecting whole-sentence reading times. The materials incorporated both a double center-embedding design and

a single center-embedding design, which were put together under parallel logic. The findings of Experiment 2 show that a 3ga cost is detectable only in double center-embedding. The implications drawn from these findings inform various previously reported processing phenomena in center-embedding, discussed in the existing literature.

Chapter 6 discusses two further of *-ga*'s syntactic functions: *-ga* as the marker of external possessors, and as the marker of parallel subjects. These functions are relevant to the investigation of the potential ambiguity of *-ga* in Experiment 3, as are the two functions considered in Chapter 3 (single subject *-ga*, nominative object *-ga*). The review of *-ga* as the external possessor marker summarizes several analyses proposed in the literature, as does that for *-ga* as the parallel subject marker. However, a subtype of the latter occurs only in literary contexts, and has not been taken up in the literature. For this reason, a preliminary analysis is proposed.

Chapter 7 reports on Experiment 3, which explores the parser's preferred interpretation of *-ga*, given its multiple possible syntactic roles. This experiment employed an off-line sentence completion paradigm, which asks participants to produce a grammatical and natural sentence by adding anything they want to each of sentence-initial fragments that are presented. (Note that Japanese is an SOV head-final language with overt case-markers, sentences frequently begin with a series of overtly case-marked NPs.) When the structures that were imposed on those fragments in participants' completion responses are analyzed to find the systematicities in structural assignments, we have evidence about the

structural hypotheses the parser preferentially makes for NP sequences. Some sentence-beginning fragments in the task included one or more NP-ga's together with other overtly case-marked NPs, in various orderings, while others had only a sequence of NP-ga's. The sentence completion data of Experiment 3 are reported as summaries of five databases. Each summary illustrates interesting interactions among (or perhaps competitions between) the general principles we have discussed in Section 1.2. The outcomes of Experiment 3 as a whole indicate that the most likely interpretation of NP-ga is that of single subject. This finding is discussed with respect to the findings of Experiments 1 and 2.

Finally, Chapter 8 draws together the experimental findings of the dissertation and discusses them as a whole. We also consider important issues for future research.

CHAPTER 2

EARLIER STUDIES ON CENTER-EMBEDDING AND SIMILARITY-BASED INTERFERENCE

2.1 Introduction

This chapter discusses some structural characteristics of Japanese center-embedding constructions and reviews several earlier explanations of the processing problem with double center-embedding. Section 2.2 summarizes properties of Japanese center-embedding structure, discussing its similarities to and differences from English center-embedding structure. Section 2.3 reviews some general characteristics of the processing problem with the double center-embedding construction discussed in the existing literature. This section also includes earlier observations and findings about the processing of Japanese center-embedding that are related to those general characteristics. Sections 2.4 to 2.6 are reviews of earlier accounts: The problem with double center-embedding is often attributed to incomplete syntactic dependencies. Section 2.4 summarizes an early hypothesis about incomplete application of phrase structure rules, and then discusses assumptions about incomplete dependencies, such as case assignment relations, X-bar relations, and thematic relations. Section 2.5 reviews an alternative view that assumes dependency locality and discourse reference to be important factors. An extension of the

incomplete-syntactic-dependency account considers similarity-based interference effects to be important. Our discussion here includes syntactic, semantic/pragmatic, and phonological similarity effects, but syntactic similarity-based interference is of direct relevance to the current study. These issues are reviewed in Section 2.6. Section 2.7 is a summary of this chapter.

2.2 Structural Characteristics of Japanese Center-Embedding

The center-embedding construction is a construction in which one category is embedded in the middle of another category, as schematized in (2.1a). Since the level of embedding of (2.1a) is one degree, the structure involves a single center-embedding. If another category is buried in the middle of the embedded category in (2.1a), the resulting configuration is a double center-embedding, as illustrated in (2.1b).

- (2.1) a. $[a \dots [a \dots] \dots]$
 b. # $[a \dots [a \dots [a \dots] \dots] \dots]$

The term “center-embedding” is often used interchangeably with “self-embedding”. Strictly, however, self-embedding is a special case of “center-embedding”: When all the categories involved in the embedding are of the same kind, the embedded configuration is referred to as self-embedding, as indicated by the symbol α in (2.1). In the current study, the term

“center-embedding” is used as a general term that also includes “self-embedding”, noted otherwise, since part of our discussions specifically refers to “self-embedding” to mean a special case of center-embedding.

In Japanese, various center-embedding constructions are possible. For example, a center-embedding construction may or may not involve relative clauses with argument extraction. Given the structural characteristics of Japanese, i.e., head-final and complementizer-final SOV, center-embedding constructions with and without relative clauses can be roughly schematized, as in (2.2a) and (2.2b), respectively, where the symbol “_” indicates a gap from which an extracted constituent originates: (2.2a) schematizes a double center-embedding structure involving two object-extracted relative clauses, whereas (2.2b), a double center-embedding structure involving sentential complements.

(2.2) a. [NP₁ [[NP₂ [[NP₃ _ V₃] NP₄] _ V₂] NP₅] V₁]

b. [NP₁ [NP₂ [NP₃ V₃] V₂] V₁]

In the current study, the test materials of Experiments 1 and 2 (Chapters 4 and 5, respectively) use only the (2.2b) type, for the following two reasons: (i) it is the type that is usually discussed in the existing literature on Japanese embeddings; (ii) it is the closest in surface form to the typically problematic English center-embedding with object-extracted relative clauses, schematized in (2.3).

(2.3) [[NP₁ [[NP₂ [NP₃ V₃ _] V₂ _] V₁]

Thus, the current study primarily focuses on Japanese center-embedding constructions without relative clauses that involve argument extraction. Some of the sentence completion responses in Experiment 3 (reported in Chapter 7), however, involved a relative clause either in the innermost or middle embedded clause. Thus, part of our discussion of that experiment includes center-embedding with relative clauses, and the discussion extends to Chapter 8.

Since Japanese is a head-final and complementizer-final SOV language, center-embedding constructions without relative clauses involve embedding of sentential complements, as schematized in (2.4). In (2.4), each NP-*ga* is the subject of its own clause, and the complementizer *-to* (“that”) is attached to the end of each embedded verb as a suffix.

(2.4) a. [_{IP} NP-*ga* [_{IP} NP-*ga* V]-*to* V]
 b. # [_{IP} NP-*ga* [_{IP} NP-*ga* [_{IP} NP-*ga* V]-*to* V]-*to* V]

The schematization in (2.4a) is single center-embedding, and that in (2.4b) is double center-embedding. Neither of the simplified schematizations in (2.4) contains an indirect object or a direct object, but some experimental sentences used in the current study include one or more objects. The canonical word order with those objects in Japanese is [Subject-*ga* (Nom) – Indirect Object-*ni* (Dat) – Direct Object-*o* (Acc)].

The example sentences in (2.5a-c) below involve one clause, a single center-embedding, and a double center-embedding, respectively.

- (2.5) a. [_S sensei-ga odotta.]
teacher-Nom danced

“The teacher danced.”

- b. [_S gakusei-ga [_S sensei-ga odotta]-to itta.]
student-Nom teacher-Nom danced-that said

“The student said that the teacher danced.”

- c. # [_S shoonen-ga [_S gakusei-ga [_S sensei-ga odotta]-to
boy-Nom student-Nom teacher-Nom danced-that
itta]-to hanasita.]
said-that spoke

“The boy stated that the student said that the teacher danced.”

Compare the above examples with the English examples given in (2.6):

- (2.6) a. [_S The teacher danced.]

- b. [_S [_{NP} The student_i [_S the teacher taught *t_i*] danced.]

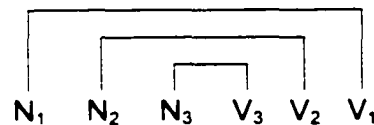
- c. # [_S [_{NP} The boy_i [_S [_{NP} the student_j [_S the teacher taught *t_j*]]met *t_i*] danced.]]

Unlike the Japanese examples in (2.5), these English center-embedded sentences involve object-extracted relative clauses. Another obvious difference between the two languages is that the NPs in Japanese sentences are overtly

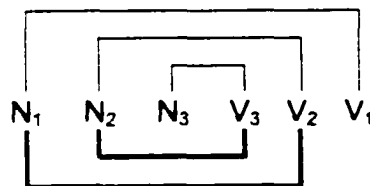
case-marked,¹⁴ whereas those in English sentences do not indicate case overtly except for limited occasions such as pronouns, e.g., “I” or “he”. English doubly center-embedded sentences can have pronouns only in the innermost subject position. (Other structural characteristics of Japanese different from English include *pro*-drop and scrambling, and these are relevant to Chapter 7.)

The difference of the above double center-embedding structures between sentential complements in Japanese and object relative clauses in English is reflected in the difference of argument-verb dependencies that the parser must find out to reach sentential meaning, as schematized in (2.7) and (2.8).

(2.7) Japanese



(2.8) English



While both languages involve doubly nested configurations, English involves two additional filler-gap dependencies because of the extracted objects in the relative

¹⁴ In daily conversation, overt case-markers are frequently deleted, but all the experimental materials and the data in the current study do not involve case deletion. For a discussion of case deletion, see e.g., Kobuchi-Philip (1994), among others.

clauses, as indicated with darker lines. Many earlier studies (e.g., Bever 1970; Just & Carpenter 1987, among others) point out the following two as main sources of the double center-embedding problem in English: (a) An outer clause is interrupted by its embedded clause, which happens twice; and (b) two of the three consecutive NPs simultaneously play two different grammatical roles (i.e. subject and object roles).¹⁵ While (a) always applies to Japanese double center-embedded sentences, (b) does not apply to the structure used in Experiments 1 and 2.

The Japanese center-embedding examples in (2.5b-c) above contain sentential complements marked with the complementizer *-to* ("that"), but complements are sometimes nominalized by means of *-koto* or *-no* ("the fact") because some verbs subcategorize for an NP complement. Using single center-embedding for simplification, the schematizations in (2.9a) illustrates the former type and (2.9b-c), two kinds of the latter type. The current study involves all of these types.

- (2.9) a. [IP NP-*ga* [IP NP-*ga* V]-*to* V]
 b. [IP NP-*ga* [NP [IP NP-*ga* V]-*no/koto*]-*o* V]
 c. [IP NP-*ga* [NP [IP NP-*ga* V]-*no/koto*]-*ni* V]

Frequently used verbs of the (2.9a) type include report-type verbs such as *iu/tutaeru/tugeru* ("to say" or "to tell"), *hookokusuru* ("to report"), and *siraseru* ("to

¹⁵ Bever (1970: 335) calls this "double function" under his heuristic strategy approach, and others, "perspective shift" (see Gibson 1998; Just & Carpenter 1987).

inform”) and think-type verbs such as *omou* (“to think”) or *kangaeru* (“to consider”). Other types of verbs used are *okotta* (“scolded”), and *hometa* (“praised”), for example. As schematized in (2.9b-c), verbs that subcategorize for an NP complement require the embedded clause to be nominalized and followed by *-koto* or *-no*¹⁶ (“the fact”), being marked with the accusative marker *-o* or a postpositional particle *-ni* (“at”).¹⁷ The singly center-embedded examples in (2.10a-b), respectively, are of these types.

- (2.10) a. [_{IP}gakusei-ga [_{NP}[_{IP}sensei-ga odotta]-no]-o sitte-iru.]
 student-Nom teacher-Nom danced-fact-Acc know
 “The student knows the fact that the teacher danced.”
- b. [_{IP}gakusei-ga [_{NP}[_{IP}sensei-ga odotta]-no]-ni kizuita.]
 student-Nom teacher-Nom danced-fact-at noticed
 “The student noticed at the fact that the teacher danced.”

Putting aside possible chains associated with subject- and verb-movement (or feature checking), English double center-embeddings that cause processing problems, such as (2.6c) repeated as (2.11a), are standardly assumed to involve nested chains created by extracting objects from the relative clauses, for which the parser must find out filler-gap dependencies. On the other hand, Japanese double center-embeddings, such as (2.5c) repeated as (2.11a), involve no chains. Simplified tree diagrams for (2.11a) and (2.11b) are shown in (2.12a) and (2.12b)

¹⁶ A difference between *-koto* and *-no* is that the latter is used more colloquially than the former.

¹⁷ The postpositional particle “*-ni*” is translated in English differently, depending on the matrix verb. “At” is just one example of such various translations.

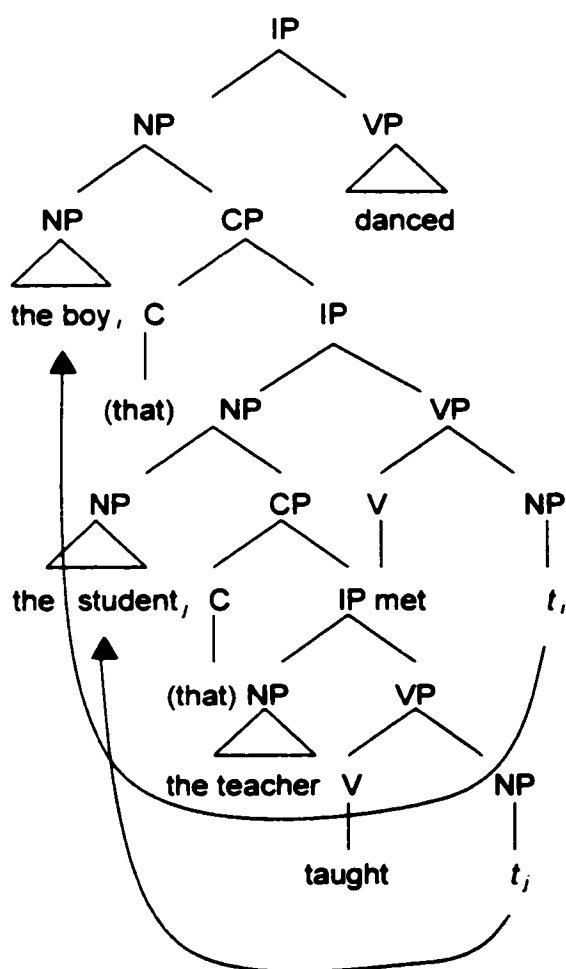
below, respectively.

(2.11) a. # [s [NP The boy_i [s' [s [NP the student_j [s' [s the teacher taught t_j]] met t_i] danced.]

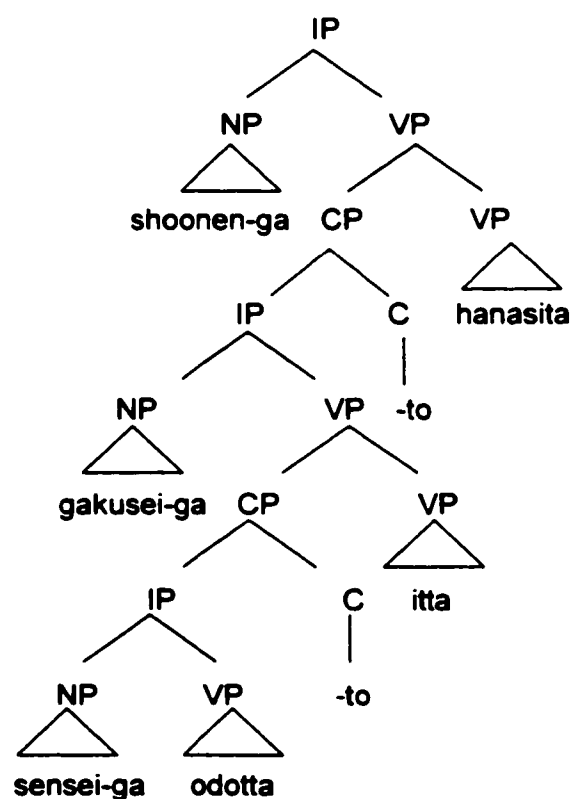
b. # [s shoonen-ga [s gakusei-ga [s sensei-ga odotta]-to
 boy-Nom student-Nom teacher-Nom danced-that
 itta]-to hanasita.]
 said-that spoke

“The boy stated that the student said that the teacher danced.”

(2.12) a. English Tree



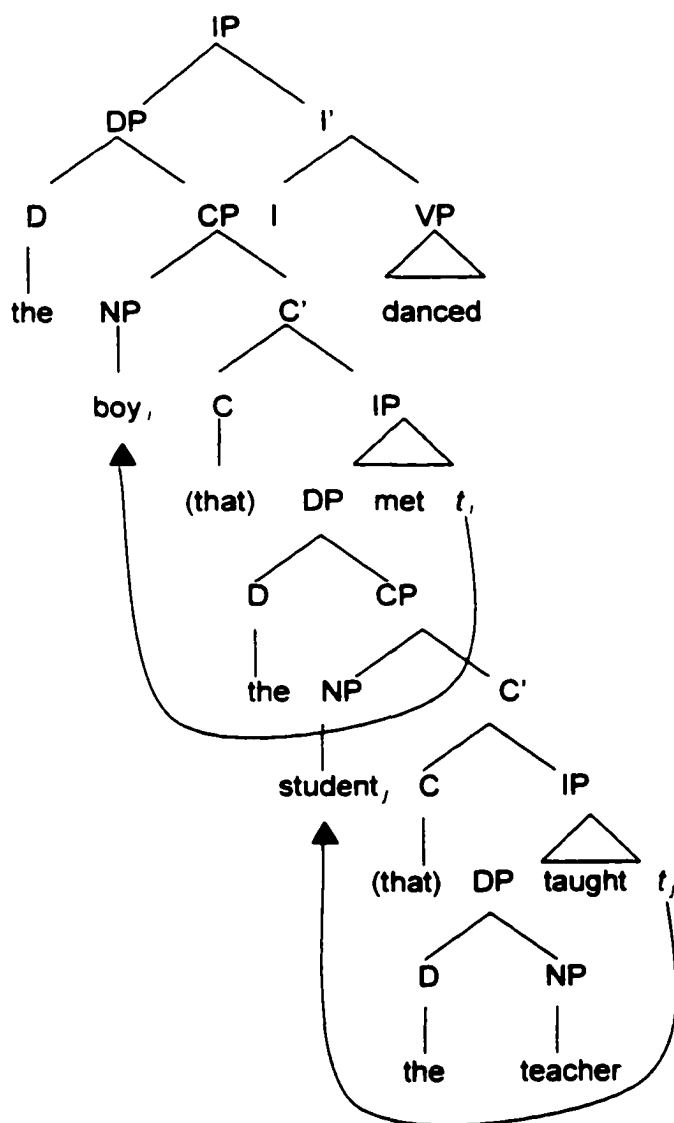
b. Japanese Tree



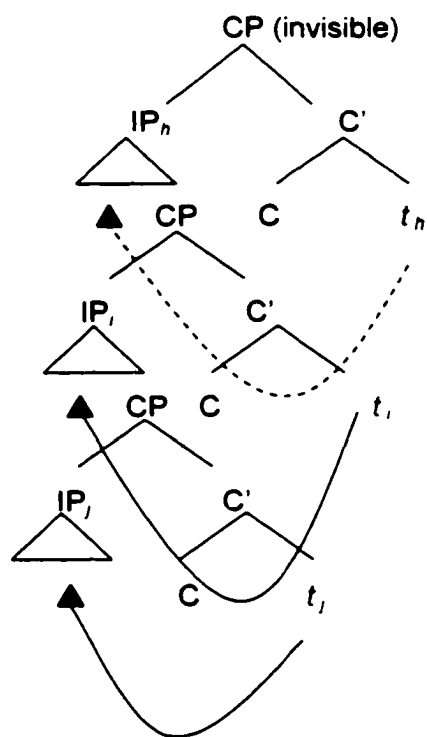
An alternative to the above view is the Antisymmetric Approach proposed by Kayne (1994), under which final complementizers are assumed to reflect the leftward movement of IP into SPEC(CP). In this approach, the Japanese sentence (2.11a) is analyzed to involve *at least* two chains left behind by overt movement of the middle and innermost IPs into SPEC(CP)'s; the matrix IP may or may not move into the uppermost SPEC(CP) overtly because the existence of this CP is not visible. In sum, under the Kaynean approach, the English doubly center-embedded sentence (2.11a) involves two chains, whereas the Japanese doubly center-embedded sentence (2.11b) may involve two (or three) chains. Simplified trees for (2.11a-b) under the Kaynean approach are presented in (2.13a-b) on the next page, respectively.

As discussed in Section 1.2, the number of chains created by overt movement is assumed to be one of the most important conditions with respect to processing cost (De Vincenzi 1991, 1994), given the parser's preference for Minimal Everything that disprefers to hypothesize unnecessary chains. Thus, it is certainly important to consider the possibility proposed under the Antisymmetric Approach view as well. The discussions provided in the current study, however, assume the standard view discussed in (2.11) and (2.12) above.

(2.13) a. English Kaynean Tree



b. Japanese Kaynean Tree



2.3 General Characteristics of the Center-Embedding Problem

Now let us summarize general characteristics of the processing problems with double center-embedding that are discussed in the literature. Findings in earlier studies, taken together, illustrate distinctive phenomena occurring in processing doubly center-embedded sentences.¹⁸ Our summary also includes earlier discussions of Japanese center-embedding.

As discussed in Section 1.1, one of the most interesting characteristics of the problem is that increasing the depth of center-embedding from one level to two makes a sentence extremely difficult to process (Chomsky 1957, 1965; Chomsky & Miller 1963; Miller & Chomsky 1963; Miller & Isard 1964; Yngve 1960).

The severe difficulty arising in processing sentences such as (1.1), repeated as (2.14), is referred to as processing breakdown.¹⁹

(2.14) # The rat the cat the dog chased ate died.

(Chomsky & Miller 1963: 286)

Processing breakdown can also occur with severe local ambiguity in garden-path sentences such as (2.15) below.

¹⁸ Part of the summary here was drawn from Lewis (1993: 53-57). For an extensive summary of earlier studies on the center-embedding problem, see Gibson (1991).

¹⁹ The difficulty is also referred to as a processing overload phenomenon (see e.g., Gibson 1991, 1998) to distinguish between the processing breakdown occurring with unambiguous complex sentences and that occurring with garden path sentences.

(2.15) ?# The horse raced past the barn fell.

(Bever 1970: 316)

The type of processing breakdown caused by the garden-path effect is very different from that arising with double center-embedding (Lewis 1993).

Although it is very difficult to comprehend garden path sentences such as (2.15), once the reader (or the listener) realizes the correct interpretation, he is able to understand the sentence relatively easily. In contrast, it is often said that the difficulty with double center-embedding hardly improves after explicit instructions or training (see Lewis 1993).

Local ambiguity may occur in the course of processing a doubly center-embedded sentence, but such ambiguity is not the source of the center-embedding difficulty (Blumenthal 1966; Foss & Cairns 1970; Lewis 1993; Miller & Isard 1964, among others). Consider the English example sentences in (2.16), for example:

(2.16) a. # The boy the student the teacher taught met danced.

b. The boy the student the teacher and the girl danced.

c. # The boy who the student who the teacher taught met danced.

At the point “the teacher” is encountered, the sentence in (2.16a) is locally ambiguous because the sentence can contain either reduced relative clauses or a conjoined NP as in (2.16b). The difficulty, however, still exists even though overt complementizers are inserted as in (2.16c). This indicates that local

ambiguity is not the cause of processing breakdown with English double center-embedded sentences.

In the case of Japanese, however, there is a possibility that accumulation of local ambiguity is a factor contributing to the double center-embedding difficulty. As introduced in Section 1.1, doubly center-embedded constructions in Japanese typically involve repetitive use of the nominative case-marker *-ga*, which has more than one syntactic function. Repeating *-ga* many times may therefore be a cause of the difficulty because of a combinatorial increase of local ambiguity. Since this possibility has never been explored before, Experiment 3 of the current study explores this ambiguity effect (see Chapter 7).

Another general characteristic of the double center-embedding difficulty is that the length of the sentence *per se* is not the problem (Lewis 1993; Schlesinger 1968). In general, relative length of constituents matters (Frazier & Fodor 1978) in processing sentences that do not involve double center-embedding. However, short doubly center-embedded sentences do not necessarily increase their acceptability, as shown by the contrast in length between (2.17a-b).

(2.17) a. # The dog the cat the rat bit ate ran.

b. # The executive officer the section chief the department manager supervised had driven to the company quit the job last week.

A next characteristic of the center-embedding problem is that semantic/pragmatic distinguishability among arguments and verbs aids the

processability of the sentences (Bever 1970; Fodor et al. 1968; Fodor & Garrett, 1967; Hudson 1996; Schlesinger 1968; Stolz 1967, among others, cf. Gibson 1998; Nakayama & Lewis 2003). This is illustrated by the example pair in (2.18). Since this is related to the similarity-based interference effect, we discuss it in Section 2.6.2.

(2.18) a. # The dog the cat the fox was chasing was scratching was yelping.

Bever (1970: 334)

b. #? The dog the distraction the wild fox produced was scaring will run away fast.

Bever (1970: 338)

Another characteristic of the center-embedding problem is the following: For two sentences that carry the same words and the same meaning differing only in the number of center-embeddings, the sentence which involves a single center-embedding is processable, but the one which involves double center-embedding is not (Gibson 1991, 1998, Lewis 1993). This phenomenon indicates that the difficulty arises not because of the meaning of the sentence or of the words themselves. The example pair in (2.19) illustrates this difference.

(2.19) a. [S The student [S_i who [S the teacher taught] tutored the boy [S_i who [S passed the exam.]]]

b. # [S The boy [S_i who [S the student [S_i who [S the teacher taught] tutored] passed the exam.]

This also applies to a minimal pair of Japanese sentences given in (2.20).

Interestingly, when the middle complement clause is scrambled to the pre-matrix subject position as in (2.20a), the sentence becomes easier, even though additional cost is presumably associated with it because of the non-minimal chain created by the movement in scrambling (see De Vincenzi 1991, 1994, and Section 1.2).

- (2.20) a. [s [s [s gakusei-ga [s [s sensei-ga odotta]-to] itta]-to], shoonen-ga
 student-Nom teacher-Nom danced-that said-that boy-Nom
 t, hanasita.]
 spoke
 “The boy stated that the student said that the teacher danced.”

- b. # [s shoonen-ga [s [s gakusei-ga [s [s sensei-ga odotta]-to] itta]-to]
 boy-Nom student-Nom teacher-Nom danced-that said-that
 hanasita.]
 spoke
 “The boy stated that the student said that the teacher danced.”

Also, the same type of phenomenon as above is observed with clausal modifiers in English: Two levels of center-embedding is unprocessable whereas one level is not problematic, even with the same words and the same meaning (Gibson 1998), as shown in (2.21).

- (2.21) a. If when the baby is crying, the mother gets upset, the father will help, so the
 grandmother can rest easily.

Gibson (1998: 4)

- b. # Because if when the baby is crying, the mother gets upset, the father will help, the grandmother can rest easily.

Gibson (1998: 4)

Furthermore, the ability to understand center-embedded structures is at least partly independent of short-term memory for words in a sentence (see Lewis 1993). Larkin & Burns (1977) showed that subjects were able to recall the words in center-embedded sentences without being able to properly pair the words. This means that subjects were unable to correctly process the structure, indicating the partial independence of short-term memory for the words in the sentence.

In contrast with the above phenomena, sentences involving non-center-embeddings are not necessarily difficult to process, and the number of recursions (or depth of embedding) itself is not relevant to the difficulty, either (e.g., Gibson 1991, Kimball 1973, 1975; Lewis 1993, among others). In English, for example, the right-branching sentence in (2.22a) and the left-branching sentence in (2.22b) both involve embedding and two levels of recursion, but they are not problematic at all.

- (2.22) a. The dog saw the cat [which chased the mouse into the house [that Jack built]].

(Kimball 1973: 35)

- b. My cousin's [aunt's [dog's]] tail fell off.

(Kimball 1973: 34)

Besides right-branching and left-branching constructions, there are a variety of acceptable embedding constructions (see Cowper 1976; Gibson 1991; Lewis 1993, among others). For example, the sentences in (2.23) are not difficult even though all of them involve multiple embedding. These examples also indicate that the degree of embedding itself is not the cause of processing difficulty.

- (2.23) a. That the man who said that the book was finished didn't know his business is clear to everyone.

Cowper (1976: 52)

- b. That the food that John ordered tasted good pleased him.

Gibson (1991: 229)

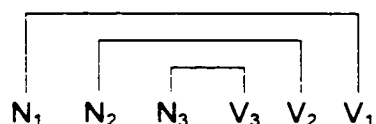
- c. What the woman that John married likes is smoked salmon.

Gibson (1991: 242)

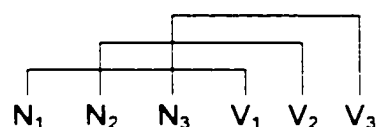
In searching for the source of the center-embedding difficulty, considerable work studied structural properties that tend to be problematic. The majority of such work points out that a common configuration of difficult center-embeddings involves doubly nested syntactic relation of the same kind.

In an interesting study of German and Dutch, Bach et al. (1986) found that Dutch word order with crossed argument-verb dependencies as in (2.24b) is easier to process than German word order with nested argument-verb dependencies as in (2.24a) below.

(2.24) a. nested dependencies



b. crossed dependencies



However, both languages show a usual tendency for degree two embedding to be extremely more difficult than degree one embedding.²⁰ Bach et al. (1986: 260) note that the relative ease of crossed argument-verb dependencies “contrast markedly” to the preference for nested filler-gap dependencies, such as (2.25), where the symbol “ Δ ” indicates a gap.

(2.25) Which violins_i are these sonatas_j easy to play Δ_j on Δ_i ?

Bach et al. (1986: 260)

The finding is also somewhat unexpected in view of the fact that nested structure seems to be far more common in Germanic languages than crossed structure. Bach et al. concluded from their study that push-down store cannot be the only memory device for natural language processing. However, they did not make any positive proposal as to what properties the memory needs to have in order to

²⁰ For a study on the processing of Dutch center-embedding, see Dickey & Vonk (1997), and for German, see Bayer et al. (2003).

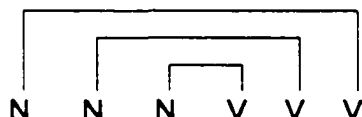
explain their findings.

Since the difficult double center-embeddings that are studied usually involve nested configurations, many explanations have focused on such configurations. The basic assumption is that in doubly nested structure, syntactic relations that are necessary to find out correctly and completely in order to reach sentential meaning are disrupted during the parsing process. Thus, the disruption causes a serious problem for the resource-limited parsing mechanism because part of each incomplete dependency must be held in working memory during the interruption and then must be accessed at the point when the other part of that dependency. What kind of dependency is assumed to account for the problem depends on the model. The incomplete dependencies assumed in the existing work include phrase structure rules (e.g., Kimball 1973, 1975), case assignment relation (e.g., Stabler 1994), X-bar relation (e.g., Lewis 1993, 1996), and thematic relation (e.g., Gibson 1991; Babyonyshev & Gibson 1995). Some models attempt to reflect locality factor and discourse factors (e.g., Gibson 1998, 2000, Babyonyshev & Gibson 1999, Warren & Gibson 1999). Others incorporate into their accounts similarity-based interference as an important factor (e.g., Lewis 1998; Lewis & Nakayama 1999, 2001, 2002; Nakayama et al 2003). We review these models below (see Sections 2.4 to 2.6).

Problematic double center-embeddings usually involve double nesting of dependencies, but double nesting itself does not necessarily cause the problem. Although Japanese two-level center-embedding involves a doubly nested construction, as illustrated in (2.7) repeated as (2.26) below, native intuition

suggests that a doubly center-embedded sentence such as (2.27a), for example, is clearly less difficult than a doubly center-embedded sentence with a 3ga sequence that is associated with the same words and same basic meaning, such as (2.27b).

(2.26) Japanese



(2.27) a. # [s shoonen-ga [s gakusei-ga [s sensei-ga odotta]-to itta]-to
 boy-Nom student-Nom teacher-Nom danced-that said-that
 hanasita.]
 spoke

b. #? [s shoonen-wa [s gakusei-ga [s sensei-ga odotta]-to itta]-to
 boy-Top student-Nom teacher-Nom danced-that said-that
 hanasita.]
 spoke

"The boy stated that the student said that the teacher danced."

Experiment 1 reported in Chapter 4 shows this phenomenon using not only the sentence pairs such as (2.27) but also other kinds of sentences.

Earlier, it was believed that Japanese allows one extra level of embedding to reach the same amount of difficulty as that the parser undergoes for English. Many models attempted to incorporate an extra level of embedding for Japanese to explain universal characteristics of the language processing mechanism (see

e.g., Babyonyshev & Gibson 1995; Lewis 1996). Among such attempts, Kimball (1975) makes an interesting remark:

[The existence of topic marker *-wa*] allows the Japanese speaker one degree more of center-embedding within the range of acceptability ... Thus, a sentence of the form NP-*wa* NP-*ga* NP-*ga* V V V is acceptable, while ... NP-*wa* NP-*ga* NP-*ga* NP-*ga* V V V is not ... [T]he memory limitation in Japanese is the same as in English, so we have evidence for its universality.

(Kimball 1975: 179)

To support his Principle of Two Sentences across languages, Kimball attributes the problem with the extra level for Japanese center-embedding to the special register of *-wa*. As we will see in Chapters 4 and 5, Kimball's observation in fact bears out — a sentence of the form [NP-*wa* [NP-*ga* [NP-*ga* V] V] V] is acceptable while a sentence of the form [NP-*ga* [NP-*ga* [NP-*ga* V] V] V] is not.

Typical examples of doubly center-embedding in English involve object-extracted relative constructions in the subject position, but the difficulty is not limited to that position (Eady & Fodor 1981; Gibson et al. 1995). Eady & Fodor (1981) performed an on-line reading study using the four structure types in (2.28) below and demonstrated that doubly center-embedded sentences cause difficulty regardless of whether the relative clauses are in the subject position as in (2.28a) or in the object position as in (2.28b).

(2.28) a. # [The patient [the nurse [the clinic had hired _] sent _ to the doctor] met Jack].

Eady & Fodor (1981: 13)

b. # [Jack met the patient [the nurse [the clinic had hired _] sent _ to the doctor]]

Eady & Fodor (1981: 13)

c. [The patient [the nurse sent _ to the doctor [the clinic had hired _]] met Jack].

Eady & Fodor (1981: 13)

d. [Jack met the patient [the nurse sent _ to the doctor [the clinic had hired _]]].

Eady & Fodor (1981: 13)

Eady & Fodor found that (2.28a-b) are significantly harder to process than (2.28c-d), but (2.28a) is significantly more difficult than (2.28b).

Eady & Fodor propose two possible causes of the difficulty: the existence of nested filler-gap relations and the three consecutive NPs. They further suggest three possible explanations of the difficulty caused by the three consecutive NPs: (a) Those NPs are misparsed as a conjoined NP; (b) A six-word package is not a phrase (based on Frazier & Fodor's (1978) Sausage Machine); and (c) The first NP is not integrated in the semantic structure.

Nested filler-gap relations do not always apply to Japanese double center-embeddings, as illustrated in (2.26) above, for example (see also Section 2.2). The existence of three consecutive NPs is directly relevant to the current study, and we will investigate the mechanism underlying the difficulty associated with it through our three experiments.

While some studies on Japanese focus on doubly center-embedded sentences with the first NP marked with *-wa*, as discussed above, some doubly center-embedded sentences observed as difficult to process in the literature contain 3ga sequences. For example, Kuno (1974a) states that the doubly center-embedded Japanese structure in (2.29a) is hard to understand, compared to the left-branching structure in (2.29b).

- (2.29) a. # John-ga [Mary-ga [Jane-ga aisiteiru] shoonen-ni kaita]
 John-Nom Mary-Nom Jane-Nom loving-is boy-Dat wrote
 tegami-o yonda.
 letter-Acc read
 “John read the letter that Mary wrote to the boy that Jane was in love with”
 (Kuno 1974a: 120)
- b. neko-ga oikaketa nezumi-ga tabeta cheese-wa kusatte-ita.
 cat-Nom chased mouse-Nom ate cheese-Top rotten-was
 “The cheese the rat the cat chased ate was rotten”
 (Kuno 1974a: 120)

Examining word orders in many sets of structures in a variety of languages, Kuno (1974a: 122) argues that “languages embody devices to minimize syntactic patterns that cause perceptual difficulties”. That is, languages are made with effective devices so that intolerable burden would not be imposed on the speaker’s (and hearer’s) memory. Kuno considers one such effective device to be the choice between the prenominal versus postnominal positioning of relative clauses.

Cowper (1976) observes that the doubly center-embedded sentence with a 3ga sequence in (2.30a) is unprocessable whereas the one with a 3wa sequence in (2.30b) is processable.²¹

- (2.30) a. # watasi-ga Yamada-san-ga nezumi-ga chiizu-o tabeta-to itta-to
 I-Nom Yamada-Mr.-Nom mouse-Nom cheese-Acc ate-that said-that
 omoi-masu.
 think
 "I think that Mr. Yamada said that the mouse ate cheese."

(Cowper 1976: 60)

- b. watasi-wa Yamada-san-wa nezumi-wa chiizu-o tabeta-to itta-to
 I-Top Yamada-Mr.-Top mouse-Top cheese-Acc ate-that said-that
 omoi-masu.
 think
 "I think that Mr. Yamada said that the mouse ate cheese."

(Cowper 1976: 60)

Cowper proposed the Parallel Processing Model, which explains a wide range of processing complexity associated with different kinds of syntactic structures. Evidence for this model was collected from three languages: English, Japanese, and Arabic. Under this model, it is assumed that the parser has three tracks, which are distinct from each other in power, and one holding cell. This model treats NP-complements differently from relative clauses. A relative clause may

²¹ Cowper's examples are different from the examples in Kimball (1975) and Kuno (1974a): While in Kimball's and Kuno's examples, the most deeply embedded clause is an object-extracted relative clause, Cowper's examples are doubly center-embedded sentential complements, which are the same type of structure as the current study uses in Experiments 1 and 2.

never be processed on the same track as its head NP, whereas an NP-complement may be processed on the same track. The processability contrast in (2.30) above is explained by the additional Clause Integrity Constraint: "In languages with clause-final complementizers, any non-topic constituent which occurs to the left of its own clause, separated from that clause by one or more embedded sentences, must be held in [the holding cell] or [the third track] until its own clause shows up" (Cowper 1976: 88). The basic idea underlying this constraint is that in complementizer-final languages, complementizers and/or relative pronouns cannot soon be related with the sentence they belong to, and the level and the type of embedding are not determinable, either. With this constraint, topic NPs marked by *-wa* do not need to be held until their clauses appear. While the processability contrast between *3ga* structure and *3wa* structure is interestingly captured, why topics do not need not to be held in working memory is not clearly explained. Note that under Cowper's model adjacency of the three NPs does not matter. A possible reason for the ease of *3wa* sentences is considered in Chapter 5.

There are very few earlier studies that examined processability of Japanese doubly center-embedded sentences, empirically. Mazuka et al. (1989) performed an eye-tracking experiment with 45 speakers of Japanese, using a set of five singly center-embedded and a set of five doubly center-embedded sentences. In each set, four sentences had a gap in various positions in the embedded clause, while one contained no gap. Three of the five singly center-embedded sentences had a string of 2NP-*ga*'s, while all the five

doubly center-embedded had a 3NP-*ga* string. The total reading time for each sentence was divided by the number of characters and by the number of morae, to obtain the reading time per character and per mora, respectively. Both singly and doubly center-embedded sentences took longer to read than control one-clause sentences, and the doubly center-embedded sentences took nearly twice as long as those control sentences. Mazuka et al. discuss their results with respect to Eady & Fodor's (1981) suggestions discussed above. Mazuka et al. argue that while the existence of three consecutive NPs is the likely cause of the difficulty, none of the three suggestions made by Eady and Fodor accounts for their data. Instead, Mazuka et al. propose that the difficulty with doubly center-embedding arises due to the surface string of stacked NPs, rather than assignment of argument structure at a deeper level. Their proposal is based on an observation that their doubly center-embedded test sentences become easier to process when one or two overt NPs are null. Japanese is a *pro*-drop language, which allows both null subjects and null objects (and other complements). However, it is not clear whether the dropped NPs are subject NP-*ga*'s or topic NP-*wa*'s. If the null elements are NP-*wa*'s, the sentence could be easier just because they are topics, given the contrast in (2.27) above, rather than because they are null.

2.4 Incomplete Dependencies

This section reviews four types of previous explanations of nesting complexity under the incomplete dependency hypothesis.²² We review these four types in two separate sections: Section 2.4.1 summarizes three types that attribute the processing difficulty arising with double center-embedding to one of incomplete application of phrase structure rules, incomplete case-assignment relations, and incomplete X-bar relations, i.e., to purely syntactic notions. The incomplete-phrase-structure-rule account is an early hypothesis, from which incomplete-dependency hypotheses are developed. Section 2.4.2 summarizes one type that attributes the difficulty to incomplete thematic relations.

Following Miller & Chomsky (1963) and Miller & Chomsky (1963), theories of processing breakdown standardly assume that doubly center-embedded constructions are difficult to process because they are beyond limited computational resources. To reach a representation of sentential meaning, a sequence of incoming words must be processed syntactically and semantically, on-line. The current syntactic and conceptual structure that has not yet been integrated must be held in memory. Thus, the fundamental assumption is that, in the doubly nested constructions, the unintegrated relations are too many for the capacity of the comprehension mechanism. Individual theories differ from each other in whether or not they assume certain computational architecture that is inherently specified as part of the theory. The theories that do not assume

²² Some part of this overview is based on Gibson (1998) and Lewis (1993). For a thorough review of individual theories and proposals, see Gibson (1991).

such architectures define specific metric over syntactic structures to predict the structure's processability, and many of these theories set a limit beyond which structures should be unprocessable.

2.4.1 Incomplete phrase structure rule applications, case assignments, and X-bar relations

An early account for the center-embedding difficulty is that nested incomplete applications of phrase structure rules are the cause of difficulty (e.g., Chomsky & Miller 1963; Miller & Chomsky 1963; Miller & Isard 1964; Yngve 1960). At a particular processing stage, if application of phrase structure rules is incomplete, these incomplete phrase structure rules must be stored in working memory. This may be beyond available resources for the parser. Under this account, the complexity associated with a sentence is indexed by the number of phrase structure rules that must be stored in memory on a stack. Since it is unlikely that the human language processing system functions purely top-down or purely bottom-up,²³ partial top-down and partial bottom-up processing algorithm, such as left-corner algorithm, is assumed (e.g., Kimball 1973, 1975, among others). Even though a language is usually predominantly either right-branching or left-branching, it has recursive structures of the opposite directionality. For example, English is predominantly right-branching but has

²³ For a concrete example, see, e.g., Yngve's (1960) purely top-down algorithm and its critiques in Chomsky & Miller (1963) and Miller & Chomsky (1963).

left-branching structure such as the genitive NP construction. Thus, the underlying assumption is as follows: While a purely bottom-up algorithm requires finite memory for the left-branching structures, it requires infinite memory for right-branching structures; while a purely top-down algorithm requires finite memory for the right-branching structures, it requires infinite memory for left-branching structures. The processing mechanism, therefore, must function partially top-down and partially bottom-up.

Under this type of hypothesis, the processability contrast between the sentence involving degree-one and degree-two self-embeddings, such as (2.19a-b) repeated as (2.31a-b), respectively, is explained as follows:

- (2.31) a. [_S The student [_{S'} who [_S the teacher taught] tutored the boy [_{S'} who [_S passed the exam]]].
- b. # [_S The boy [_{S'} who [_S the student [_{S'} who [_S the teacher taught]] tutored] passed the exam].

In the degree-one sentence (2.31a), there are three incompletely processed phrase structure rules at the point of maximal stack depth in which the second “the” is encountered:

- (a) $S \rightarrow NP VP$ (the sentence rule)
- (b) $S' \rightarrow Comp S$ (the relative clause rule)
- (c) $NP \rightarrow Det N (S')$ (the NP rule)

On the other hand, in the degree-two sentence (2.29b), the maximal stack depth reaches five at the point in which the third “the” is encountered. In addition to the above three incomplete rules, one more application of each of the sentence rule and the relative clause rule are incomplete:

- (a) $S \rightarrow NP VP$ (the sentence rule applied to the matrix clause and the middle clause)
- (b) $S' \rightarrow \text{Comp } S$ (the relative clause rule applied to the outer and inner relative clauses)
- (c) $NP \rightarrow \text{Det } N(S')$ (the NP rule applied to the subjects of the matrix and middle clauses)

Kimball's (1973: 33) Principle of Two Sentences is a representative of this type. The principle states that “[t]he constituents of no more than two sentences can be parsed at one time”. Assuming a left-corner algorithm, he considered that a sentence-initial NP triggers the prediction of an S node, and that processing breakdown occurs if more than two S nodes are predicted at a certain point of processing before their head verbs are encountered.

Kimball's (1973, 1975) theory correctly predicts the difficulty with English double center-embedding construction with relative clauses such as (2.14) repeated as (2.32a), but it incorrectly predicts that the acceptable (2.23c) repeated as (2.32b) below should be unprocessable (Gibson 1991).

(2.32) a. #The rat the cat the dog chased ate died.

(Chomsky & Miller 1963: 286)

b. That the food that John ordered tasted good pleased him.

Gibson (1991: 229)

When the second “that” is encountered, there are three incomplete S nodes for the top-down parser: the matrix clause, the subject sentence “that the food tasted good”, and the embedded relative clause.

Another problem with the two-incomplete-sentence account pointed out in the literature is that it does not explain the asymmetry of processability between a subject-extracted relative clause and an object-extracted relative clause in English, such as the examples in (2.33a-b), respectively.²⁴

(2.33) a. [_S The student [_S who [_S liked the teacher] tutored the boy].

b. [_S The student [_S who [_S the teacher liked] tutored the boy].

Under this account, two sentential nodes are predicted at the point when “who” is encountered for both sentences. Since this is below the limit, the acceptability of these sentences is correctly predicted, but the contrast between the two is not explained.

²⁴ The asymmetry of processability between a subject-extracted relative clause and an object-extracted relative clause in English has been shown in earlier studies with various measures, including the phoneme-monitoring measure, the on-line lexical decision measure, the reading times measures, and the response-accuracy measures. See Gibson (1998) for references.

Some theories are developed as extended versions of the incomplete-phrase-structure-rule model to compensate for the above (and other²⁵) problems. The extended theories attribute the difficulty of nested complexity to incomplete syntactic dependencies of various kinds rather than just the phrase structure dependencies just discussed. The asymmetry illustrated in (2.33) above is now accounted for as follows: The object-extracted relative clause involves one extra incomplete dependency, compared to the subject-extracted relative clause, due to the presence of intervening material (the subject “the teacher”) between “who” and the verb “liked” which assigns its syntactic role, such as case-assignment relation, X-bar relation, or thematic relation, as we see below.

Stabler (1994) proposed the Finite Connectivity Hypothesis, which assumes that the parser can hold in memory only up to two syntactic operations of the same type which cross constituent boundaries, including clause-to-clause verb raising, *wh*-movement, and case-assignment relation. Case-assignment relation is of particular relevance to the current study. Under the Finite Connectivity Hypothesis, the unprocessability of the doubly center-embedded sentence in (2.32a) discussed earlier is predicted due to the three incomplete nominative-case assignment relationships at the point of the third NP “the dog”. Importantly, this hypothesis does not include adjacency factors. Thus, as long as three incomplete case-assignment relations of the same kind are predicted at a point of processing, a sentence should be unprocessable.

²⁵ See Gibson (1991).

Lewis (1993,1996) proposed a computational model under which memory resources are defined in terms of the number of locally incomplete X-bar relations of the same kind, such as SPEC-IP, SPEC-CP, and Comp-V'. The limit for processable sentences is set at two nodes of those structural indices. Under this model, an incomplete relation refers to a situation in which part of a relation (i.e., the head, complement, or specifier) has already been encountered but the remainder has not yet been encountered but has already been predicted. The maximum capacity of syntactic working memory is set at two such incomplete relations, and if there are more than two such incomplete relations at a point of processing a sentence, the sentence is predicted to be unprocessable. For example, when the most deeply embedded subject "the dog" is encountered in (2.32a), there are three incomplete SPEC-IP relations (i.e., "the rat", "the cat", and "the dog"), and the sentence is therefore predicted to be unprocessable.

Lewis's theory has its psychological motivation in findings of traditional memory research and assumes that "an interesting range of core sentence processing phenomena can be explained as interference effects in a sharply limited syntactic working memory (Lewis 1996: 94)." While the original version (Lewis 1993, 1996) of this theory did not explicitly state adjacency of incomplete X-bar relations, it is included in the later version (Lewis 1998; see also Lewis & Nakayama 2002). Despite the difference in their theoretical motivations, the original version of Lewis's theory, in effect, makes the same prediction as Stabler's (1994) hypothesis for Japanese center-embedded sentences, but the later version does not. Since the later version of Lewis's theory emphasizes

similarity-based interference effects, we discuss them in Section 2.6.

The models developed by Stabler (1994) and Lewis (1993, 1996) explain a much broader range of psycholinguistic phenomena than the early incomplete-phrase-structure-rule model (e.g., Kimball 1973, 1975) does. There are, however, still some phenomena that they do not explain, and part of them are common to the incomplete-phrase-structure-rule model and Stabler's and Lewis's models. For example, they do not account for why (2.34) does not result in processing breakdown (Babyonyshev & Gibson 1995):

(2.34) [The information that [the frightened child who [the rescue worker looked for] had survived the crash] comforted the old woman greatly].

Babyonyshev & Gibson (1995: 20)

At the point of the third NP "the rescue worker", the sentence is assumed to be associated with three incomplete sentences for Kimball's, three incomplete SPEC-IP X-bar relations under Lewis's theory, and three locally incomplete nominative case-assignments under Stabler's theory. Thus, (2.34) should be unprocessable under these models, but it is processable.²⁶

In Chapters 4 and 5, it is shown that the results of Experiment 1 and 2 cannot be explained by any of incomplete application of phrase structure rules, incomplete case assignments, and incomplete X-bar relations.

²⁶ For more problems common to the three theories, see Babyonyshev and Gibson (1995).

2.4.2 Incomplete thematic roles

Another type of model attributes the difficulty with nesting complexity to incomplete thematic-role assignment. Gibson (1991) proposed a processing overload metric within the GB framework, attributing a cumulative processing load associated with a sentence to locally incomplete thematic relations and self-embedding interference. Each processing load is computed as 1 PLU (i.e., Processing Load Unit), and a sentence is predicted to be unprocessable when the accumulation of PLUs for its correct analysis exceeds 4 PLUs at a maximal point. Local θ -Criterion violations are assumed to apply not only to lexical items but also head of each chain confirmed to be in a position presumably associated with but not yet assigned a thematic role. Gibson's metric also assumes processing load that is associated with self-embedding interference: When one self-embedding is predicted at a given point of processing, 1 PLU is added, but the matrix clause is not included in the self-embedding count.²⁷ In this way, processing overload is defined in terms of the above two factors. Relative pronouns such as "who" are assumed to correspond to 1 PLU each regardless of whether they are visible or not in surface form.

Under the original version of the metric (i.e., Gibson 1991), both structural Case and inherent Case are treated equally, and each of local θ -Criterion violations is assumed to accrue 1 PLU. To explain a broader range of

²⁷ Gibson & Thomas (1995) found that the cost associated with self-embedding interference ranges between 0.5 and 2 PLUs, but to simplify the cost calculations, each self-embedding is assumed to accumulate 1 PLU (Babyonyshev & Gibson 1995).

phenomena associated with complex sentences across languages (i.e., English and Japanese, in particular), a distinction is made in a revised version (Babyonyshev & Gibson 1995) between structural and inherent Case: Only structural Case (e.g., nominatives, accusatives, and genitives) induce processing costs whereas inherent Case (e.g., datives, quirky Cases) is associated with no costs.

For example, the right-branching sentence (2.35a) below is predicted to be easily processable because it has only a maximal cost of one local θ -Criterion violation (i.e., 1 PLU) at any point of processing. On the other hand, the sentence in (2.35b) is associated with 6 PLUs at the point of “the rescue worker” and is hence predicted to be unprocessable: 5 PLUs from three NPs and two relative pronouns that will eventually need thematic roles but have not yet received them plus 1 PLU from a self-embedding of the middle and innermost clause. Finally, the sentence (2.35c) is associated with 4 PLUs (three NPs and one relative pronoun), and it is predicted to be processable.

- (2.35) a. [The rescue worker looked for [the old woman [who had greatly comforted the frightened child who [survived the crash]]]].

Babyonyshev & Gibson (1995: 3)

- b. # [The frightened child who [the old woman who [the rescue worker looked for] had comforted greatly] survived the crash].

Babyonyshev & Gibson (1995: 1)

- c. [The information that [the frightened child who [the rescue worker looked for] had survived the crash] comforted the old woman greatly].

Babyonyshev & Gibson (1995: 20)

Gibson's overload metric explains a very wide range of processing phenomena cross-structurally and cross-linguistically, and it makes correct predictions for problems with not only nesting complexity but also garden path effects.

2.5 Dependency Locality and Discourse Referents

Gibson (1998, 2000) proposes the Dependency Locality Theory²⁸ which explains the relationship between sentence processing mechanism and the available computational resources in terms of two factors, integration cost and memory cost. These two are quantified as Energy Units (EUs) and Memory Units (MUs), respectively. Integration cost is assumed to occur when each new discourse referent (i.e., NP (object referent) and main verb (event referent)) is structurally incorporated.²⁹ Memory cost is assumed to incur in storing in memory each syntactic category that is required to complete the current input string as a grammatical sentence (e.g., a head N for the subject and a head V for the predicate). Under this theory, the two kinds of cost are considered as being

²⁸ In Gibson (1998), the original version of the Syntactic Prediction Locality Theory is proposed together with its variant, the Dependency Locality Theory. This section discusses the latter, which is proposed alone in Gibson (2000).

²⁹ This includes attachment and θ -role assignment.

influenced by locality as follows: The integration cost becomes the greater as the distance becomes longer between an incoming word and the most local head or dependent to which it attaches; the memory cost becomes the greater as the time a predicted category must be kept in memory becomes longer. It is also assumed that both linguistic integration processes and storage access the same pool of limited working memory resources.

The matrix verb is assumed to be cost-free because the parser is always expecting it (and perhaps the matrix subject, as well). Also, pronouns in the most-deeply embedded clause are assumed to be cost-free, unlike proper names and indefinite NPs.³⁰

With all the above assumptions, the theory predicts any given point of complexity of a sentence and overall acceptability of the sentence. The theory accounts for processing phenomena across languages and across various structures, including (a) the lower complexity of subject-extracted relative clause compared to object-extracted relative clause; (b) various processing breakdown effects including the difficulty with multiple center-embedding constructions; (c) the lower complexity of cross-serial dependencies compared to center-embedding dependencies; (d) length/heaviness effects; and (e) various ambiguity effects.

Based on a broad range of empirical evidence, linguistic working memory capacity is set at 6 MUs (Memory Units) or just below it, beyond which

³⁰ For this kind of observations, see e.g., Bever (1970, 1974) and Kac (1981), among others. For empirical evidence, see Warren & Gibson (2000a, b). We discuss this issue in Section 2.6.2.

processing breakdown is assumed to occur.³¹ For example, the maximal memory complexity associated with the unprocessable doubly object-extracted relative construction in (2.31b), repeated now as (2.36), is 6 MUs, which occurs at the most deeply embedded NP “teacher”, totaling (a-d) below:

(2.36) # [_S The boy [_S who [_S the student [_S who [_S the teacher taught]] tutored] passed the exam].

- (a) The prediction of the outer relative clause verb, which has been held over the processing of two new discourse referents = 2 MUs
- (b) The prediction of an empty category position for the *wh*-pronoun of the outer relative clause, which has been held over the processing of two new discourse referents = 2 MUs
- (c) The prediction of the inner relative clause verb, which has been held over the processing of one new discourse referent = 1 MU
- (d) The prediction of an empty category position for the *wh*-pronoun of the inner relative clause, which has been held over the processing of one new discourse referents = 1 MUs

In Gibson’s (2000) theory, there are other factors that are assumed to affect comprehension difficulty: (i) The lower the frequency of the lexical item is, the greater the processing difficulty becomes; (ii) The less contextually plausible the final structure is, the greater the processing difficulty becomes; (iii) the ranking of accessibility of discourse referents is focused entities > non-focused elements introduced using definite descriptions > elements introduced using indefinite

³¹ The computation example given here is based on Gibson (1998), but simplified. In Gibson (2000) uses EUs to compute nesting complexity.

NPs; (iv) if the structure currently being processed is not compatible with the highest ranked structure built so far, reanalysis difficulty results.

This model is involved in our later discussions with respect to the following points: First, one of the theory's assumptions is that the matrix verb and the matrix subject are cost-free because the parser always expects them. Second, to increasing the distance between a verb and its arguments, placing an element that does not introduce a discourse referent (e.g., an adverb) should make no difference in processability.³² Third, pronouns in the most-deeply embedded clause are assumed to be cost-free, unlike proper names and indefinite NPs. Fourth, the accessibility of discourse referents is ranked as focused entities > non-focused elements introduced using definite descriptions > elements introduced using indefinite NPs. This is relevant to NP-ga's focused reading as an interaction between subject NP-ga and the verb type requirement for object NP-ga (see Chapter 3).

³² Gibson (1998: 51-53) explains how his theory predicts of length/heaviness effects using English sentences. The contrast between (ia) and (ib) (the latter is easier than the former).

- (i) a. The young boy gave [_{NP} the beautiful green pendant that had been in the jewelry store window for weeks] [_{PP} to the girl].
- b. The young boy gave [_{PP} to the girl] [_{NP} the beautiful green pendant that had been in the jewelry store window for weeks].

Gibson (1998: 52)

The adverbs referred to here are not directly relevant to the length/heaviness effects. See Chapters 4 and 5.

2.6 Similarity-Based Interference Effects

Some models explaining the processing problem with double center-embedding incorporates similarity-based interference effects. The basic idea underlying this view is that similar incomplete dependencies that simultaneously exist at certain point of processing are difficult for the parser to keep track of. Since the current study explores the effect of repetitive use of NP-ga on the processing of doubly center-embedded sentences, the similarity-based interference effect is directly relevant to our interest. Syntactic, semantic, and phonological similarity-based interference effects are discussed in Sections 2.6.1 to 2.6.3, respectively.

2.6.1 Syntactic similarity

Lewis's (1993, 1996) theory reviewed above is a similarity-based interference computational model of sentence processing. The model is built into a human general psychological architecture, assuming that similarity-based interference is general to all types of human working memory, including working memory for linguistic structure in sentence processing. The basic assumption of this model is based on findings of traditional psychology research that interference effects occur due to the similarity of a target item to those from which that item is retrieved. The more similar items are to each other, the more difficult it is to access a to-be-retrieved item, and the less similar items are to

each other, the easier it is to access a to-be-retrieved item. Similarity-based interference effects have been demonstrated in various areas, including visual, phonological, odor, verbal, conceptual, and semantic areas.

As reviewed earlier, Lewis (1993, 1996) assumes that content-dependent interference occurs syntactically, particularly in terms of locally incomplete X-bar relations of the same kind, including SPEC-IP, SPEC-CP, and Comp-V'. The capacity of the data structure in working memory is not defined absolutely in terms of the number of syntactic nodes, which are indexed by their potential syntactic relations. Rather, the capacity is a function of the syntactic content of what is to be stored. When nodes must be indexed by the same syntactic relations, they interfere with each other. The capacity of syntactic working memory is sharply limited; it endures up to two incomplete X-bar relations of the same kind. If there are more than two incomplete relations of the same kind at a given point in processing a sentence, the parsing is predicted to crash due to the overwhelming syntactic similarity-effect.

Lewis's (1993, 1996) original model was revised in Lewis (1998, also Lewis & Nakayama 2002 with experimental results), focusing on the syntactic similarity effect: While Lewis's (1996) model is based only on retroactive interference, his revised model is based both retroactive interference and proactive interference, as schematized in (2.37):

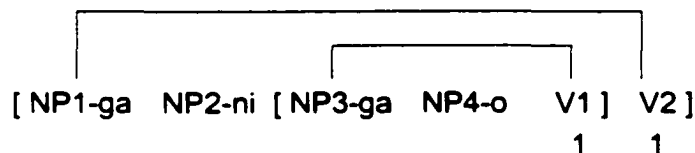
$$(2.37) \quad \Phi_1 \Phi_2 \dots \Phi_n X \rho_1 \rho_2 \dots \rho_m Y$$

Lewis & Nakayama (2002: 88)

For example, if X in (2.37) is to be assigned the subject position of a sentence, then proactive interference from the items in $\Phi_1 \dots \Phi_n$ that have not yet been attached and so may potentially fill subject position. Also, retroactive interference is expected from the items in $\rho_1 \dots \rho_m$ if they are potential subjects. Retroactive interference is assumed to result from encoding or storage interference, whereas proactive interference is considered to result from retrieval interference.

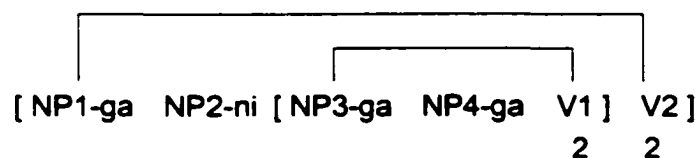
Importantly, this model does not distinguish between interference due to identical case-marking and interference due to preferred structural position. Consider the schematized Japanese examples in (2.38):

(2.38) a.



Lewis & Nakayama (2002: 89)

b.



Lewis & Nakayama (2002: 89)

In Japanese, *-ga* is the nominative-marker, which marks the grammatical subject. NP1-*ga* and NP3-*ga* in (2.38a-b) are the subject of the outer clause and the inner clause, respectively. In both examples, NP2 is marked with the dative-marker

-ni, whereas NP4 is marked with different case-markers: NP4 in (2.38a) is marked with the accusative-marker *-o*, whereas NP4 in (2.38b) is marked with *-ga*. NP4 in both examples is in fact the object of the inner clause. Since Japanese allows the nominative-marking on object NPs with stative predicates, V2 is a stative predicate. (We discuss details of the nominative object construction in Chapter 3)

Let us consider what happens at the point of the subject attachment for the embedded verb, V1. Here, it is NP3-*ga* that must be retrieved. In (2.38a), no items potentially contribute to retroactive interference because the only item that intervenes between V1 and NP3-*ga* is NP-*o*, which cannot appear in subject position. In contrast, NP4-*ga* in (2.38b) potentially contributes to retroactive interference because just like the to-be-retrieved subject NP3-*ga*, it is marked by *-ga* even though it is a nominatively-marked object. As for the subject attachment of V2, the amount of proactive interference potentially contributing is consistent between (2.38a) and (2.38b). That is, the retrieval of NP1-*ga* involves no proactive interference because there are no items preceding it, while it is interfered by NP3-*ga* retroactively. This model assumes that it is the encoding of NP3 as a potential subject that interferes with the representation of NP1 also as a potential subject. In other words, even though NP3 is not NP1's active competitor at the point of NP1's retrieval because NP3 has been already attached, the damage has been already occurred at the time of encoding. The amount of Retroactive Interference and that of Proactive Interference are computed by the RI unit and the PI unit, respectively. The digits added below

V1 and V2 in (2.38a-b) above indicate how many units of interference for the subject attachments are predicted at each of those verbs. Since it is assumed that retroactive and proactive interference contributes equally to retrieval difficulty, each digit is a total of PI and RI units at a given point.

Also, Lewis's (1998, Lewis & Nakayama 2002) model incorporates the positional similarity effect. That is, "when syntactically similar items NPs are closer to each other, there is a substantial increase in the perceived complexity of the structure" (Lewis & Nakayama 2002: 92). By incorporating an adjacency factor, Lewis's (1998, Lewis & Nakayama 2002) model makes the following prediction: Whenever more than two incomplete case-assignment relations of the same kind exist adjacently to each other at a point of structural integration of a sentence, the sentence should be unprocessable.

2.6.2 Semantic similarity and pragmatic-based contrast

Another type of similarity-based interference effects that is frequently discussed in the literature is semantics and/or pragmatics-based. Although the effect of semantic/pragmatic similarity-based interference is not explored in the current study, we summarize earlier studies' observations and findings here because it is an important issue and is discussed later.

Difficult doubly center-embedded sentences become "relatively easy" if the consecutive NPs are in different semantic classes from each other, and if semantic links between those NPs and their VPs are explicitly distinguishable

from others (Bever 1970; Fodor et al. 1968; Fodor & Garrett, 1967; Hudson 1996; Schlesinger 1968; Stolz 1967). That is, discriminability in the semantic links appears to guide the parsing to reach appropriate combinations of NPs and their VPs. The examples in (2.39) illustrate this contrast. The second NP in the less difficult (2.39b) is inanimate whereas the first and third NPs are animate. Also, the verbs are different in tense in (2.39b). In contrast, all the NPs in (2.39a) are animate and the verbs are all in the same past progressive form.

(2.39) a. # The dog the cat the fox was chasing was scratching was yelping.

Bever (1970: 334)

b. #? The dog the distraction the wild fox produced was scaring will run away fast.

Bever (1970: 338)

Stolz (1967) performed un-timed paraphrase tasks and showed that semantically supported center-embedded sentences such as (2.40b) is understood better than those such as (2.40a) that do not have such support.

(2.40) a. # The chef that the waiter that the busboy appreciated teased admired good musicians.

Stolz (1967: 870)

b. #? The bees that the hives that the farmer built housed stung the children.

Stolz (1967: 870)

Furthermore, using Korean sentences, Rosenbaum & Kim (1976) observe that (2.41a) is clearly less difficult than (2.41b).

- (2.41) a. #? [ku ay-tul-i [wuli apenim-kkeyse [nal ssi-ka kay-ko-lul]
 that child-PI-Nom we father-Nom(Hon) weather-Nom clear-that-Acc
 palako-keysita-nun-kes-ul] alkoissta.]
 wish(Hon)-AdNom that-Acc knows
 "The children know that our father wishes that the weather clears up."

(Rosenbaum & Kim 1976: 47)

- b. # [ku ay-tul-i [wuli hyeng-i [sensayng-i olh-ko-lul]
 that child-PI-Nom we brother-Nom teacher-Nom right-that-Acc
 palanta-nun kes-ul] alkoissta.]
 wish-AdNom that-Acc knows
 "The children know that my brother wishes that the teacher is right."

(Rosenbaum & Kim 1976: 54)

Rosenbaum & Kim emphasize a variety of "structure aiding cues" working altogether for the comprehensibility of (2.41a), none of which exists in (2.41b). Rosenbaum & Kim do not explicitly make remarks about the types of those aiding cues, but one type among those cues is that lexical/conceptual content of each subject NP and its VP is semantic and/or pragmatic distinguishable from others.³³ For example, "children-know" and "weather-clear up", but neither "children" can ever "clear up" nor "weather" can ever know" anything. In contrast, the subject NPs and the VPs in (2.41a) can be combined freely: Either one of "children", "brother", and "teacher" can "know" or "wish" something, and all of them can "be

³³ Another type of cues in Rosenbaum & Kim's less difficult example is a phonological discriminability effect. In the difficult sentence, all the subject NPs are marked with the nominative marker *-i* whereas those in the less difficult sentence are marked with different nominative markers. We discuss this study with respect to the phonological cues below.

right". Thus, semantic/pragmatic dissimilarity seems to contribute to improvement in processability of doubly center-embedded sentences across languages.

Based on earlier observations and his own investigation, Hudson (1996) argues that semantic similarity is the major cause of the problem as follows:

[R]ather than being the solution to a problem caused by syntax, [semantics] is the cause. The syntax is quite straightforward and parsable, but it requires some support from the meaning. When the meaning is unhelpful or misleading, the whole system fails and the processor either gives up or resorts to purely pragmatic reasoning.

(Hudson 1996: 299)

On the other hand, some researchers argue that semantic similarity factors are not the major source of the problem. Gibson (1998: 4, Footnote 4) makes this point with the following two examples: First, even though semantic dissimilarity contributes to some improvement in processability, sentences that have semantic support are still very complex and difficult to process. For example, although (2.42a) is easier to understand than (2.42b), it is yet hard to understand.

(2.42) a. # The vase that the maid that the agency hired dropped on the floor broke into a hundred pieces.

Gibson (1998: 4, Footnote 4)

b. # The administrator who the intern who the nurse supervised had bothered lost the medical reports.

Gibson (1998: 3)

c. # The vase that the maid that the agency that the lawyer represented hired dropped on the floor broke into a hundred pieces.

Gibson (1998: 4, Footnote 4)

Second, when another pragmatically-distinguishable relative clause is embedded in (2.42a), creating (2.42c), the structure becomes completely unprocessable, and this unprocessability is similar or more complex than (2.42a). This indicates that factors other than semantic similarity are responsible for the complexity of center-embedded structure. Based on these facts, Gibson (1998: 4, Footnote 4) argues that a complexity theory that relies on semantic role interference alone is not sufficient to explain complexity effects.

Moreover, there are empirically motivated suggestions that semantic similarity does not aid comprehension in the center-embedding context. For example, Nakayama & Lewis (2002) and Nakayama et al. (2003) tested the effects of semantic similarity in five experiments in Japanese, using off-line questionnaires, the on-line moving window paradigm, and the on-line magnitude estimation paradigm. They focused on the effect of semantic discriminability of animacy and that of verb types (i.e., active intransitive versus passive transitive), in single center-embeddings. The semantic similarity effects were tested in

roughly two groups of sentences: One group contained two consecutive NP-*ga*'s, while sentences in the other group did not to have any NP-*ga*'s consecutively. The animacy effect was tested for both adjacent and non-adjacent NPs. Although the results of those experiments showed significant differences between the sentences with and without consecutive NP-*ga*'s, there were no significant animacy effects, neither in the adjacent/non-adjacent NPs that were syntactically identical (i.e., both *ga*-marked), nor in those NPs that were syntactically distinct (i.e., one is NP-*ni*, and the other NP-*o*). Moreover, there were no significant differences in verb types, either, suggesting that discriminability between thematic roles associated with consecutive subject NPs has no effect. The above results, taken together, lead Nakayama & Lewis (2002) to conclude as follows:

[E]ven in cases where syntactic discriminability is low and the parser might be expected to rely on semantic cues to help establish the correct dependencies, increasing semantic discriminability has little or no effect relative to the large effect of syntactic and positional similarity.

(Nakayama & Lewis 2002: 1)

Apart from the semantic similarity effect, it is pointed out that discourse-based contrasts may play a role in processing doubly center-embedded sentences. It has been observed in the earlier literature that

sentences, such as those in (2.43), are processable even when they involve double center-embedded construction.

- (2.43) a. The reporter everyone I met trusts said the president won't resign yet.

Bever (1974: 189)

- b. The shells that the children we watched collected were piled up.

Hudson (1996: 298)

- c. Isn't it true that example sentences that people that you know produce are more likely to be accepted?

De Roeck et al. (1982: 332)

Kac (1981) attributes the acceptability of these sentences to the existence of pronouns in the most deeply embedded clause. Also, Gibson (1998) argues that difficult doubly center-embedded sentences become acceptable only when the most deeply embedded subject NP is an indexical pronoun, such as "I", "you", and so forth. Using an acceptability questionnaire, Gibson³⁴ found that only an indexical pronoun and not other types, such as a short name (e.g., "Jen"), a full NP (e.g., "the scientist"), a pronoun with no established referent (e.g., "they"), aid acceptability of doubly center-embedded sentences.³⁵ Under Gibson's (1998,

³⁴ See Warren & Gibson (2000a, b).

³⁵ It is interesting, however, that English pronouns provide information about case to certain extent. That is, while nouns of other classes (e.g., common nouns) do not show what case is associated with them unless they have a Saxon possessive marker "-s", pronouns such as "I", "my", and "me" morphologically show what case is associated with them. Another possibility for processability improvement of difficult double center-embeddings with pronouns is the prosodic effect: Pronouns are phonologically light, altering repetitive prosody associated with double center-embedding, so that structural packaging becomes easier (see Fodor 1998; Frazier & Fodor 1978).

2000) theory reviewed earlier, it is assumed that the maximal memory cost necessary to process a doubly center-embedded structure with a new referent in its most deeply embedded subject position is larger than the maximal memory cost necessary to process a similar structure with an old referent in that position. The basic idea is that if a non-indexical pronoun is in that position, it should be more costly in a null discourse context.

2.6.3 Phonological similarity

Similarity-based interference effects that may contribute to the processing of doubly center-embedded sentences also include phonological similarity effects. Recall the various structure aiding cues which Rosenbaum & Kim (1976) point out in their observation of the contrast between the Korean sentences in (2.41), repeated as (2.44) below:

- (2.44) a. #? [ku ay-tul-i [wuli apenim-kkeyse [nal ssi-ka kay-ko-lul]
 that child-PI-Nom we father-Nom(Hon) weather-Nom clear-that-Acc
 palako-keysita-nun-kes-ul] alkoissta.]
 wish(Hon)-AdNom that-Acc knows
 "The children know that our father wishes that the weather clears up."

(Rosenbaum & Kim 1976: 47)

- b. # [ku ay-tul-i [wuli hyeng-i [sensayng-i olh-ko-lul]
 that child-Pl-Nom we brother-Nom teacher-Nom right-that-Acc
 palanta-nun kes-ul] alkoissta.]
 wish-AdNom that-Accknows

"The children know that my brother wishes that the teacher is right."

(Rosenbaum & Kim 1976: 54)

In Section 2.6.3, we discussed the role of semantic links created by the lexical/conceptual dissimilarity among NPs and VPs. Another type of interesting cue is the morphophonological dissimilarity between the same nominative case-markers. Unlike Japanese that has the only one nominative case-marker *-ga*, Korean has three nominative case-markers, *-i*, *-ka*, and *-kkeyse*. Of these three, *-kkeyse* is the honorific nominative marker, while *-i* and *-ka* are a pair of phonologically-conditioned nominative markers. In the difficult sentence (2.44b), the subject NPs are all marked with phonologically identical *-i*, whereas those in the less difficult (2.44a) are marked with completely different nominative markers.

Existing information on the effect of repeating phonologically identical case-marker on processing center-embedded sentences is rather slim. Uehara & Bradley (1996, see also Uehara & Bradley 2002) preliminarily investigate this effect on processability of doubly and singly center-embedded sentences. Since *-ga* is the only nominative case-marker in Japanese, this investigation was carried out in Korean, which is structurally similar to Japanese and has a pair of phonologically conditioned nominative markers.

Isolating the phonological cue from the various cues that are suggested by Rosenbaum & Kim (1976) as altogether supporting comprehension, Uehara &

Bradley performed an off-line processability rating experiment with 40 native speakers of Korean. There were 32 test sentences (eight quadruples) constructed by a native speaker of Korean. These test sentences were created in a 2x2 factorial design combining phonological type (*-i* versus *-ka*) and structural complexity (double embedding versus single embedding). In doubly center-embedded sentences, the nominative marking on the third NP of the three sentence-initial NPs was replaced from *-i* (or *-ka*) to *-ka* (or *-i*), minimizing the phonological repetition from two levels to one level. Singly center-embedded sentences were created by eliminating the second clause of the doubly center-embedded sentences. Lexical items were chosen to allow the phonological substitution in the third NP position, and adjacent NPs were designed to be of different types to avoid possible semantic/pragmatic similarity effects that were discussed in the previous section.

Uehara & Bradley found a significant main effect of structural complexity but no significant main effect of phonological repetition effect and no interaction between the factors, either. Based on these results, they concluded that the phonological repetition effect is unlikely to contribute to the processing difficulty of doubly center-embedded sentences and that if there is a phonological repetition effect, it is undetectably small. This study is presented in a different format from the published paper in Appendix A.

On the other hand, Lee & Nakayama (2003, see also Nakayama et al. 2003) report an effect of phonological similarity on the processability of Korean singly center-embedded sentences, employing a magnitude estimation rating

task³⁶ with 48 native speakers Korean. There were 24 target sentences to test the effects of syntactic similarity (Nom-Nom versus Top-Nom) and of phonological similarity between the two NPs. The lexical content of NP1 and NP2 were restricted to proper nouns (e.g., *Eunewu*, *Swuceng*), as a means of controlling lexical influences. Lee & Nakayama found a significant similarity effect in both syntactic and phonological comparisons. Although the phonologically identical 2Nom sentences were rated as more difficult than their phonologically different 2Nom counterparts, and significantly so, the effect was surprisingly small. The cost of the phonological similarity is one-third the magnitude of the "cost" associated with a sentence-initial NP-Nom compared to a sentence-initial Nom-Top.

The effect of phonological similarity on processability of double center-embedding was tested in Uehara & Bradley, but not in Lee & Nakayama. It is clear, however, that there is a disagreement in their findings in the single embedding context. Certainly, further work is needed to clarify this disagreement, as far as phonological similarity is concerned, but the phonological similarity effect (if any) seems not to be a major factor of the

³⁶ The magnitude estimation task usually presents sentences as wholes, and requests an *unsped* assessment of "acceptability". In Lee & Nakayama's experiment, however, ratings were requested for sentences presented in a non-cumulative moving window display. It is unclear what impact this departure from normal procedure might have had for the basis on which sentence-final ratings were made. This observation suggests that the participants' ratings may have conflated stylistic considerations with processability, a conflation that is all too likely when instructions in the magnitude estimation procedure only loosely specify what the basis of ratings should be. Lee & Nakayama also report phrase-by-phrase reading time data over the same sentences (and the same subjects), but it is unclear that these "on-line" data have sufficient stability to be taken as supporting the claims made for the ratings data.

problem with doubly center-embedding.

2.7 Summary of Chapter 2

This chapter summarized some structural properties of center-embedded constructions in Japanese. We also reviewed several general characteristics of the processing problems discussed in the earlier literature, together with some observations and findings about the processing of Japanese center-embedded sentences. Among previous explanations, we focused on some models that attribute the problem to incomplete application of phrase structure rules, to incomplete syntactic dependencies, to thematic dependencies, or to dependency locality and discourse referents. Similarity-based effects were also discussed. The earlier proposals reviewed in this chapter have various implications for the investigations of the current study, that are to be reported.

CHAPTER 3

PROPERTIES OF NP-*ga*, PART I

3.1 Introduction

This chapter discusses some properties of the nominative case-marker *-ga* that are relevant to Experiments 1 and 2 reported in Chapters 4 and 5, respectively.³⁷ The primary goal of this chapter is to provide a basic background for the structural manipulations employed in those experiments and for the discussion of their results. We focus on two of *-ga*'s functions, *-ga* as the single subject marker and as the nominative object marker.

In what follows, some characteristics of these functions are reviewed in turn, along with those of other markers, which were used to create experimental manipulations. These manipulations included three kinds of particle substitutions: The subject-marking *-ga* was substituted for by the topic marker *-wa* or by the genitive marker *-no*, and the object-marking *-ga*, by the accusative marker *-o*. The purpose of utilizing these particle substitutions is to manipulate the degree of NP-*ga* repetition without changing basic sentential meaning and the level of embedding, in order to investigate the 3*ga* effect on processing

³⁷ Besides the subject-marking and object-marking roles discussed in this chapter, the study utilizes two more of *-ga*'s roles to carry out an exploratory investigation on the ambiguity effect associated with *-ga*'s multiple syntactic functions, which is reported as Experiment 3 in Chapter 7. These roles are *-ga* as the external possessor marker and as the parallel subject marker. Since they are relevant only to Experiment 3, we review them in Chapter 6.

doubly center-embedded sentences. Our discussions of relevant properties of *-wa*, *-no*, and *-o* occasionally include those of *-ga* in a comparative manner, so that the idea underlying the experimental manipulations are captured easily.

Section 3.2 first describes some interpretive and syntactic characteristics of *-ga* as the single subject marker (Section 3.2.1), and then reviews those of the topic marker *-wa* (Sections 3.2.2) and the subject-marking *-no* (Sections 3.2.3).

Section 3.3 reviews some characteristics of the nominative object marking *-ga* and the accusative marker *-o*. Besides the role to manipulate the degree of *-ga* repetition, the substitution between *-o* and the nominative-object marking *-ga* played another important role in Experiments 1 and 2: It was used as a device to decrease the level of embedding, without changing the number of NP-*ga*'s.

Finally, to manipulate the degree of NP-*ga* repetition, Experiments 1 and 2 employed another device, in addition to the particle-substitution devices: An adverb was placed to maintain or split up a sequence of three consecutive *-ga* phrases. Adverb placement is not part of *-ga*'s properties *per se*, but its mechanism involves some syntactic issues. Also, the adverb placement manipulation was used differently between the two experiments. Thus, Section 3.4 describes the basic idea of this manipulation, and Section 3.5 summarizes the chapter.

3.2 NP-ga as Single Subject

3.2.1 Single Subject Construction

The most prototypical role of the nominative case-marker *-ga* is to mark the single grammatical subject of a clause in the Single Subject Construction (hereafter, SSC). The examples in (3.1) illustrate relationships between the number of SSCs and the level of embedding: In the simple one-clause sentence in (3.1a), NP-*ga* serves as the sole subject of its own clause, and there is one SSC contained in the structure of this sentence. In the singly center-embedded sentence in (3.1b), the matrix and embedded clauses each have a single subject, and the entire structure contains two SSCs in total. In the doubly center-embedded sentence in (3.1c), each of the matrix, middle, and innermost clauses has a single subject, and the sentence contains three SSCs.

- (3.1) a. [_S sensei-ga odotta.] **1 SSC**
 teacher-Nom danced **No embedding**
 "The teacher danced."
- b. [_S gakusei-ga [_S [_S sensei-ga odotta]-to] itta.] **2 SSCs**
 student-Nom teacher-Nom danced-that said **1 embedding**
 "The student said that the teacher danced."
- c. # [_S shoonen-ga [_S [_S gakusei-ga [_S [_S sensei-ga **3 SSCs**
 boy-Nom student-Nom teacher-Nom **2 embeddings**
 odotta]-to] itta]-to] hanasita.]
 danced-that said-that spoke
 "The boy stated that the student said that the teacher danced."

Traditionally, it has been assumed that subject-marking *-ga* plays various roles in interpretation. First, the NP-*ga* subject is understood as either non-focused or focused. Kuno (1973a) makes a distinction between "neutral-description" and "exhaustive-listing" interpretations, respectively.^{38,39} The most typical interpretation of the sentence in (3.2a) represents the former and that in (3.2b) the latter.

- (3.2) a. Jon-*ga* kita.
 John-Nom came
 "John came."
- b. Jon-*ga* gakusei desu.
 John-Nom student is
 "John and only John is a student. / It is John who is a student."

(Kuno 1973a: 60)

In (3.2a), the non-focused NP-*ga* is interpreted as the subject of a sentence describing an event, whereas the focused subject NP-*ga* in (3.2b) is taken to mean "NP (and only NP)". Neutral-descriptive sentences, such as (3.2a), require no special context. In contrast, exhaustive-listing sentences, such as

³⁸ The distinction between "neutral description" and "exhaustive listing" was originally made by Kuroda (1965).

³⁹ While some researchers (e.g., Kuno 1973a, b, among others) assume that there are two different kinds of subject-marking *-ga*, others (e.g., Fiengo & McClure (2002), Kuroda (1992); Shibatani (1990), among others) argue that there is only one *-ga*, from which the two different senses naturally fall out. We will briefly review the ideas of Shibatani and Fiengo & McClure in Section 3.2.2. The study takes a neutral stance with respect to whether there is one *-ga* or two. However, it is fact that subject-*ga* is interpreted either focused or non-focused and that these readings affect interpretation of the sentence containing it.

(3.2b), require certain contextual grounds because *-ga*'s exhaustive-listing function is a means to pick an entity out of a presupposed universe of discourse.⁴⁰

Whether the *ga*-marked matrix subject is interpreted as focused or non-focused depends on the predicate type: While it is interpreted neutrally with a Stage-Level predicate (i.e., a predicate representing a temporary or non-inherent property), it is interpreted as focused with an Individual-Level predicate (i.e., a predicate representing an inherent property or stable/permanent state). According to Kuno (1973a, b), the *ga*-marked subject receives the neutral-description reading with a predicate that represents an action, existence, or temporary state, and it receives only the exhaustive-listing interpretation with a predicate which represents a stable state.^{41,42} For example, the predicate *kita* in (3.2a) is a Stage-Level predicate, whereas *gakusei desu* in (3.2b), an Individual-Level predicate. Hence, the two sentences obtain a neutral-description interpretation and an exhaustive-listing interpretation,

⁴⁰ For discussions on possible reasons for the existence of the sense of exhaustive listing, see Kuroda (1992: 50-55) and Shibatani (1990: 269).

⁴¹ Kuno (1973a) notes that quantified NPs are exceptional to this dichotomy. In the study, however, no quantified NP-*ga*'s are used in test materials.

⁴² For a detailed analysis of the interaction of *-ga*'s interpretation and predicate type, see Miyajima (2002).

respectively.⁴³

Importantly, when the NP-*ga* subject is embedded,⁴⁴ the distinction between the two interpretations becomes neutralized, and regardless of predicate type, it can receive only a neutral-descriptive interpretation (Kuno 1973a: 56, see also Kuroda 1992). That is, the interaction between -*ga*'s (non-)focused readings and Stage-/Individual-Level predicates diminishes in embedded clauses. It follows from this analysis that all of the NP-*ga*'s in the center-embedded sentences in (3.1b-c), repeated as (3.3a-b), and those in (3.4) typically receive the neutral-descriptive reading.

- (3.3) a. [_S gakusei-*ga* [_S [_S sensei-*ga* odotta]-to] itta.]
 student-Nom teacher-Nom danced-that said

“The student said that the teacher danced.”

- b. # [_S shoonen-*ga* [_S [_S gakusei-*ga* [_S [_S sensei-*ga* odotta]-to]
 boy-Nom student-Nom teacher-Nom danced-that
 itta]-to] hanasita.]
 said-that spoke

“The boy stated that the student said that the teacher danced.”

- (3.4) a. [_S gakusei-*ga* [_S [_S sensei-*ga* kanji-da]-to] itta.]
 student-Nom teacher-Nom party organizer is-that said

“The student said that the teacher is the party host.”

⁴³ A sentence containing an Individual-Level predicate does not obtain the exhaustive-listing interpretation if the subject NP is topicalized, as shown in (i).

(i) Jon-wa gakusei *esu*.
 John-Top student is
 “As for John, he is a student.”

⁴⁴ This “embedded” also includes other subordinate clauses, such as adverbial clauses, as well as nominalized clauses, such as [_S]-*koto/-no* (“the fact that [_S]”).

b. #[_S shoonen-ga [_S [_S gakusei-ga [_S [_S sensei-ga
 boy-Nom student-Nom teacher-Nom
 kanji-da]-to] itta]-to] hanasita.]
 party organizer is-that said-that s poke

"The boy stated that the student said that the teacher is the party host."

In (3.3) and (3.4), the matrix subject is interpreted as non-focused because it is associated with a Stage-Level predicate. The middle subject receives a non-focused reading, as well, because it is associated with a Stage-Level predicate and embedded. While the innermost subject in (3.3) is associated with a Stage-Level predicate, that in (3.4) has an Individual-Level predicate. Regardless of the predicate type, however, they receive non-focused interpretations because they are embedded in another clause. As illustrated above, all the *-ga* phrases in the singly and doubly center-embedded test sentences in Experiments 1 and 2 were designed to be interpreted as neutral as possible.⁴⁵

Another interpretive function associated with *-ga* is pragmatic or discourse-oriented: An NP it marks conveys new information which is introduced into the universe of discourse for the first time (Chafe 1976; Kuno 1973a, 1978; Mikami 1963; Ono 1973; Shibatani 1990). As for the relationship between new information and *-ga*, Shibatani (1990) offers an interesting insight that there are two ways for *-ga* to play a role in representing new information. For example, a

⁴⁵ Note, however, that in examining the ambiguity effect on processing NP-*ga* sequences, Experiment 3 (Chapter 7) exploits *-ga*'s functions as the external possessor marker and as the parallel subject marker. These roles are focused in nature, and thus non-neutral readings are unavoidable. Issues related to *-ga*'s non-neutral readings relevant to Experiment 3 are discussed in Section 6.2, Section 6.3, and Chapter 7.

sentence, such as (3.5) below, can be used felicitously in two contexts: In one context, the entire sentence itself is new information, while only *Mearii* is the focus of new information in the other. In the former type of context, what has just been witnessed is expressed with the sentence, and no particular part of the sentence draws special attention.

- (3.5) *Mearii-ga naita.*
 Mary-Nom cried
 "Mary cried."

In the latter type, *Mearii* is the information that answers what a question such as (3.6a) is asking, and it is thus the focus of new information. Usually focused NP-*ga* requires the primary stress in spoken sentences, as illustrated by the italicized *Maearii-ga* and its capitalized translation in (3.6b).

- (3.6) a. *dare-ga naita-no?*
 who-Nom cried-Q
 "Who cried."
 b. *Mearii-ga naita.*
 Mary-Nom cried
 "It is MARY that cried."

In the context in (3.6), *Mearii-ga* is focused and interpreted as "It is Mary (and only Mary) that ..." because it is the center of attention, the remainder of the sentence having already been known. This point was discussed by Kuno (1973a), as well: Neutral-descriptive sentences can also be used as

exhaustive-listing in some contexts. Notice that *Mearii-ga* is interpreted as focused even though the predicate of the sentence is Stage-Level. The focus effect we see here results because of the contextual necessity external to the sentence in question, overriding the effect of predicate type we discussed earlier. Note, however, that this is not relevant to Experiments 1 and 2 because their test sentences did not involve NP-*ga*'s that require this type of discourse or pragmatic grounds.⁴⁶

The function of *-ga* as a signal for new information has been discussed in earlier studies on information structure, and has often been contrasted with the role of the topic marker *-wa*, which is considered to convey old/given information. Discussions of new versus old/given information also involve *-ga* and *-wa* as the non-topic and the topic marker, respectively. Since these issues involve both characteristics of *-ga* and *-wa*, we review them together in the next section (Section 3.3.2).

Let us now summarize some syntactic properties associated with *-ga*, particularly what the structure of a Japanese subject is like and how it is licensed. The current study assumes the generative framework, and our summary is based on that literature. Although there are a variety of views on the subjecthood of Japanese and on the licensing of the subject, a consensus among researchers is that the structure of Japanese is configurational⁴⁷ and that

⁴⁶ In contrast, *-ga*'s role as the external-possessor of *-ga* is associated with pragmatically motivated focus, and this is discussed in Chapter 6.

⁴⁷ For details of the non-configurational view, see Inoue (1978), Hale (1980), Farmer (1984), Miyagawa (1980), among others.

nominative case is assigned (or checked) by T via a Spec-Head relation. There are, however, two views as to where the sentential subject originates: One view assumes that the subject is base-generated outside VP. For example, Kuno (1973a) analyzes Japanese sentential structure to be “S $\rightarrow$ NP VP” (see Chomsky 1965) and considers the subject as [NP, S]. Saito (1985) and Hoji (1985) consider Japanese to have fully configurational structure, [_S NP, VP]. Tateishi (1991) analyzes the Θ -marked subject of Japanese sentences as base-generated in SPEC(AgrP), and neither in SPEC(IP) nor SPEC(VP). Alternatively, some assume that the subject is base-generated VP internally: For example, Fukui (1986) and Kuroda (1992) assume that the nominative argument (but not the topic NP-*wa*) is the subject, which is generated inside the VP and stays *in situ* at S-Structure. Kitagawa (1986), on the other hand, proposes that the nominative argument and other arguments in Japanese are all in the checking domain of I at S-Structure, and interpreted as VP-internal arguments at LF.

The divergence in opinions appears to have emerged partly because of the nature of Japanese itself and partly because of theory-internal reasons. Since Japanese lacks overt agreement and allows multiple NP-*ga* constructions, how nominative case is assigned is a complication. However, details of the above various views including whether the grammatical subject is base-generated VP-internally or VP-externally does not have any impact for the purpose of the current study.

the non-scramblability of subject NP-*ga* but does not explicitly discuss it in our later discussions.

3.2.2 NP-*ga* subject and NP-*wa* topic

In order to investigate the repetition effect of *-ga* on the processing of center-embedded sentences, it was necessary to create environments in which processability of sentences containing a sequence of three consecutive NP-*ga*'s could be minimally compared with that of sentences lacking such a sequence. In one of the manipulations for enabling comparisons, *-ga* was replaced by the topic marker *-wa* in Experiments 1 and 2. As *-ga* prototypically marks sentential subjects, *-wa* typically topicalizes sentential subjects, and the propositions expressed by *-ga* and *-wa* sentences are truth-conditionally equivalent to each other (Shibatani 1990: 263). Taking these advantages, the substitution of *-ga* with *-wa* was employed as an experimental manipulation (for details, see Chapters 4 and 5).

Let us now see the basic idea behind the *-ga* / *-wa* substitution manipulation first, and then discuss some of *-wa*'s interpretive and syntactic characteristics. Since *-wa*'s multiple interpretive roles are often contrasted with those of *-ga*, we contrast the two particles, particularly their roles as the topic versus non-topic markers and the old/given versus new information markers.

The structural skeleton pair in (3.8) is one of the pairs from which some of the test sentences in the experiments were created.⁴⁸

- (3.8) a. [s NP-**ga** [s NP-*ga* [s NP-*ga* NP-o V] V] V] 3*ga*
 b. [s NP-**wa** [s NP-*ga* [s NP-*ga* NP-o V] V] V] 2*ga*

By replacing the first *-ga* with *-wa*, the degree of NP-*ga* repetition was reduced from three to two, but the level of embedding was kept the same.

Just as illustrated in (3.8), the *-ga* / *-wa* substitutions employed in Experiments 1 and 2 were all in the matrix subject position. It has been assumed that *wa*-marked NPs are taken as either regular topics or contrastive topics, i.e., “thematic *-wa*” and “contrastive *-wa*”, respectively, in Kuno’s (1973a) term.⁴⁹ According to Kuno, a sentence can contain only one thematic *-wa*. If there is more than one *-wa* in a sentence, only the first *-wa* receives a thematic reading, and the others will be contrastive.⁵⁰ Also, for native speakers of Japanese, an NP-*wa* in an embedded clause tends to trigger a contrastive reading.⁵¹ Thus, by applying the *-ga* / *-wa* substitution only to the matrix subject

⁴⁸ This skeleton pair is one of those used in Experiment 1 (Chapter 4).

⁴⁹ Contrary to Kuno (1973a), there is another line of analysis that there is only one *-wa* (and only one *-ga*), e.g., Shibatani (1990) and Fiengo & McClure (2002). Under this analysis, it is argued that the distinction between different interpretations of *-wa* (and different interpretations of *-ga*) naturally fall out. We discuss this issue below.

⁵⁰ Contrastive *-wa* is not used in the experimental materials of Experiments 1 and 2, but are relevant in analyzing elicited responses in Experiment 3 (Chapter 7).

⁵¹ According to Kuno (1973a: 56), the distinctions between thematic *-wa*, descriptive *-ga*, and exhaustive listing *-ga* are neutralized in subordinate clauses, and all three realize as nominatively marked subject.

position, NP-*ga* sentences and their NP-*wa* counterparts were designed to be interpreted as neutrally as possible in Experiments 1 and 2.⁵²

Materials for these experiments were created in two steps: First, structural skeleton pairs were constructed with the *-ga* / *-wa* substitution device in the manner described above; then minimal *-ga* / *-wa* sentence pairs were produced by inserting lexical items shared within a pair. Details of the material constructions will be described in each experimental report (see Chapters 4 and 5).

Another interpretive function associated with the topic marker *-wa* involves discourse-functional or pragmatic factors: *-wa* is said to signal old/given information, which contrasts with that of *-ga* to signal new information. In an information structural view, it is often said that potential topics are “objects and concepts that have been mentioned and recorded in the registry of the present discourse” (Kuno 1973a: 39, cf. Fiengo and McClure 2002; Hinds 1987; Iwasaki 1987; Maynard 1987; Shibatani 1990). In contrast, NP-*ga*’s represent what is introduced into the universe of discourse for the first time (e.g., Chafe 1976; Kuno 1973a, 1978; Mikami 1963; Ono 1973; Shibatani 1990; see Section 3.3.1).

However, the fundamental notion of “new” versus “old/given” does not seem to be so simple.⁵³ Summarizing the early literature, Shibatani (1990: 269)

⁵² Although certain predicates may trigger *-wa*’s contrastive reading, the NP-*wa* test sentences in Experiments 1 and 2 did not involve them. For a discussion on the interaction between the two readings of *-wa* and predicate type, see Miyajima (2002).

⁵³ Contrary to the above definitions, some discourse studies point out that the *-ga* / *-wa* distinction does not perfectly correspond to a distinction between new and old/given. Under a discourse structural view, the *-wa* / *-ga* choice is used to organize the thematic structure of texts or the flow of information in them. For details, see Hinds (1987),

argues that the two notions branch from whether “the center of the thought” is on the subject or in the predicate. The center of the thought refers to “the focus of new information” which is important both for the speaker and the listener because the given part is already presupposed and hence less important. According to Shibatani (1990), the inherent nature of the old/given distinction is explained via the notion of experiential judgment:

[T]he existence of the central entity of the state of affairs to be known is presupposed. The prototypical *wa*-expression reflects an experiential judgment, and, as such, the existence of what is marked by *-wa* must be presupposed. The correlation of *-wa* and the concept of given is thus rooted in the fundamental property of *-wa*.

(Shibatani 1990: 269)

NPs marked with *-ga* are often referred to in the literature as “non-topic” NPs, and are contrasted with “topic” NPs marked with *-wa*. While the discourse-functional view attempts to capture the difference between them in information structure, there are some alternatives: One approach takes the differences in cognitive judgments, and seeks an analysis from which the *-ga* / *-wa* meaning difference naturally falls out, emphasizing that there is only one *-wa* and only one *-ga* (Kuroda 1992; Shibatani 1990, cf. Kuno 1973a, b).

Iwasaki (1987), Maynard (1980, 1981, 1987), and Prince (1981), among others, cf. the pragmatic view proposed by Fiengo and McClure (2002).

For example, Shibatani (1990) points out that the non-topic *ga*-sentence in (3.9a) on the next page is a description of an event/state whereas the topic *wa*-sentence in (3.9b) is a generic statement.

(3.9) a. Hi-ga noboru.
sun-Nom rises
"The sun rises."

b. Hi-wa noboru.
sun-Top rises
"The sun rises."

(Shibatani 1990: 262)

Shibatani states that the pragmatic effects of *-ga* versus *-wa* are extra-propositional because propositional content of *-ga* and *-wa* sentences is identical. He argues that the contrast between the two constructions comes not from the difference between the two particles, but rather it is attributed to how *-wa* affects the entire sentence. That is, the difference arises due to the essential difference in the cognitive judgment: The topic construction involves a two-step analysis of a state of affairs, apprehending substance as a subject and associating predicate to the subject; whereas the non-topic construction involves no such analysis (Kuroda 1992). In the process of the non-topic construction, "a state of affairs is grasped as a whole, analyzing the recognition, through perception, a state of affairs itself, and its participants" (Shibatani 1990: 268).

Another alternative to the discourse-functional view is a speech-act analysis proposed by Fiengo & McClure (2002).⁵⁴ Based on Austin's (1962) theory, they attempt to account for the uses of *-wa* forms and non-*wa* forms (e.g., *-ga* forms). Austin's theory on which Fiengo & McClure base themselves analyzes speech acts as matching item-types and senses of predicates in the form of " α is a Φ ". Here, α and Φ are a "name" representing an item (i.e., a thing-in-the-world) and a "predicate" representing a sense, respectively, and these relationships are established through linguistic convention alone. With an item represented by α and Φ , there are two possible directions to match them — either a name is given and predicate is produced to match it, or a predicate is given and a name is produced to match it. According to Fiengo & McClure, *-wa* sentences are used to make a match only in the former direction and non-*wa* sentences in the latter. This means that NP-*wa* sentences are used only for speech acts in which their predicates are produced to match to given⁵⁵ items referred to by the *-wa* marked NPs. On the other hand, NP-*ga* sentences (non NP-*wa* sentences) are used for speech acts in which the *-ga* marked NPs are produced to match the senses of the given predicates.⁵⁶

⁵⁴ Fiengo & McClure point out that the distribution of *-wa* is not defined by discourse structure. Rather, the distribution of *-wa* is determined by speech-act choice, and it is a sequence of choices whether to use the *-wa* form or non-*wa* forms that constitutes discourse structure.

⁵⁵ Fiengo & McClure use the term "given" differently from that used to mean "previously mentioned" such as "old/given information". In speech act term, every structure has a "given" and "produced" part.

⁵⁶ With these notions, Fiengo & McClure further explain the neutral/non-neutral interpretation difference of *-wa* and *-ga*.

Let us now see how the syntax of *-wa* phrases are analyzed in the earlier literature. Syntactically, *-wa* is the topic-marker which makes the constituent it marks the grammatical topic of a sentence. NPs that are grammatically topicalized by the *wa*-marking are usually translated as “as for NP” or “speaking of NP”. (Note that English translations in the current study do not always reflect this translation.) Under Kuno’s (1973a) analysis, what can become topics are generic referents (e.g., “man” as human beings in general; “Americans” as Americans in general), and anaphoric referents (e.g., John; that cat). When the sentential subject is marked by *-wa*, nominative *-ga* cannot co-occur with *-wa*, as shown in (3.10c).⁵⁷

- (3.10) a. Jon-ga kinoo odotta.
 John-Nom yesterday danced
 “John danced yesterday.”
- b. Jon-wa kinoo odotta.
 John-Top yesterday danced
 “As for John, he danced yesterday.”
- c. * Jon-ga-wa kinoo odotta.
 John-Nom-Top yesterday danced
 (*intended*) “As for John, he danced yesterday.”

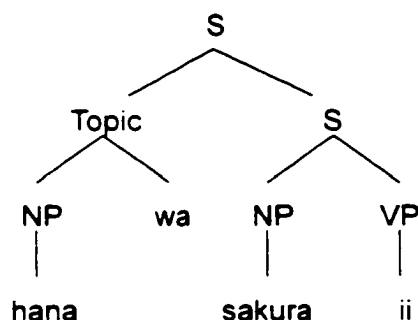
⁵⁷ It depends on the particle whether it can be followed by *-wa* or it cannot co-occur with *-wa* (or either). For example, when direct objects are topicalized and marked by *-wa*, accusative *-o* cannot co-occur with *-wa*. By contrast, the dative case-marker *-ni* marking indirect objects and most postpositions can be followed by *-wa*. The *-wa* marker’s function to topicalize non-subjects are relevant to Experiment 3 (Chapter 7).

Constituents that *-wa* marks include not only arguments but also adjuncts, i.e., adverbial and postpositional phrases (see Shibatani 1990, among others).

However, matrix subjects to which the *-ga* / *-wa* substitution manipulation applied in Experiments 1 and 2 were all subject NPs.⁵⁸

There are various opinions as to how *-wa* is derived.⁵⁹ For example, Kuno (1973a) assumes that topics in Japanese are base-generated in a position adjoined to S. Thus, topicalization under his analysis does not involve movement, as schematized in (3.11).

(3.11) Kuno's (1973a) Topicalization



hana-wa [s sakura-ga ii.]
 flower-Top cherry blossoms-Nom good

"As for flowers, cherry blossoms are the best."

(Kuno 1973a: 255-256)

⁵⁸ The multi topicalizing functions of *-wa* become relevant to our discussion in Experiment 3 in terms of the following two points: First, the ambiguity (or neutrality) associated with those functions were exploited to seek for possible explanations of part of response patterns (for details, see Chapter 7, Database E). Also, NP-*wa*'s given in sentence fragment stimuli were interpreted as non-subject topicalized NPs in some sentence completion responses (for details, see Chapter 7, Database D).

⁵⁹ Note that although the study involves NP-*wa*'s only in the matrix subject position, some of the syntactic analyses summarized here also involve those in other positions.

Underlying Kuno's analysis is the idea that topics such as (3.11) do not bind any argument position in their sentences, and hence they cannot be derived by movement. Therefore, Island Constraints (Ross 1967) are not an issue for topicalization.⁶⁰ In contrast, some argue that topic constructions involve movement. For example, Kuroda (1965) analyzes the derivational process of the sentence in (3.12) as in (3.13a-e).⁶¹

- (3.12) a. Kono hon-wa Jon-ga yonda.
 This book-Top John-Nom read
 "As for that book, John read it."

⁶⁰ Kuno (1973a) argues that topicalization and relativization in Japanese are not constrained by Subjacency. He assumes that the derivation of topic constructions with constituents other than subjects, such as the object *kono hon* ("this book") in (ia), involves deletion.

- (i) a. kono hon-wa Jon-ga yonda.
 this book-Top John-Nom read
 "As for this book, John has read it."
- b. [kono hon]_{topic} Jon kono hon yonda

The sentence in (ia) is derived from the deep structure schematized in (ib) *via* the deletion of the NP in the main clause identical to the topicalized item (Kuno 1973a: 62-63). Note that he uses the term "theme" for the topic in (ib).

⁶¹ Kuroda's original formula is abstract. For this reason, the example in (3.12) is cited from Kuno's (1973a) discussion. Note, however, that Kuno himself analyzes the topic construction as being base-generated, as reviewed above.

- (3.13) a. [Jon] [kono hon] [yonda] + wa (deep structure)
 b. [Jon]-ga [kono hon]-o [yonda] + wa (subject/object marking)
 c. [Jon]-ga [kono hon]-o-wa [yonda] (-wa attachment)
 d. [Kono hon]-o-wa [Jon]-ga [yonda] (topic preposing)
 e. [Kono hon]-wa [Jon]-ga [yonda] (deletion of particles)

(Kuno 1973a: 62)

Alternatively, Hoji (1985) proposes that there are two kinds of derivations corresponding to the two types of *-wa*, “topic” and “contrastive”, as summarized in (3.14).⁶²

- (3.14) a. The “topic” *wa*-phrase is base-generated under S” (S-double-bar).
 b. The “contrastive” *wa*-phrase is generated under S, and is subject to Move α .

(Hoji 1985: 189)

As was mentioned earlier, the two kinds of *-wa*’s interpretation were originally proposed by Kuno (1973a, b), as “theme” and “contrastive”, respectively.

Regular topic (or thematic) *-wa* obtains neutral readings, whereas contrastive *-wa* receives non-neutral readings, which require an appropriate contextual backgrounds in which the *wa*-marked element must be contrasted with others

⁶² Saito (1985) proposes that topicalization in Japanese involves an S-adjoined NP, and that NP topics are either base-generated or derived by movement. He assumes that while a scrambled item is licensed directly by binding its trace, topicalization is licensed by an aboutness condition. For details of the aboutness condition, see Kuno (1973a: 253-254, Footnote 12), Saito (1985: 286-287), and Shibatani (1990: 274-275).

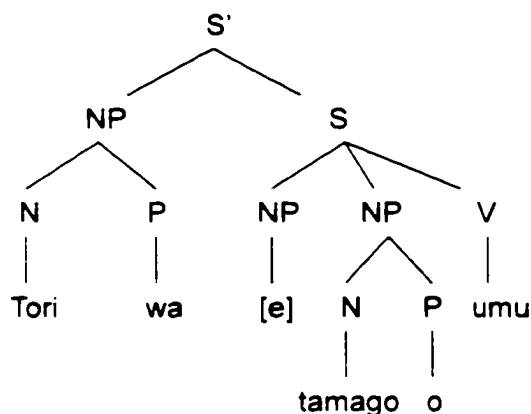
either inter- or intra-sententially. Hoji shows that only the contrastive *-wa*, but not the thematic *-wa*, exhibits properties which involve syntactic movement, such as variable/anaphor binding through reconstruction, Subjacency violations, and the impossibility of resumptive pronouns.⁶³

Finally, Shibatani (1990) assumes two kinds of structures for the Japanese topic construction: One kind is for sentences in which the topic phrase does not contain a postposition ("regular topic sentences" in his term), and the other is for the sentences in which the topic phrase does contain a postposition ("PP topicalization" in his term). Shibatani's (1990) analysis is that regular topics are base-generated, as illustrated in (3.15) below, while those containing a postpositional phrase are derived via movement.⁶⁴ As we discussed earlier, Shibatani (1990) argues that the topic construction involves a two-step analysis of a state of affairs, first apprehending an entity as a topic and then associating a comment to that topic. Thus, the base-generated topics express entities about which such analyses are made, whereas the topics derived via movement do not.

⁶³ Hoji (1985) also proposes that the contrastive *-wa* phrase that has not undergone movement at S-structure undergoes movement at LF.

⁶⁴ For Shibatani's structure of the sentence in which the topic phrase contains a postposition (i.e., PP topicalization), see Shibatani (1990: 276).

(3.15) Shibatani's (1990) NP Topicalization



(Shibatani 1990: 274)

Tori-wa e tamago-o umu
 bird-Top egg-Acc lay

"A bird is such that it lays eggs."

While only the topic interpretation of *-wa* is relevant to the test materials for Experiments 1 and 2, the analyses and discussion of Experiment 3 involve both of the two interpretations of *-wa*, i.e., the topic and contrastive interpretations.

3.2.3 NP-*ga* and NP-*no*

A second substitution manipulation employed in the current study replaced *-ga* with *-no* (Gen), exploiting the so-called *-ga / -no* alternation (or conversion) phenomenon.⁶⁵ Japanese optionally allows the subject-marking *-ga* to be

⁶⁵ Possible case alternation phenomena in Japanese involve the conversion between two particles in the following combinations: *-ga / -o*, *-ga / -no*, *-ga / -ni*, and *-ni / -o* (for a

substituted for by *-no* without changing basic sentential meaning in relative clauses or nominal complements⁶⁶ (Bedell 1972; Fujita 1988; Futagi 1994; Harada 1971, 1976; Inoue 1976; Mikami 1972; Miyagawa 1989; Saito, 1982, 1983; Takahashi 1996; Watanabe 1994).

In the current study, the *-ga* / *-no* substitution manipulation was utilized only in Experiment 1 (Chapter 4) in the following manner: First, to create an environment in which the effect of NP-*ga* repetition could be investigated without involving topic NPs, a minimal pair of structural skeletons was constructed, as schematized in (3.16).

- (3.16) a. [S NP-*ga* [NP [S NP-*ga* [NP [S NP-*ga* V] NP] V] NP]V] 3*ga*
 b. [S NP-*ga* [NP [S NP-*ga* [NP [S NP-*no* V] NP] V] NP]V] 2*ga*

The structures in (3.16) both involve double center-embedding, differing from each other only in the case-markings on the innermost subjects: While the innermost subject in (3.16a) is marked with *-ga*, it is marked with *-no* in (3.16b). Thus, (3.16a) contains a sequence of three consecutive NP-*ga*'s, whereas

thorough examination of all of these alternations, see Morikawa (1993), among others). Technically, the substitution between the nominative marker *-ga* and *-wa* is not part of the case alternation phenomena. However, as we have discussed in Section 3.3.2, *-wa* is used to manipulate structure because it typically marks sentential subjects and because the proposition expressed by *-ga* sentences is the same as that expressed by *-wa* sentences (Shibatani 1990:263).

⁶⁶ In this study, *-no* is substituted only for the subject-marking *-ga*, but the *-ga* / *-no* alternation occurs with nominative objects as well (whereas the *-no* marker cannot be substituted for *-o* in accusatively marked objects). For details of the *-ga* / *-no* alternation in the object position, see Dubinsky (1992), Fukui (1986), Fukui & Nishigauchi (1992), Saito (1982), Takahashi (1996), and Watanabe (1994).

(3.16b) has only two consecutive NP-*ga*'s. Test sentence pairs for Experiment 1 involving the *-ga /-no* substitution manipulation were all created using the skeleton pair in (3.16). In the second step of the construction of experimental materials, as with the *-ga /-wa* substitution manipulation introduced in the previous section, the same lexical items were inserted into a skeleton pair so that the basic sentential meaning and the level of embedding within a pair were consistent. Details of the test sentences are described in the report of Experiment 1 presented in Chapter 4.

Let us now discuss some characteristics of the *-ga /-no* alternation phenomenon. The *-ga /-no* alternation optionally occurs in the subject position of a nominal complement or a relative clause, as shown in (3.17a-b) and (3.17c), respectively.

(3.17) a. Mearii-*ga* [[Jon-*ga /-no* de*kaketa*] koto]-ni kizuita.
 Mary-Nom John-Nom/Gen went out fact-Dat noticed
 "Mary noticed the fact that John went out."

b. Mearii-*ga* [[Jon-*ga /-no* de*kaketa*] no⁶⁷]-o sitteita.
 Mary-Nom John-Nom/Gen went out fact-Acc know
 "Mary knew the fact that John went out."

c. [Jon-*ga /-no* *t*, ta*beta*] pizza ,
 John-Nom/Gen ate pizza
 "the pizza that John ate"

⁶⁷ This *-no* ("fact") is frequently used in daily conversation, and nominalizes sentential complements just as *koto* ("fact") in (3.17a).

Experiment 1 utilizes the *-ga /-no* alternation in a *toki* phrase in the innermost embedded clause of a doubly center-embedded sentence. An example of a *toki* phrase is given in (3.18).

- (3.18) [Jon-ga /-no dekaketa] toki
 John-Nom/Gen went out time
 “(the time) when John went out”

The *toki* phrase can be considered as either a relative clause, or an adverbial, which corresponds to “when ...” in English. In existing literature on the *-ga/-no* conversion, the *toki* phrase is standardly treated in the same way as nominalized clauses with *koto* (“the fact that ...”) without a gap (see e.g., Fujita 1988; Futagi 1994; Miyagawa 1989; Takahashi 1996, see also Babyonyshev & Gibson 1995; Mazuka et al. 1989). As it is not clear whether or not the *toki* phrase involves a gap inside it (i.e., the so-called gap-less relative clause that Japanese is said to have), all the examples in the current study do not include a gap in the *toki* phrase, following the above standard analysis.

All the actual *-ga /-no* doubly center-embedded test sentences for Experiment 1 were created by nominalizing the innermost embedded clause with *toki* (“time”) and the middle embedded clause by *no* (“fact that”), as schematized in (3.19).

- (3.19) a. [_{IP1} NP₁-ga [_{NP}[_{IP2} NP₂-ga [_{NP}[_{IP3} NP₃-ga V₃] *toki*] V₂]-no]-ni V₁] 3ga
 b. [_{IP1} NP₁-ga [_{NP}[_{IP2} NP₂-ga [_{NP}[_{IP3} NP₃-no V₃] *toki*] V₂]-no]-ni V₁] 2ga

Contrary to the nominalized clauses discussed above, neither the subject of matrix clauses nor that of complement clauses can be marked by *-no*, as illustrated in (3.20) and (3.21), respectively.

- (3.20) a. Jon-ga /*-no pizza-o tabeta.
 John-Nom/Gen pizza-Acc ate
 "John ate pizza."
 b. Jon-ga /*-no dekaketa.
 John-Nom/Gen went out
 Janet went out.
- (3.21) a. Mearii-ga [Jon-ga /*-no piza-o tabeta]-to itta.
 Mary-Nom John-Nom/Gen pizza-Acc ate-that said
 "Mary said that Janet ate pizza."
 b. Mearii-ga [Jon-ga /*-no dekaketa]-to omotta.
 Mary-Nom John-Nom/Gen went out-that thought
 "Dianne thought that Janet went out."

According to earlier studies on the *-ga* / *-no* alternation, there are dialectal variations with respect to its availability in terms of the transitivity of predicates and of the argument/adjunct distinction. Let us now review those variations in turn. Earlier observations on the transitivity restriction (Takahashi 1996; Terada 1987; Watanabe 1994) seem to suggest three dialectal groups:⁶⁸ The least restricted group allows the *-ga* / *-no* alternation for the subject of both transitive and intransitive predicates. The second group allows the alternation for the

⁶⁸ The first two of the three groups here are discussed in Takahashi (1996) and Watanabe (1994), and the third group is discussed in Terada (1987).

subject of intransitive predicates, but not for transitive predicates, as shown in (3.22).⁶⁹ Note that the symbol “ % ” is used here instead of “ * ” in order to indicate that not all native speakers of Japanese reject the examples in question.

- (3.22) a. [Jon-ga /%-no piza-o tabeta] resutoran/koto
 John-Nom/Gen pizza-Acc ate restaurant/fact
 “the restaurant where/the fact that John ate pizza”
- b. [Jon-ga /%-no Mearii-ni atta] toki/koto
 John-Nom/Gen Mary-Dat met time/fact
 “the time when/the fact that John met Mary”

While these two groups allow the *-ga /-no* alternation with all intransitive predicates, the more restricted group exhibits a restriction within intransitive predicates — the alternation is allowed only with unaccusative predicates and not with unergative verbs (Terada 1987), as illustrated in (3.23) and (3.24), respectively.

- (3.23) a. [Jon-ga /-no kaetta] toki/koto
 John-Nom/Gen returned time/fact
 “the time when/the fact that John came back”
- b. [kaze-ga /-no huku] basho/koto
 wind-Nom/Gen blow place/fact
 “the place where/the fact that it is windy”

⁶⁹ Harada (1971, 1976) observes that the variation depends on whether there is an intervening element between the subject and the predicate, and did not associate it to the transitivity constraint.

- (3.24) a. [Jon-ga /%-no oyoida] toki/koto
 John-Nom/Gen swam time/fact
 “the time when/the fact that John swam”
- b. [Jon-ga /%-no odotta] basho/koto
 John-Nom/Gen danced place/fact
 “the place at which/the fact that John danced”

As for the argument/adjunct distinction, Fujita (1988) and Miyagawa (1989) observe that the alternation is always acceptable in argument clauses, whereas in adjuncts⁷⁰ it is possible only with unaccusative predicates but not with unergative predicates (cf. Futagi 1994⁷¹).

In addition, Futagi (1994) reports an age variation in the acceptability of the *-ga/-no* alternation: Younger informants accept it only in relative clauses and not in noun complement clauses regardless of whether it is in an argument position or an adjunct position.

As we have reviewed, the judgments for the availability of the *-ga/-no* alternation vary significantly. In the materials construction for Experiment 1, *-ga/-no* test sentences were created using relative clauses in the innermost

⁷⁰ Fujita (1988) and Miyagawa (1989) use NPs with *toki* (“time”) as adverbial adjuncts. They pointed out, however, that NPs with *mae* (“before”) and *ato* (“after”) appear to allow the *-ga/-no* alternation.

⁷¹ Futagi (1994) surveyed acceptability of the alternation in 17 Japanese sentences with 14 native speakers. The effect of intervening elements was most clearly observed, and the argument/adjunct distinction was observed to some extent — most informants judged argument examples better than their adjunct counterparts with the same phrases. However, there were no clear judgmental differences between unaccusative and unergative predicates. There were variations in judgments even within unergative predicates in adjunct clauses, which are judged as ungrammatical in Fujita (1988) and Miyagawa’s (1989) analyses. She notes that other factors such as subject, tense, or mood appear to have affected the judgment of the unaccusative/unergative distinction.

clause of a double center-embedding construction. These relative clauses were all *toki* ("time") phrases as in (3.18b), which function as an adverbial meaning "when", and contained an unaccusative predicate. For the *-ga /-no* test sentences used in Experiment 1, even the most restricted dialectal group was observed to allow the *-ga /-no* alternation. Moreover, subjects that participated in that experiment were relatively young in their age. Thus, it is considered that the dialectal and age variations in judging (un)acceptability of the *-ga /-no* alternation we discussed here had nothing to do with the experimental results.

Syntactic analyses of the *-ga /-no* alternation in earlier studies directly reflect the variations we have summarized so far. Some have focused on the availability difference in terms of the distinction between unaccusative and unergative predicates (although to what extent this distinction exists seems unclear), and others have extended their attention to the argument/adjunct distinction.⁷² For example, Terada (1987) analyzes the *-ga /-no* alternation as being possible only with unaccusative predicates, assuming that an NP moves up to SPEC(NP) to be genitively marked from the object position when the sentence has an unaccusative predicate. When the sentence contains an unergative predicate, it moves up from the subject position. While the trace left behind in the former structure is properly governed (lexically governed by the

⁷² Fujita (1988) and Miyagawa (1989) observe that the *-ga /-no* alternation is always possible in argument clauses but is allowed in adjunct clauses only with unaccusative verbs. They utilize the notion of the Subjacency Condition and attempt to explain the asymmetric acceptability of the alternation in the adjunct clauses. However, Miyagawa himself has pointed out that there are a number of problems in his (and Fujita's) analysis because Subjacency is applied non-standardly. For details of their analysis and related discussions, see Fujita (1988), Futagi (1994), and Miyagawa (1989).

verb), the latter is not, resulting in a violation of the Empty Category Principle.⁷³

In sum, although the details differ from each other, earlier studies standardly analyze the syntactic derivation of the *-ga* / *-no* alternation as follows: The genitive subject is an NP (or DP) dominating the relative clause or the nominal complement, and the subject moves up to a higher NP position (or SPEC(DP)) from its original sentence-internal position (or SPEC(AgrSP)), leaving a trace behind (Bedell 1972; Fujita 1988; Futagi 1994; Miyagawa 1989, 1993; Saito 1982, 1983; Takahashi 1996; Terada 1987; Ura 1993; Watanabe 1994, among others, cf. Harada 1971, 1976⁷⁴).

Recent studies focus more on the Head responsible for the checking of the Case-feature and the level of representation in which Case-licensing of the subject takes place.^{75,76} A typical analysis of the case alternation from *-ga* to *-no* proposes that the subject covertly moves up to a higher NP position or SPEC(DP) from its original sentence-internal position or SPEC(AgrSP), leaving a trace behind, as illustrated in (3.25).

- (3.25) [DP Jon, -no [AgrSP *t*, tabeta] pizza]
 John-Gen ate pizza
 “the pizza that John ate”

⁷³ Chomsky (1981). See also Rizzi (1990).

⁷⁴ Harada (1971, 1976) assumes that the structure remains the same when the alternation applies, i.e., no movement involved.

⁷⁵ Discussions center around the transitivity condition of the restricted dialect and the scrambling condition of the non-restricted dialect.

⁷⁶ For analyses that assume covert subject raising in the Minimalist-type Case-checking system, see Miyagawa (1993), Takahashi (1996), Ura (1993), and Watanabe (1994).

Finally, it is in general assumed that genitive case in Japanese is a structural case, just as other languages (e.g., Miyagawa 1993; Takahashi 1994; Ura 1993, among others). Evidence for this assumption includes the following (Takahashi 1996): First, Japanese genitive case is associated with various kinds of meanings, suggesting its independence of a particular Θ -marking, as illustrated in (3.26) below, for example.

- (3.26) a. kinoo-no sinbun
 yesterday-Gen newspaper
 “yesterday’s newspaper”
- b. kono mae-no Iraku-no sinryaku
 last time-Gen Iraq-Gen invasion
 “Last time’s invasion of Iraq”

Also, Japanese genitive case can be assigned to not only DPs but also PPs, and it behaves in ways similar to nominative case in that neither of them can be scrambled.

3.3 NP-*ga* as Object: Nominative Object Construction

Besides its prototypical function as the subject marker, *-ga* can mark direct objects in the so-called Nominative Object Construction (hereafter, NOC) (Kuno 1973a). This function was used in Experiments 1 and 2 (Chapters 4 and 5, respectively) to manipulate the degree of NP-*ga* repetition as well as the level of

embedding.⁷⁷

Whether a sentence can or cannot have an NOC depends on the type of predicate. Further, if the predicate type does not support the NOC, the object is marked with the accusative marker *-o* in the Accusative Object Construction (hereafter, AOC). A certain class of predicates, however, allows both constructions interchangeably. The sentential structures in (3.27a) and (3.27b) schematize the NOC and the AOC, respectively.

(3.27) a.	[_S NP- ga NP- ga V]	Nominative Object Construction
b.	[_S NP- ga NP- o V]	Accusative Object Construction

In materials construction, the structural skeletons in (3.27) were embedded in the middle of another sentence to create singly center-embedded environments. The structure skeleton pair in (3.28) is the one used to create test sentences for Experiment 1.

(3.28) a.	[_S NP- <i>ga</i> [_S NP- <i>ga</i> NP- ga V] V]	NOC, 3 <i>ga</i>
b.	[_S NP- <i>ga</i> [_S NP- <i>ga</i> NP- o V] V]	AOC, 2 <i>ga</i>

⁷⁷ The function as the nominative object marker is also relevant to Experiment 3 (Chapter 7) which examines the effect of ambiguity associated with the multiplicity of *-ga*'s syntactic functions on the processability of doubly center-embedded sentences. If an NP-*ga* encountered in input is ambiguous for the parser, a sequence of consecutive NP-*ga*'s can be multiply ambiguous. The function of nominative-object marking is therefore a competitor for the subject-marking function in the parser's structure-building, together with the external-possessor marking and the parallel-subject marking functions (see Chapter 6).

(3.31) a. [_S NP₁-**ga** [_S NP₂-**ga** NP₃-**ga** V] V]

NP3 = NOC
Single embedding

b. [_S NP₁-**ga** [_S NP₂-**ga** [_S NP₃-**ga** V] V] V]

NP3 = SSC
Double embedding

Details of materials and experimental design for Experiments 1 and 2 are introduced in Chapters 4 and 5, respectively.

Let us now summarize some characteristics of the object-marking *-ga* and the *-ga/-o* alternation phenomenon. A generalization of the ground which supports the NOC is the stativity of the predicate: All transitive adjectives, all nominal adjectives,⁷⁸ and transitive stative verbs license the NOC (Koizumi 1994; Kuno 1973a; Tada 1992; Takahashi 1996, among others). These NOC-supporting predicates correspond to a certain class of Individual-Level predicates (e.g., Takahashi 1996, among others), but the [+stative] and [-stative] notations are used in what follows for convenience. If a predicate is [-stative], it assigns accusative case to its object, and accusative objects are marked by the accusative marker *-o*. The sentences in (3.32) and (3.33) are examples of the NOC and the AOC, respectively.

(3.32) a. [_S Jon-*ga* orandago-*ga* dekiru.]

[+stative]

John-Nom Dutch-Nom can do

"John can speak Dutch."

⁷⁸ Japanese adjectives are often dichotomized into adjectives and nominal adjectives. Adjectives inflect in a way similar to verbs and can constitute predicates without being followed by copulas, whereas nominal adjectives are adjectival in meaning, sharing certain characteristics with nouns, and do not inflect (Kuno 1973a: 28-29).

- b. * [_S Jon-ga orandago-o dekiru.] [+stative]
 John-Nom Dutch-Acc can do
 “(intended) John can speak Dutch.”

- (3.33) a. * [_S Jon-ga beeguru-ga taberu.] [-stative]
 John-Nom bagel-Nom eat
 “(intended) John eats bagels.”

- b. [_S Jon-ga beeguru-o taberu.] [-stative]
 John-Nom bagel-Acc eat
 “John eats bagels.”

As shown in (3.32), [+stative] verb *dekiru* (“can do”)⁷⁹ marks its direct object with *-ga* but not with *-o*, whereas [-stative] verb *taberu* (“to eat”) marks its direct object with the accusative-marker *-o* but not with the nominative marker *-ga*, as shown in (3.33).

Stative predicates that license the NOC include not only simplex predicates such as *dekiru* in (3.31a) above but also complex predicates, such as *yom-eru* (“read-can”), which consist of a lower verb and a [+stative] higher predicate. In the experimental sentences of the current study, both simplex and complex NOC predicates were used. Thus, we will summarize some of their characteristics.

The NOC-supporting predicates are a certain type of experiencer predicates (see Dubinsky 1992; Takahashi 1996, among others), and hence the subject and object of NOC sentences have the experiencer role and the theme role, respectively. A characteristic common to all NOC predicates, both simplex and complex, is that they consistently disallow the experiencer subject to be

⁷⁹ Note that *dekiru* is a verb, neither an auxiliary nor an adjective.

marked by postpositional *-ni* and the theme object to be marked by *-o*, simultaneously. This phenomenon may suggest that [+stative] predicates in Japanese do not have the Case-feature to check against the object NP (Takahashi 1996). Alternatively, the fact may indicate that the Nominative feature must be checked by those predicates.

Simplex NOC predicates can be classified into three types, depending on the possible combination of the particles that mark the experiencer subject and the theme object.⁸⁰ This is summarized in Table 3-1, where NP1 and NP2 represent the subject and object, respectively.⁸¹

Table 3-1: Three Groups of Simplex NOC Predicates

Type	NP1- <i>ga</i> + NOC	NP1- <i>ga</i> + AOC	NP1- <i>ni</i> + NOC
A	✓ NP1- <i>ga</i> NP2- <i>ga</i> V	* NP1- <i>ga</i> NP2- <i>o</i> V	✓ NP1- <i>ni</i> NP2- <i>ga</i> V
B	✓ NP1- <i>ga</i> NP2- <i>ga</i> V	? NP1- <i>ga</i> NP2- <i>o</i> V	* NP1- <i>ni</i> NP2- <i>ga</i> V
C	✓ NP1- <i>ga</i> NP2- <i>ga</i> V	✓ NP1- <i>ga</i> NP2- <i>o</i> V	✓ NP1- <i>ni</i> NP2- <i>ga</i> V

As shown in the table, Type A simplex predicates allow the experiencer subject to be marked either the nominative marker *-ga* or the postpositional particle *-ni*, but

⁸⁰ This classification is similar to Dubinsky's (1992). He classifies the entire set of NOC predicates, including simplex and complex predicates, into three types. In his classification, complex potential predicates [V + *-eru*] and [V + *-uru*] are grouped into the same type as those in our Type A. For another classification, see Takahashi (1996). We look at our complex predicate types below.

⁸¹ In Table 3-1, "V" is used in each structure to represent a predicate due to a space limit. Note that it is not only verbs but also adjectives and nominal adjectives with [+stative] features that allow the NOC, as already mentioned.

disallow the AOC. By contrast, Type B predicates allow the experiencer subject to be marked only by *-ga*, and the AOC is slightly degraded. Finally, Type C predicates allow all the three combinations. This means that Type C predicates allow the NOC and the AOC to occur interchangeably. For Type B predicates, the interchangeability between the NOC and the AOC generally increases when the sentences are embedded in another clause or in a clausal noun such as [NP [S ...] *koto/-no*] ("the fact that ... "). In contrast, Type A predicates disallow the AOC in any environment.⁸²

Examples of Types A to C predicates are given in (3.34) to (3.36) below, respectively, where verbs, adjectives, and nominal adjectives of Japanese predicates are labeled as "V", "Adj", and "N-Adj", respectively. Note that the English translations do not always reflect a straightforward correspondence in syntactic categories between the two languages. That is, even though words are verbs or adjectives in Japanese, their corresponding English translations may not be.

(3.34) Simplex NOC Predicates Type A:	<i>aru</i>	V	"to have/exist" ⁸³
	<i>iru</i>	V	"to need"
	<i>kowai</i>	Adj	"to be afraid of"
	<i>kawaii</i>	Adj	"to adore" ⁸⁴

⁸² Some researchers say that judgments for the availability of the NOC/AOC with Type-B and Type-C predicates reflect, to some certain degree, informants' ages and dialects (see e.g., Dubinsky 1992; Takahashi 1996). However, details are not clear to summarize.

⁸³ For inanimate object, *iru* is used instead of *aru*. This *iru* is different from *iru* listed in (3.34), which means "to need".

⁸⁴ The original and primary meaning of this word is "cute" but used to mean "adore" in the above types of sentences.

- a. [s Jon-ga joshu-ga iru.]
John-Nom assistant-Nom need
"John needs an assistant."
- b. * [s Jon-ga joshu-o iru.]
John-Nom assistant-Acc need
"(intended) John needs an assistant."
- c. [s Jon-ni joshu-ga iru.]
John-Dat assistant-Nom need
"John needs an assistant."

(3.35) Simplex NOC Predicates Type B:	<i>suki-da</i>	N-Adj	"to like" ^{85,86}
	<i>kirai-da</i>	N-Adj	"to dislike"
	<i>hosii</i>	Adj	"to want"

- a. [s Jon-ga gakusei-ga suki-da.]
John-Nom student-Nom fond-is
"John likes students."
- b. ? [s Jon-ga gakusei-o suki-da.]
John-Nom student-Acc fond-is
"John likes students."

⁸⁵ A better English translation for *sukida* is perhaps "to be fond" since it is an adjective. However, to be consistent with the translation for *kirai-da* ("to dislike"), "to like" is used in the list here (*kirai-da* may also be translated as "not to be fond", but it does not involve negation). Alternatively, *sukida* and *kirai-da* may be translated as "to be pleasing" and "to be displeasing", respectively, but they are not perfectly expressive translations for the two words.

⁸⁶ Takahashi (1996:120, Footnote 7) remarks that *sukida* with Obj-*ga* is generally preferred over that with Obj-*o*, but she judges that acceptability improves if the object NP-*o* is animate. The author's intuition disagrees with this, and, as indicated in (3.35b), it is awkward. However, the author's intuition agrees with the judgment, as discussed earlier in the text, that the interchangeability highly improves when the Obj-*o* sentence is embedded in another clause or a nominal clause.

- c. * [_S Jon-ni gakusei-ga suki-da.]
 John-Dat student-Nom fond-is
 “(intended) Bill likes students.”

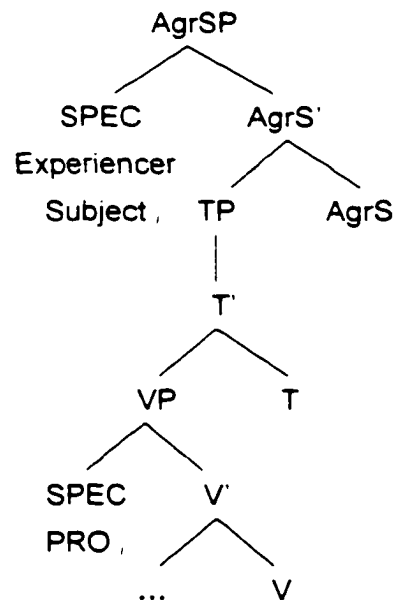
(3.36) Simplex NOC Predicates Type C: *wakaru* V “to understand”

- a. [_S Jon-ga nihongo-ga wakaru.]
 John-Nom Japanese-Nom understand
 “John understands Japanese.”
- b. [_S Jon-ga nihongo-o wakaru.]
 John-Nom Japanese-Acc understand
 “John understands Japanese.”
- c. [_S Jon-ni nihongo-ga wakaru.]
 John-Dat Japanese-Nom understand
 “John understands Japanese.”

Let us now discuss how the derivation of the NOC with simplex predicates has been analyzed. The majority of the existing literature on the NOC focuses on that with complex predicates and few studies explicitly discuss the derivation of the NOC with simplex predicates.

Takahashi (1996) assumes NOC-supporting predicates to be a class of experiencer predicates. Following Diesing (1992a), she further assumes experiencer predicates to be Individual-Level predicates, with the experiencer subject base-generated VP-externally, in SPEC(AgrSP), controlling PRO in SPEC(VP), as illustrated in (3.37) on the next page.

(3.37) Takahashi's (1996) Experiencer Subject



(Takahashi 1996: 136)

Takahashi proposes that the Case-features and Φ -features of nominative objects are checked off by two different functional heads, AgrS and AgrO, respectively.

Underlying this is the following idea, as illustrated in (3.38).

(3.38) a. Syntax

[AgrSP (SPEC) Exp_i (DP)-ga [VP PRO_i Th]]

b. LF

[AgrSP (SPEC) Th_j -ga [AgrSP (SPEC) Exp_i (DP)-ga/PP_i [AgrOP (SPEC) t'_j [VP PRO_i t_j]]]]

(Takahashi 1996: 138)

Since the theme DP is the object of the predicate, its Φ -features are checked off by AgrO in SPEC(AgrOP). On the other hand, its Case-features cannot be checked off in the same position due to the lack of Case-licensing ability of [+stative] predicates, and it moves further up to SPEC(AgrSP). More than one SPEC(AgrSP) position becomes available for multiple nominative Case-checking because the Case-feature of T is [+multiple] in Japanese. Therefore, the Case-feature of the nominative object can enter into a checking relation with the nominative Case-feature of T.

Let us now turn to the NOC with complex predicates, which consist of a lower verb and a [+stative] higher predicate (Dubinsky 1992; Koizumi 1994; Tada 1992; Takahashi 1996, among others). They can be grouped into two, as shown in Table 3-2, where the two groups are referred to as D and E.

Table 3-2: Two Groups of Complex NOC Predicates

Type	NP1- <i>ga</i> + NOC			NP1- <i>ga</i> + AOC			NP1- <i>ni</i> + NOC		
D	✓	NP1- <i>ga</i>	NP2- <i>ga</i> V	✓	NP1- <i>ga</i>	NP2- <i>o</i> V	✓	NP1- <i>ni</i>	NP2- <i>ga</i> V
E	✓	NP1- <i>ga</i>	NP2- <i>ga</i> V	✓	NP1- <i>ga</i>	NP2- <i>o</i> V	*	NP1- <i>ni</i>	NP2- <i>ga</i> V

As summarized in the table, the two types both allow the NOC and the AOC with NP-*ga* subjects, but only Type D allows NP-*ni* subjects. Just like the [+stative] simplex predicates we reviewed earlier, [+stative] complex predicates disallow the [subject-*ni* object-*o*] pattern, which may be considered as lacking the Case-feature needed to check against the object or as being associated with the

Nominative Case-feature needed to be checked off. Again, judgments for the availability of the NOC/AOC with Type-E and Type-D predicates seem to reflect ages and dialects (see e.g., Dubinsky 1992; Takahashi 1996). Examples of the two types of predicates are given in (3.39) and (3.40).

(3.39) Complex NOC Predicates Type D: V-(*rar*)*eru* Potential V “can V”

- a. [_S Jon-ga nihongo-ga kak-eru.]
 John-Nom Japanese-Nom write-can
 “John can write Japanese.”
- b. [_S Jon-ga nihongo-o kak-eru.]
 John-Nom Japanese-Acc write-can
 “John can write Japanese.”
- c. [_S Jon-ni nihongo-ga kak-eru.]
 John-Dat Japanese-Nom write-can
 “John can write Japanese.”

(3.40) Complex NOC Predicates Type E: V-*tai* Desiderative Adj “want to V”

- a. [_S Jon-ga eiga-ga mi-tai.]
 John-Nom movie-Nom watch-want
 “John wants to watch a movie.”
- b. [_S Jon-ga eiga-o mi-tai.]
 John-Nom movie-Acc watch-want
 “John wants to watch a movie.”
- c. * [_S Jon-ni eiga-ga mi-tai.]
 John-Dat movie-Nom watch-want
 “(*intended*) John wants to watch a movie.”

As shown in the above examples, even when the lower verb alone has [-stative] feature, the entire complex predicate becomes to behave as a [+stative] predicate, and thereby allows the NOC. The higher predicates *-(rar)eru* in (3.39) and *-tai* in (3.40) are [+stative], and have suffixed as morphemes to the lower verb, *kaku* ("to write") and *miru* ("to watch"), respectively (see e.g., Dubinsky 1992; Takahashi 1996, among others).

Let us now review recent analyses of the NOC with complex predicates.⁸⁷ Some assume agreement-based Case-licensing in the overt syntax (e.g., Koizumi 1994; Tada 1992), while others propose covert raising (e.g., Takahashi 1996). Here, we summarize Koizumi (1994) and Takahashi's (1996) analyses. Both of them are based on the Minimalist notion of Agreement Phrase that is assumed to facilitate checking of Case- and Φ -features. Under this notion, Case-checking is considered to be an instance of agreement, and is applicable to Japanese even though Japanese does not exhibit overt agreement morphology.

Koizumi (1994) generalizes nominative Case-licensing in Japanese as follows: "An NP is marked with *-ga* only if it is Case-licensed in the checking domain of T" (cf. Tada 1992). He assumes that in clauses with complex predicates such as *V-(rar)eru*, a kind of restructuring (see Miyagawa 1986; Rizzi 1982) may or may not occur.⁸⁸ In the case of the NOC, restructuring applies,

⁸⁷ For earlier analyses than those we review here, see Dubinsky (1992), Kuno (1973a), Kuroda (1965), Saito (1982, 1983), Shibatani (1977), and Takezawa (1987).

⁸⁸ According to Rizzi (1982), restructuring verbs typically include modals, aspectuals, and motion verbs. It is generally believed that restructuring is an optional process, and according to Miyagawa (1993), this is also the case in Japanese.

and the lower verb and the higher predicate form a monomial predicate. In the case of the AOC, on the other hand, restructuring does not apply, and the lower and higher predicates remain bifurcated. Assuming restructuring for the NOC and the phrase structure containing two AgrOP's, Koizumi proposes that the Case-features of accusative objects are checked off under Spec-Head agreement in SPEC(AgrOP), and that nominative objects are licensed in SPEC(TP), and not SPEC(AgrOP). Examining scope-interaction data, he concludes that the Case-checking position of the nominative object is a position higher than NegP but lower than AgrSP,⁸⁹ i.e., in SPEC(TP).⁹⁰

Takahashi (1996) also assumes restructuring and agrees with Koizumi's analysis that the nominative Case on subjects and objects is uniformly checked off in the domain of T. However, the two differ with respect to the stage of the derivation at which Case-checking of the nominative object takes place: While Koizumi assumes that it occurs in the overt syntax, Takahashi argues that the nominative objects stay *in situ* in the overt syntax and covertly raises to SPEC(AgrSP) via SPEC(AgrOP) to be Case-checked at LF, as shown in (3.41) below, in a way similar to her analysis of simplex NOC predicates.

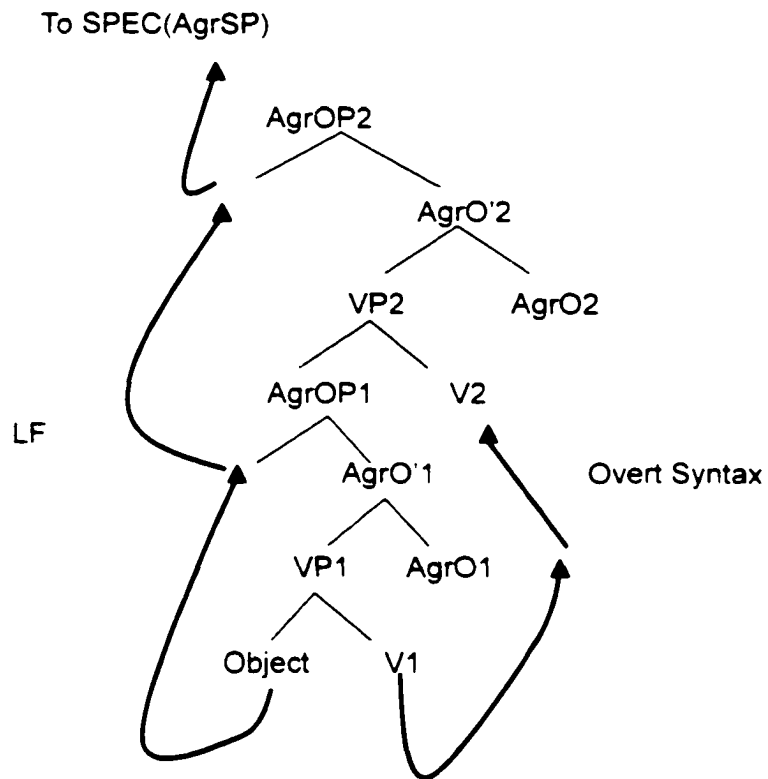
⁸⁹ Koizumi follows the standard view that the nominative object is not a surface subject, but there are discussions as to whether or not the nominative object is a surface subject. For details, see Dubinsky (1992), Kuno (1973a), Kuroda (1965), Saito (1982, 1983), Shibatani (1977), and Takezawa (1987).

⁹⁰ Koizumi (1994: 223) further differentiates the Case-checking position of major subjects from that of regular subjects, and illustrates his entire scheme as shown in (i), where MS, SU, and OB represent major subject, regular subject, and object, respectively:

(i) [AgrSP MS-Nom [AgrSP SU-Nom [TP OB-Nom [NegP (or AP) [AgrOP OB-Acc [VP ...]]]]]]

(Koizumi 1994: 223)

(3.41) Takahashi's (1996) NOC with complex predicate



(Takahashi 1996: 136)

Takahashi provides two pieces of evidence for her proposal: First, examining sentential- and manner-adverb positions, she shows that the nominative object cannot be in SPEC(AgrSP) in the overt syntax. Second, using a Quantifier-float interaction between an experiencer subject and its numeral quantifier, she demonstrates that the nominative object does not overtly raise out of the VP to SPEC(AgrOP). Takahashi assumes that the Case-features and Φ -features of nominative objects are checked off by two

different functional heads, AgrS and AgrO, respectively.⁹¹

3.4 Adverb Placement Manipulation and Related Matters

In addition to the case-marker substitutions introduced above, Experiments 1 and 2 employed another manipulation with adverbs (or adverbial phrases) to examine the adjacency effect of NP-*ga* repetition on the processing of center-embedded sentences. Henceforth, this manipulation is referred to as the adverb placement manipulation. The adverb placement manipulation does not directly involve *-ga*'s properties themselves, but it plays an important role in the experiments, and there are several syntactic issues that should be noted prior to the experimental reports.

The fundamental idea of the adverb placement manipulation is that placing an adverb (or adverbial phrase) at either of two sites in a sentence can maintain or break up a 3*ga* sequence, as schematized in (3.42a-b), respectively.

- (3.42) a. -ga -ga -ga ... **Adv** ... 3ga
b. -ga -ga **Adv** -ga ... 2ga

That is, the adverb in (3.42a) is placed after a *3ga* sequence to maintain the sequence, whereas the adverb in (3.42b) is located between the second and third *-ga*, splitting up the sequence.

⁹¹ For details of her rationale, see Takahashi (1996: 143-150).

This idea was realized in Experiments 1 and 2 in different ways. To make minimal sentence pairs in Experiment 1, the same adverb was inserted in the middle clause, either immediately after the innermost clause to maintain a 3ga sequence, as in (3.43a), or immediately before that clause to split up the sequence, as in (3.43b).

- (3.43) Adv Placement a. [s -ga [s -ga [s -ga VP] **Adv** V] V] 3ga
 in Experiment 1 b. [s -ga [s -ga **Adv** [s -ga VP] V] V] 2ga

This particular manipulation had two advantages: (i) the same adverb was used within a sentence pair; (ii) that adverb modified the verb in the middle clause within a sentence pair. However, there were at least two potential problems. First, the location of the adverb in the 2ga structure in (3.43b) could be permanently ambiguous between the middle and the innermost clause, unless there was some clear indication as to which clause that adverb belonged to, as schematized in (3.44).

- (3.44) a. -ga -ga **Adv** -ga VP V V
 b. [s -ga [s -ga **Adv** [s -ga VP] V] V]
 c. [s -ga [s -ga [s **Adv** -ga VP] V] V]

To solve this problem, a temporal adverb that agreed in tense only with the middle verb (but not with the innermost verb) was selected, as emphasized in boldface in (3.45) below.

(3.45) [s -ga [s -ga **Adv** [s -ga VP] **V**] V]

Given that the parsing process proceeds from left to right, however, temporary ambiguity was unavoidable, despite the effort described above. The position of the adverb is disambiguated only at the point of the innermost VP and confirmed at the middle verb.

Another concern with the adverb placement manipulation in Experiment 1 was relevant to the 3ga version in (3.43a). The adverbs used in Experiment 1 were VP modifiers, and their most natural (canonical) position is the post-subject position, i.e., where the adverb was placed in the 2ga structure in (3.43b). A possible effect of placing a VP modifier immediately before the verb is a focus reading of that modifier (and/or the verb).⁹² Syntactically, it is commonly assumed that adverbial phrases are adjoined to (non-argumental) maximal projections. Given this assumption, the adverb in (3.43a) is considered to be adjoined to VP. An alternative assumption, however, is that “adverbs are the overt manifestation of (the specifiers of) different functional projections” (Cinque 1999: v-vi). That is, adverbs are not adjoined, but rather base-generated in the unique SPEC positions of distinct maximal projections. If so, the 3ga structure in (3.43a) must be derived via the left-ward movement of the complement, i.e., the innermost clause. This in turn means that there may be a processing cost associated with this movement.

⁹² Personal Communication, William McClure, March 2000. Also, citing Kuno (1995), Frazier (1999: 62) points out that (at least in languages such as Japanese) placing a constituent immediately before the verb may be associated with focus if the normal position of that constituent is not immediately in front of the verb.

To compensate for the above concerns, the adverb placement manipulation was modified in Experiment 2. Unlike Experiment 1, the materials for Experiment 2 were designed not in pairs but in quadruples, as schematized in (3.46). The purpose of designing the materials in quadruples was to isolate the effect of 3ga sequences (if any) by comparing the processability difference in the experimental contrast between (3.46a-b) with the processability difference in the control contrast between (3.46c-d).

(3.46)	Adv Placement in Experiment 2	a. [s NP-ga [s NP-ga [s NP-ga AdvP₁ VP] V] V]	3ga
		b. [s NP-ga [s NP-ga AdvP₂ [s NP-ga VP] V] V]	2ga
		c. [s NP-wa [s NP-ga [s NP-ga AdvP₁ VP] V] V]	2ga
		d. [s NP-wa [s NP-ga AdvP₂ [s NP-ga VP] V] V]	1ga

As indicated by AdvP1 and AdvP2 above, two lexically different adverbial phrases were used within a quadruple, either to maintain a sequence of three NPs, as in (3.46a) and (3.46c), or to split it, as in (3.46b) and (3.46d). The two adverbial phrases were controlled in orthographical length and phonological weight (i.e., matched for the number of characters and the number of morae), and placed in identical canonical slots (i.e., on top of the VP they were modifying). Although there was still a possibility of unavoidable temporary ambiguity concerning which of the middle and innermost clauses the AdvP2 belonged to, at the very least, the problem with the unnecessary focus effect was resolved. Details of the adverb placement manipulation are described in each Materials

Section of Experiments 1 and 2 (see Chapters 4 and 5, respectively).

3.5 Summary of Chapter 3

This chapter reviewed *-ga*'s interpretive and syntactic characteristics that are relevant to Experiments 1 and 2. As its prototypical role, *-ga* marks the single subject of its own clause in the Single Subject Construction (SSC). However, it has another role to mark the nominative object in the Nominative Object Construction (NOC).

Along with *-ga*'s characteristics, the basic ideas of the four manipulations used in Experiments 1 and 2 were introduced. With these manipulations, experimental environments were created to allow investigations of the effect of NP-*ga* repetition on the processing of double and single center-embeddings. Preliminary evidence for the existence of the repetition effect of *-ga* is presented in Experiment 1, and whether the effect is general across double and single embeddings is reported in Experiment 2.

The syntactic and interpretive properties associated with *-ga* that were summarized in this chapter are important throughout the current study. As discussed in Section 1.2, the parser prefers economical structure-building (Inoue & Fodor 1995, among others). Thus, it avoids hypotheses involving movements (De Vincenzi 1991, 1994, among others) and hypotheses postulating unnecessary nodes (Frazier 1978; Frazier & Fodor 1978, among others). The preference for economical structural hypotheses applies to both syntactic and

interpretive stages during first-pass processing (Frazier 1999, among others).

When *-ga* plays its prototypical single subject marking role, no movement is assumed, but the number of clauses in a sentence must be (at least) the same as the number of overt subject NPs. If a sentence contains two overt NP-*ga*'s (and no invisible NP-*ga*'s), and these NP-*ga*'s are the single subject and a nominative object, the sentence has one clause. This is more economical than having two single subjects, each of which having its own clause. As noted, however, the NOC is assumed to involve at least one chain (either overtly or covertly, depending on the syntactic analysis). This, on the other hand, is less economical than the SSC.

In the test materials of Experiments 1 and 2, focused readings of *-ga* are minimized as much as possible. On the other hand, focused readings of *-ga* are relevant in Experiment 3:⁹³ For example, given the [+stativity] requirement for NOC, the subject of a sentence that has a nominative object would involve an exhaustive-listing reading, which may be subject to Minimal Lowering.

Some of interpretive properties of *-ga* summarized in this chapter involve discourse contextual or pragmatic factors. Although the current study is the most interested in the syntactic parsing stage, they are relevant when we discuss results of off-line tasks employed in Experiments 1 and 3.

⁹³ Experiment 3 reported in Chapter 7 investigates the effect of ambiguity associated with multiple syntactic roles of *-ga*, including the subject marking role, the nominative object marking role, the external possessor marking role, and the parallel subject marking role (for a summary of some characteristics of the latter two, see Chapter 6). The external possessor marking role also involves focused interpretation.

CHAPTER 4

EXISTENCE OF 3ga COST

4.1 Introduction

As a preliminary exploration, two off-line processability rating experiments were conducted to find evidence about the effect of three consecutive NPs, all marked with the same nominative case-marker *-ga*, on the processability of doubly center-embedded sentences.⁹⁴ The goal of this exploration was to evaluate the proposal that there is a special processing cost associated with 3ga sequences, above and beyond whatever cost is associated with the double center-embedding construction itself.

As discussed in Chapter 2, previous reports in the literature have suggested that, in Japanese, an extra level of embedding is required before speakers experience the degree of difficulty engendered by doubly center-embedded sentences in English (see Babyonyshev & Gibson 1995; Kimball 1975; Lewis 1996). Setting aside any consideration of the inherent problem (and perhaps impossibility) of such cross-linguistic claims — absent a pool of *perfect* Japanese-English bilinguals — it seems important to note that Japanese doubly center-embedded sentences with three consecutive NP-*ga*

⁹⁴ Parts of the data for which analyses are reported in this chapter have previously been reported elsewhere. (See Uehara 1995, 1996a, 1996b, 1997a; Uehara & Bradley 1996, 2002.)

subjects, such as (4.1), are judged very difficult indeed to process:

(4.1) # shoonen-ga gakusei-ga sensei-ga odotta-to itta-to hanasita.
 boy-Nom student-Nom teacher-Nom danced-that said-that spoke

"The boy stated that the student said that the teacher danced."

Native intuition also suggests that processing clearly becomes easier when the NP-*ga* sequence in (4.1) is minimized or broken. Since it has been standardly considered that the mechanisms and resources of human sentence processing are universal and that the typical problem with double center-embedding is a realization of resource-limits on processing, the possibility of greater tolerance for embedding in Japanese must be considered mysterious (see Lewis 1996). Thus, the above intuition invites close examination.

The experiment to be reported finds that Japanese speakers do experience extreme difficulty with double center-embedding, in the particular instances where three nominatively marked subjects are surface-adjacent. The existence of the processing cost associated with those sentences indicates that the parsing mechanism for Japanese does experience difficulty with two levels of center-embedding, to an extent that is broadly comparable to that for other languages. Thus, results for this experiment serve as a stepping stone to investigate possible accounts of a universal problem with double center-embedding, through the NP-*ga* repetition effect.

The two experiments were performed consecutively in one procedure using the same participants. Experiment 1A employed an absolute

processability judgment task, and Experiment 1B, a relative processability judgment task. These two kinds of judgment were requested because it was uncertain *a priori* whether naïve participants would be able to assign stable ratings to necessarily complex stimulus sentences, in the potentially quite difficult absolute processability judgment task. Thus, the relative processability judgment task was added because it seemed intuitively an easier task. As we will see, outcomes with the two different paradigms are entirely compatible.

To create experimental environments in which the degree of *-ga* repetition was manipulated without changing sentence meanings or the number of levels of embedding, the construction of materials exploited case-marker substitution manipulations (i.e., the *-ga /-wa*, *-ga /-no*, and *-ga /-o* substitutions) and an adverb placement manipulation. The logic behind these manipulations was introduced in Chapter 3 along with a summary of *-ga*'s relevant properties, and details of test materials are described in the report of each experiment in the current chapter.

The remainder of this chapter is organized as follows: Since the two experiments were performed together, Section 4.2 describes the participants and procedure which were common to both. Section 4.3 describes test materials and data treatment of Experiment 1A and presents results together with a brief discussion; Section 4.4 does likewise, for Experiment 1B. Section 4.5 is a general discussion of the two sets of experimental results. We consider the relationship between them, and how they bear on the predictions made by previous research (reviewed in Chapter 2). Section 4.6 is a summary of the chapter.

4.2 Participants and Procedure, Experiment 1

Participants

Thirty-two native speakers of Japanese (N=15 males, N=17 females) participated in the experiment. They were currently living in New York City or in Boston, but all had lived in Japan until they obtained a bachelor's degree. (Those degrees were in a variety of disciplines, other than linguistics.) Their average age was 31 years (range, 22 to 46 years), and their average length of residence in the U.S. was 3;6 years (range, 0;1 to 14;0 years). Participants took part in the experiment voluntarily, having been told that the experiment was an investigation of how native speakers of Japanese usually comprehend Japanese sentences.

Procedure

Participants were presented with a paper-and-pencil questionnaire which consisted of three sections: Section 1 sought basic demographic information (see Appendices B-1 and B-2, for the original Japanese version and its English translation, respectively). Section 2 presented sentences for Experiment 1A singly, and asked for absolute processability ratings. Finally, Section 3 presented minimal sentence pairs for Experiment 1B, and asked for relative processability ratings. The absolute processability ratings were always performed before the relative processability ratings, so that participants did not know what constituted the critical comparisons of the questionnaire while they were engaged in the absolute processability ratings.

The entire questionnaire was printed in normal Japanese script, and was presented in a booklet. Participants were requested to proceed through the questionnaire at their own pace, and were asked additionally to try to understand the meaning of sentences at a natural speed with no back-tracking. On average, it took no more than 25 minutes to complete the entire procedure.

4.3 Experiment 1A: Off-line Absolute Processability, 3ga versus Non-3ga Sentences

Materials

In order to investigate the effect of NP-*ga* repetition on the processability of doubly center-embedded sentences, five basic structural skeletons containing a 3ga (or 4ga) sequence were created. These structural skeletons were then modified to step down the *ga* sequence, utilizing one of the following three manipulations: -ga /-wa substitution, -ga /-no substitution, or adverb placement. Thus, each original 3ga structural skeleton also had a minimally different counterpart which stepped that sequence down, while maintaining sentence meaning and depth of embedding. Table 4-1 lists the five structural skeleton pairs created in this way. In the table, boldface indicates where the manipulation device applied.

Table 4-1: Test Sentence Structural Skeletons, Experiment 1A

Manipulation		Test Sentence Structural Skeletons						
<i>-ga /-wa</i> substitution # 1	3ga	[s	-ga	[NP[s	-ga	[NP[s	-ga	V]] V]] V]
	2ga	[s	-wa	[NP[s	-ga	[NP[s	-ga	V]] V]] V]
<i>-ga /-wa</i> substitution # 2	3ga	[s	-ga	[s	-ga	[s	-ga	-o V] V] V]
	2ga	[s	-wa	[s	-ga	[s	-ga	-o V] V] V]
<i>-ga /-wa</i> substitution # 3	4ga	[s	-ga	-ga	[s	-ga	[s	-ga V] V] V]
	3ga	[s	-wa	-ga	[s	-ga	[s	-ga V] V] V]
<i>-ga /-no</i> substitution	3ga	[s	-ga	[NP[s	-ga	[NP[s	-ga	V]] V]] V]
	2ga	[s	-ga	[NP[s	-ga	[NP[s	-no	V]] V]] V]
ADV placement	3ga	[s	-ga	[s	-ga	[s	-ga	-o V] Adv V] V]
	2ga	[s	-ga	[s	-ga	Adv	[s	-ga

As shown in Table 4-1, the five structural skeleton pairs consist of three *-ga /-wa* pairs, one *-ga /-no* pair, and one adverb placement pair. All of the double center-embedding structures in the table involve self-embedding of sentences. However, the *-ga /-wa* Pair # 1 and the *-ga /-no* pair involve self-embedding of nominal clauses in the middle and innermost clauses.

In the *-wa* versions of the three *-ga /-wa* pairs, the first NP-*ga* was topicalized and thus marked by the topic marker *-wa*. Since topicalization of the subject NP in the matrix clause involves few restrictions (see Sections 3.2.2, 3.2.3, and 3.3), three subtypes of this substitution were examined. The three subtypes, however, differed from each other in the following manner: The first and second pairs were constructed to compare processability of 3ga sentences against 2ga sentences whereas the third pair was constructed to test 4ga against 3ga sentences. The purpose of the third pair was to examine whether

there would be any further large decrease in processability from sentences involving a *3ga* sequence to those involving *4ga*. The *4ga* sequence was created with the nominative object marking *-ga* on the second NP in the matrix clause. Although the first and second pairs were created to compare processability of *3ga* sentences with *2ga* sentences, both of which involved degree-two center-embedding, they differed from each other structurally: The first pair contained center-embedded nominal clauses but no object in the innermost clause, whereas the second pair contained center-embedded sentential complements and an accusatively-marked object in the innermost clause.

In the *-no* version of the *-ga / -no* pair, a genitively marked NP replaced the third NP-*ga* of a *3ga* sequence. As reviewed in Section 3.2.3, Japanese allows the subject of a relative clause or the head of a noun complement clause to be marked by either *-ga* or *-no* (e.g., Miyagawa 1989, among others). In the *-ga / -no* pair, the innermost embedded clause was nominalized with a *toki* (“time”) phrase and the middle embedded clause, with a *no* (“fact that”) phrase. Thus, the *-ga / -no* structural pair involved self-embedding of nominalized clauses.

Finally, in the adverb placement pair, the same adverb was inserted in the middle clause either to maintain a *3ga* sequence or to split it up: The *3ga* skeleton placed that adverb adjacent to its corresponding verb, whereas the *2ga* version placed it on top of the VP it modifies (i.e., between the second and the third NP-*ga*’s). The placement of the adverb in the *2ga* versions meant that it could permanently be ambiguous, interpreted with either the middle-clause verb

Two sets of lexical items were inserted into each of the above five skeleton pairs to create 10 test sentence *pairs*; this resulted in a total 20 experimental sentences. The 20 experimental sentences were distributed to form two counterbalanced versions of a questionnaire, so that no participant saw any 3ga sentence and its adapted non-3ga counterpart with the same lexical content. The sentence pairs in (4.3) to (4.5) below exemplify test sentence pairs constructed with the *-ga /-wa* substitution, the *-ga /-no* substitution, and the adverb placement devices, respectively. For a full list of the Japanese test sentence pairs, see Appendix C-1, and for their English translations, see Appendix C-2.

- (4.3) a. [Tanaka-san-**ga** [Suzuki-san-ga [kachoo-ga
 Tanaka-Mr./Ms.-**Nom** Suziki-Mr./Ms.-Nom section-chief-Nom
 Yamada-san-o suisensuru]-to itta]-to omotta.]
 Yamada-Mr./Ms.-Acc recommend-that said-that thought

- b. [Tanaka-san-**wa** [Suzuki-san-ga [kachoo-ga
 Tanaka-Mr./Ms.-**Top** Suziki-Mr./Ms.-Nom section-chief-Nom
 Yamada-san-o suisensuru]-to itta]-to omotta.]
 Yamada-Mr./Ms.-Acc recommend-that said-that thought

"Mr./Ms. Tanaka thought that Mr./Ms. Suzuki said that the section chief would recommend Mr./Ms. Yamada."

- (4.4) a. [Keiichi-ga [[otooto-ga [[ryoosin-**ga** dekaketa] toki]
 Keiichi-Nom younger brother-Nom parents-**Nom** went-out time
 kaettekita]-no]-ni tomadotta.]
 came home fact-at was embarrassed

- b. [Keiichi-ga [[otooto-ga [[ryoosin-**no** dekaketa] toki]
 Keiichi-Nom younger brother-Nom parents-**Gen** went-out time
 kaettekita]-no]-ni tomadotta.]
 came home fact-at was embarrassed

"Keiichi was embarrassed at the fact that his brother came home when their parents went out."

- (4.5) a. [oji-ga [Yoko-ga [Keiji-ga sono seito-o sukida]-to
 my uncle-Nom Yoko-Nom Keiji-Nom that student-Acc like-that
yuube itta]-to omotta.]
last night said-that thought

- b. [oji-ga [Yoko-ga **yuube** [Keiji-ga sono seito-o
 my uncle-Nom Yoko-Nom **last night** Keiji-Nom that student-Acc
 sukida]-to itta]-to omotta.]
 like-that said-that thought

"My uncle thought that Yoko said last night that Keiji likes that student."

In this experiment, participants were asked to make processability judgments on a 6-point Likert scale, for sentences presented singly. The points on the scale were represented by symbols frequently used in Japanese culture as follows:⁹⁸

⁹⁸ It is rather difficult to translate into English the exact sense of the Japanese expressions used to explain the six rating symbols. The actual expressions in Japanese is as follows:

- ◎ 良く分かる
- 分かりやすい
- ? まあまあ分かる
- X? やや分かりにくい
- X 分からない
- XX 全く分からない

- ◎ understand completely
- easy to understand
- ? understand fairly well
- X? a little hard to understand
- X don't understand
- XX don't understand at all

In Japanese culture, the symbols ○ and X commonly represent “good” and “not good”, respectively. Also, ◎ and X X are used to express “very good” and “very bad”, respectively, and ?, to mean “not certain”. Thus, the six symbols were considered to represent judgments of sentence acceptability, appropriately.

The idea behind the employment of a 6-point scale rather than the conventionally used 5- or 7-point scale was that the difference between understandable and non-understandable sentences could be signaled by participants with the middle values between ○? and X?. In order to familiarize participants with the use of these rating symbols, three practice sentences were given before the task. The three sentences were created to be very easy to understand, understandable but not completely, and impossible to understand. Those sentences contained no material relevant to the experimental sentences.

Besides the 20 experimental sentences, the questionnaire included four additional test sentences that were designed to anchor the interpretation of any processing cost associated with 3ga sequences. The anchoring of scale values was necessary because interpretation of the data requires that the magnitude and endpoints of any observed shift be tied to scale points. If there are systematic shifts in rated processability, they would provide evidence for the existence of a processing cost associated with the 3ga sequence. Moreover, if

the cost associated with 3ga sequences was demonstrated independently, then it would also be of interest to know whether the cost is measurable relative to other sources of processing load, as well as whether the cost is large enough to shift a sentence from processable to unprocessable. The questionnaire therefore included two kinds of test sentences for ratings: (i) sentences through which the existence of 3ga cost would be established and (ii) sentences containing no 3ga sequences, through which scale values might be anchored.⁹⁹

The four anchor sentences were thus designed to cover a range from somewhat easier than the test sentences to somewhat more difficult than them, and were presented in an identical form in the two versions of the questionnaire. The anchor sentences are listed below, where AS stands for Anchor Sentence.¹⁰⁰ (See Appendices D-1 and D-2 for a full list of the sentences in Japanese script and their English translations, respectively.)

⁹⁹ Sentences created for these two types counted for Babyonyshev & Gibson's (1995) processing complexity metric as follows: The former type (assessing 3ga costs) were all uniformly associated with 5 PLUs, whereas the latter type (anchoring scale values) ranged between 3 PLUs and 6 PLUs. This is relevant to our discussion in Section 4.5. For a brief review of Babyonyshev & Gibson (1995), see Chapter 2.

¹⁰⁰ Under the metric of Babyonyshev and Gibson (1995) which assumes that up to 4 PLUs are processable, "hard" AS-3 and "unprocessable" AS-4 count as 5 PLUs and 6 PLUs, respectively. "Easy" AS-1 and "processable" AS-2 both count as 3 PLUs because the metric assumes that inherently cased-marked NP-*ni* 's (Dat) are not cost-bearing (i.e., 0 PLUs). However, native intuition suggested that AS-2 was less easy than AS-1 and easier than AS-3. For this reason, AS-2 was used to anchor interpretation of the relevant range of ratings, somewhere between AS-1 and AS-3. The intuition proved correct, as is shown in the results. For details of this issue, see Uehara (1995, 1996b, 1997a).

- AS-1 [Michiko-ga [imooto-ga Hajime-o sukida]-to EASY
 Michiko-Nom younger sister-Nom Hajime-Acc like-that
 omotteiru.]
 think
 "Michiko thinks that her younger sister likes Hajime."
- AS-2 [haha-ga Kawada-san-ni [oba-ga PROCESSABLE
 my mother-Nom Kawada-Mr./Ms.-Dat my aunt-Nom
 ani-ni Noriko-san-o shookaisita]-to hanasita.]
 my brother-Dat Noriko-Ms.-Acc introduced-that told
 "My mother told Mr./Ms. Kawada that my aunt introduced
 Noriko to my brother."
- AS-3 [Ichiro-ga tomodati-o [Akira-ga [sono seito-ga HARD
 Ichiro-Nom friend-Acc Akira-Nom the student-Nom
 byookida]-to itta]-to settokusita.]
 sick-is-that said-that persuaded
 "Ichiro persuaded his friend that Akira said that the student
 was sick."
- AS-4 [Ootoo-ga Yumi-o [Masaru-ga UNPROCESSABLE
 younger brother-Nom Yumi-Acc Masaru-Nom
 [Kimiko-ga sensei-o sukida]-to itta]-to
 Kimiko-Nom teacher-Acc like-that said-that
 iihukumeta.]
 convinced
 "The younger brother convinced Yumi that Masaru said
 that Kimiko likes the teacher."

The questionnaire, by design, did not to include filler sentences for the following reason: The primary concern in developing the questionnaire was that processability judgments should be sensitive over the relevant range. The doubly center-embedded sentences used in this experiment were necessarily

difficult to process, so that even a large number of filler sentences was unlikely to distract the participant's attention from their presence. Furthermore, the existence of many filler sentences that were much easier than the test sentences might mute the relevant range of processability judgments which would otherwise be reflected in the ratings. Thus, the anchor sentences were considered to cover a range larger than that in which the ratings for the experimental materials would fall, without masking judgments' sensitivity to those materials.

Data Treatment

For the purpose of data analysis, it was assumed that subjects treated the rating scale at least as quasi-interval. Thus, responses were converted to numerical values (© = 1, XX = 6), and their distribution was analyzed parametrically.

Results and Discussion

Table 4-2 below shows mean processability ratings for the anchor sentences, and Figure 4-1 illustrates how the mean processability ratings were tied to the rating scale.

Table 4-2: Mean Rated Processability for Anchor Sentences, Experiment 1A

Sentence	Prediction	Rating
AS-1	EASY	2.47
AS-2	PROCESSABLE	3.22
AS-3	HARD	3.84
AS-4	UNPROCESSABLE	4.63

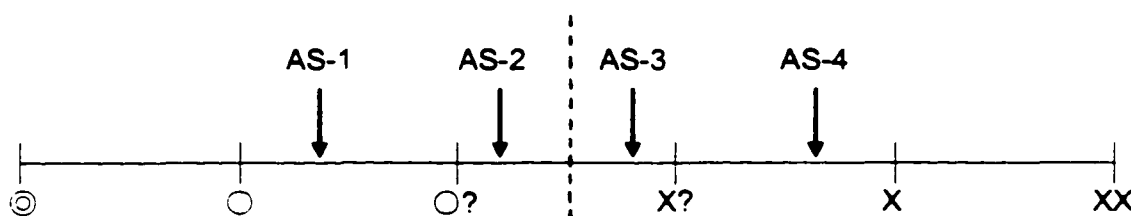


Figure 4-1: Mean rated processability for anchor sentences and the rating scale, Experiment 1A

As expected, processability of the four anchor sentences was distributed on either side of a notional breakpoint falling between Rating 3 (Symbol ○?) and Rating 4 (Symbol X?). Importantly, the difference between the mean ratings for “processable” AS-2 and “hard” AS-3 was reliable, $F(1,31)=5.00$, $p<.05$.

Moreover, stepwise testing showed that subjects were able to distinguish between degrees of understandable and non-understandable sentences. That is, the mean ratings for “easy” AS-1 and “processable” AS-2 differed from each other, $F(1,31)=8.45$, $p<.01$, and those for “hard” AS-3 and “unprocessable” AS-4

also differed from each other $F(1,31)=16.16, p<.001$.

The summary data and analyses for the absolute processability ratings of Experiment 1A are presented in Table 4-3 below. In the table, the second column lists test-sentence numbers under "Item #". Since there were four anchor sentences AS-1 to AS-4, the experimental sentence pairs are here numbered 5 to 14. Within these pairs, the sentences through which the existence of 3ga processing cost was examined are numbered 5 to 14 whereas their non-3ga counterparts are numbered 5' to 14'. The table collapses mean ratings over sentences differing only in lexical content, and presents data for both the 3ga version of any structure and for its non-3ga counterpart. Recall that in non-3ga counterparts, the 3ga sequence was either broken or minimized so that the sentence contains a 2ga sequence, except for -ga /-wa substitution #3 which compared processability ratings of 4ga sentences with those for their 3ga counterparts.

Table 4-3: Absolute Processability Ratings, Experiment 1A

Manipulation	Item #	Test Sentence Skeletons	Mean Rating	F Value ¹
-ga /-wa substitution # 1	5 & 6	[s -ga [NP[s -ga [NP[s -ga V]] V]] V]	3ga	3.59
	5' & 6'	[s -wa [NP[s -ga [NP[s -ga V]] V]] V]	2ga	2.84
-ga /-wa substitution # 2	7 & 8	[s -ga [s -ga [s -ga -o V] V] V]	3ga	4.31
	7' & 8'	[s -wa [s -ga [s -ga -o V] V] V]	2ga	3.16
-ga /-wa substitution # 3	9 & 10	[s -ga -ga [s -ga [s -ga V] V] V]	4ga	4.72
	9' & 10'	[s -wa -ga [s -ga [s -ga V] V] V]	3ga	4.03
-ga /-no substitution	11 & 12	[s -ga [NP[s -ga [NP[s -ga V]] V]] V]	3ga	3.88
	11' & 12'	[s -ga [NP[s -ga [NP[s -no V]] V]] V]	2ga	3.09
ADV placement	13 & 14	[s -ga [s -ga [s -ga -o V] Adv V] V]	3ga	4.53
	13' & 14'	[s -ga [s -ga Adv [s -ga -o V] V] V]	2ga	3.63

¹ Degrees of freedom (1,30) for all comparisons

* p < .05 ** p < .01 *** p < .0001

For each of the comparisons summarized in Table 4-2, the 3ga versions were rated as significantly less processable than their 2ga counterparts. Furthermore, an overall analysis (Manipulation x Comparison) showed no reliable difference in the magnitude of the cost among the cases tested, $F < 1$ for the interaction term.

The existence of the 3ga cost was demonstrated, overall, in a shift in rated processability of 0.85 scale points, which corresponds approximately to the ratings difference between AS-3 and AS-4 (see Table 4-2 and Figure 4-1).

The above findings mean in turn that the parser for Japanese experiences real difficulty with doubly center-embedded sentences when a 3ga sequence is present. Thus, contrary to earlier claims, it is not the case that an extra level of

embedding is needed for the parser for Japanese speakers to encounter processing difficulty.

What we see here is that, just as other languages such as English, the processing problem with double center-embedding cannot be attributed to the level of embedding itself or to the cost of opening three clauses (contra Kimball 1973, 1975). Also, the problem cannot simply be attributed to repetition of non-topic constituent (contra Cowper 1976) because there was a clear difference with the *-ga* /-*no* sentences even though no topicalized constituents were involved in those sentences. Moreover, the 3*ga* cost appears to arise for reasons other than constant repetition of case-assignment of the same kind (contra Stabler 1994), given the outcomes for the adverbial placement pairs. That is, it is *adjacency* of the three *-ga* phrases that matters (Lewis 1998, Lewis & Nakayama 2002). We will discuss these matters further in Section 4.5.

Processability was always degraded whenever the sentence included a 3*ga* sequence, but there was some variability among the cases assessed. In particular, although the mean rating for the 3*ga* version of the adverb placement pairs was 4.53 on the scale (differing significantly from their 2*ga* counterparts, $F(1,30)=16.19$, $p<.001$), the mean rating for the 2*ga* version was 3.63, a rating already equivalent to AS-4. That is, these 2*ga* sentences were judged as less processable than other 2*ga* sentences.

There are some possible explanations for this outcome: First, as was mentioned in the Materials Section, the location where the adverb was placed in the 2*ga* sentences might have been temporarily ambiguous. That is, given an incremental comprehension process, it might have been costly for the parser to

decide whether the adverb related to the middle or innermost embedded clauses, even though the relevant verb(s) did disambiguate its structural position. Also, the *3ga* sentences in these pairs were rated as more difficult than the *3ga* versions of other structures. As was discussed earlier, the position where the temporal adverbs were placed in the *2ga* structure was canonical. On the other hand, the position where they were placed in the *3ga* structure was not, and this might have triggered focus readings. If this is true, it might have affected processability of the *3ga* sentences. Thus, although the same adverb was used within each adverb placement pair, the position in which it was placed might have been problematic.¹⁰¹

A second finding of Experiment 1A is that the *-ga /-wa* Pairs #3 were rated as between “a little hard to understand” and “don’t understand”, but that there was still a significant difference between them, $F(1,30)=8.66$, $p<.01$. That is, respondents were able to distinguish between the difficulties associated with *3ga* and *4ga* sentences. This suggests that *3ga* doubly center-embedded sentences do not cause complete processing breakdown, from which the parser cannot recover at all. This issue is taken up in our discussions in Chapter 5, but one possible explanation is that subjects tried so hard to understand the meaning of given sentences that they might have been tempted to backtrack as in reanalysis. Even though they were asked not to, this was possible because the task was an off-line questionnaire.

¹⁰¹ Taking the above possibilities into consideration, Experiment 2 employed a different type of adverb placement manipulation (see Chapter 5).

4.4 Experiment 1B: Off-line Relative Processability, 3ga versus Non-3ga Sentences

Materials

The materials construction for Experiment 1B proceeded in a manner similar to that of Experimental 1A: Structural skeletons for 3ga sentences were created and then adapted to produce non-3ga alternatives, using the case-marker substitution manipulations and the adverb placement manipulation introduced earlier.

Experimental materials for Experiment 1B consisted of seven minimal structural pairs. These are schematized in Table 4-4 below. Of the seven pairs, five were exactly the same as those tested in Experiment 1A, but the remaining two were created with the -ga /-o substitution manipulation introduced earlier in Section 3.4.¹⁰²

¹⁰² The five structural skeleton pairs replicating those in Experiment 1A are 5 PLUs under Babyonyshev & Gibson's (1995) metric, while -ga /-o Pairs # 1 and # 2 are 4 PLUs and 6 PLUs, respectively.

Table 4-4: Test Sentence Structural Skeletons, Experiment 1B

Manipulation		Test Sentence Structural Skeletons	
-ga /-wa substitution # 1	3ga	[s -ga [NP[s -ga [NP[s -ga V]] V]] V]	
	2ga	[s -wa [NP[s -ga [NP[s -ga V]] V]] V]	
-ga /-wa substitution # 2	3ga	[s -ga [s -ga [s -ga -o V] V] V]	
	2ga	[s -wa [s -ga [s -ga -o V] V] V]	
-ga /-wa substitution # 3	4ga	[s -ga -ga [s -ga [s -ga V] V] V]	
	3ga	[s -wa -ga [s -ga [s -ga V] V] V]	
-ga /-no substitution	3ga	[s -ga [NP[s -ga [NP[s -ga V]] V]] V]	
	2ga	[s -ga [NP[s -ga [NP[s -no V]] V]] V]	
ADV placement	3ga	[s -ga [s -ga [s -ga -o V] Adv V] V]	
	2ga	[s -ga [s -ga Adv [s -ga -o V] V] V]	
-ga /-o substitution # 1	3ga	[s -ga [s -ga -ga V] V]	
	2ga	[s -ga [s -ga -o V] V]	
-ga /-o substitution # 2	4ga	[s -ga -ga [s -ga [s -ga V] V] V]	
	3ga	[s -ga -o [s -ga [s -ga V] V] V]	

Recall that Japanese allows nominatively marked objects with [+stative] predicates, and that some such predicates freely allow either *ga*-marked objects or *o*-marked objects. The predicates used in the *-ga /-o* pairs were of this type. In the *-ga /-o* substitution Pair #1, the third *-ga* is the nominative object marker. The structure therefore involves a single center-embedding even though it contains a 3ga sequence. Thus, the processability comparison made with this pair was between a 3ga sentence and its 2ga alternative in a single center-embedding structure. On the other hand, the *-ga /-o* substitution Pair # 2

applied the substitution to the matrix object, and the structure involved double embedding. The comparison made with this pair was between a 4ga sentence and its 3ga counterpart. These two pairs were added to enrich the current exploration, but these comparisons, (and particularly, the case of single embedding) become relevant later to our discussion for Experiment 2 in Chapter 5.

After the above skeleton pairs were created, identical lexical items were filled into each pair. The lexical content used in Experiment 1B was entirely different from that used in Experiment 1A. Also, since just one set of seven test sentence pairs was created, Experiment 1B presented identical materials to all 32 participants, unlike Experiment 1A.

In the questionnaire, the 3ga (or 4ga) version was labeled A, and was always placed above its 2ga (or 3ga) counterpart, labeled B. The -ga /-wa pair in (4.6) exemplifies double embedding pairs, and the -ga /-o pair in (4.7) is the single embedding pair highlighted in the discussion.

- (4.6) a. [Ogawa-san-**ga** [buchoo-ga [Inoue-san-ga raikyaku-o
 Ogawa-Mr./Ms.-**Nom** manager-Nom Inoue-Mr./Ms.-Nom guest-Acc
 annaisuru]-to itta]-to omotta.]
 show around-that said-that thought
- b. [Ogawa-san-**wa** [buchoo-ga [Inoue-san-ga raikyaku-o
 Ogawa-Mr./Ms.-**Top** manager-Nom Inoue-Mr./Ms.-Nom guest-Acc
 annaisuru]-to itta]-to omotta.]
 show around-that said-that thought

"Mr./Ms. Ogawa thought that the manager said that Mr./Ms. Inoue would show the guest around."

- (4.7) a. [Haha-ga [Miyuki-ga Shun-**ga** sukida]-to omotteiru.]
 my mother-Nom Miyuki-Nom Shun-**Nom** like-that think
- b. [Haha-ga [Miyuki-ga Shun-**o** sukida]-to omotteiru.]
 my mother-Nom Miyuki-Nom Shun-**Acc** like-that think

"My mother thinks that Miyuki likes Shun."

A full list of the test materials for Experiment 1B is presented in Appendix E-1 and a list of their English translations in Appendix E-2.

For each pair, participants were asked to indicate their judgment of relative processability, by circling their choice of the options "A better" or "B better", where "better" was defined as easier to understand. They were also permitted to respond "same" if no discrimination was possible.

Data Treatment

Data analysis for this experiment first established the percentage of responses that did not indicate a clear preference: Overall, only 18.3% of the responses were of this type. Then, among the responses indicating a clear choice, the percentage favoring the alternative in which the 3*ga* (or 4*ga*) sequence was minimized or split up was calculated, for each pair.

Results and Discussion

The relative processability ratings data of Experiment 1B are summarized in Table 4-5 on the next page.

Table 4-5: Relative Processability Ratings, Experiment 1B

Manipulation		Test Sentence Skeletons		Data ¹
<i>-ga/-wa</i> substitution # 1	3ga	[s -ga [NP[s -ga [NP[s -ga V]] V]] V]		100.0%
	2ga	[s -wa [NP[s -ga [NP[s -ga V]] V]] V]		
<i>-ga/-wa</i> substitution # 2	3ga	[s -ga [s -ga [s -ga -o V] V] V]		92.6%
	2ga	[s -wa [s -ga [s -ga -o V] V] V]		
<i>-ga/-wa</i> substitution # 3	4ga	[s -ga -ga [s -ga[s -ga V] V]] V]		100.0%
	3ga	[s -wa -ga [s -ga[s -ga V] V]] V]		
<i>-ga/-no</i> substitution	3ga	[s -ga [NP[s -ga [NP[s -ga V]] V]] V]		87.0%
	2ga	[s -ga [NP[s -ga [NP[s -no V]] V]] V]		
ADV placement	3ga	[s -ga [s -ga [s -ga -o V] Adv V] V]		92.3%
	2ga	[s -ga [s -ga Adv [s -ga -o V] V] V]		
<i>-ga/-o</i> substitution # 1	3ga	[s -ga [s -ga -ga V] V]		100.0%
	2ga	[s -ga [s -ga -o V] V]		
<i>-ga/-o</i> substitution # 2	4ga	[s -ga -ga [s -ga [s -ga V] V] V]		91.7%
	3ga	[s -ga -o [s -ga [s -ga V] V] V]		

¹ Percentage favoring the alternative with 3ga/4ga broken or minimized, among those responses making a clear choice.

Among the responses indicating a preference for one or the other sentence of the minimal pair, 93.0% overall favored the sentence in which the 3ga sequence was either minimized or split up. In all the four cases that compared processability of 3ga doubly embedded sentences with their 2ga counterparts, findings replicated those for the corresponding cases tested in Experiment 1A: Whenever there is a sequence of 3ga, a doubly center-embedded sentence becomes difficult to process, compared to a

sentence without such a sequence.

As for the relative processability comparisons between 4*ga* and 3*ga* sentences, (i.e., -*ga* /-*wa* Pair #3, and -*ga* /-*o* Pair #2), overall, the former was judged more difficult than the latter, in 95.9% of clear choices. Thus, the results entirely replicated those of Experiment 1A.

Interestingly, for the -*ga* /-*o* Pair #1 in the *single* embedding context, the pattern of choices also indicates that there is a cost associated with 3*ga* sequences. This suggests that the 3*ga* cost may always emerges whenever there are three consecutive NPs that are all marked nominatively, regardless of the level of embedding. If so, the cause of this cost could be attributed to repetition of consecutive case-assignment relation of the same kind more than twice, or to the same *potential* structure being possible in the parser's incremental structure-building. We will discuss this issue further in the next section.

Since Experiment 1 offered only one case probing the existence of a 3*ga* cost in single embedding, the question of whether the 3*ga* cost reliably occurs regardless of the level of embedding was directly investigated in the self-paced reading study reported in Chapter 5.

4.5 Consequences of the Existence of 3*ga* Cost

The outcomes of Experiment 1A and 1B, taken together, provide strong evidence for the existence of a special processing cost associated with threefold,

consecutive repetition of the nominative marker *-ga*, and certainly so in double center-embedding constructions. This finding implies that, contrary to the positions reviewed in Chapter 2, the Japanese speaker does experience processing difficulty with two levels of center-embedding, that difficulty taking a contribution from repeated consecutive *ga*-marking.

Interestingly, the singly center-embedded pair tested in Experiment 1B for exploratory purposes raises the possibility that a 3*ga* cost is not peculiar to the double center-embedding context. The results of Experiment 1 therefore seem to suggest that additional processing difficulty arises whenever there are more than two incomplete nominative case-assignment relations at any point during the processing of a center-embedded sentence, if the three NPs that are nominatively marked are adjacent. Therefore, the results of Experiment 1 indicate that the difficulty can be explained in none of the following terms: incomplete clauses, incomplete case-assignment relations (without an adjacency factor); incomplete thematic relations; and locality dependency.

Let us discuss the relationship between our findings and the predictions made by prior research, as reviewed in Chapter 2. First, Kimball (1975: 178-179) observed that doubly center-embedded sentences in Japanese whose matrix subject is topicalized are processable, while triply center-embedded sentences whose matrix subject is topicalized are not. Although the details of the structure were not exactly the same, the results of the comparisons between 3*ga* and 4*ga* sentences in the *-ga/-wa* pairs and their topicalized counterparts (*-ga /-wa* Pairs #1, #2, #3) are broadly consistent with Kimball's assertion.

Also, Lewis's Similarity-Based Interference Theory (Lewis 1993, 1996, 1998; Lewis & Nakayama 1999, 2001, 2002; Nakayama et. al. 2003; Nakayama & Lewis 2000) predicts both 3ga doubly and singly center-embedded sentences to be unprocessable. This theory asserts that interference occurs if the items to be stored in working memory are positionally adjacent in the surface string *and* syntactically similar. Here, "syntactically similar" is assumed to refer to *potential* structural similarity, under the notion of X-bar relation. This means that not only ga-marked subjects but also ga-marked objects are considered similar because of their shared nominative case; interference is predicted at the point in the parser's structure-building when these are to be retrieved for definitive syntactic assignment. Thus, the similar outcomes for the double- and single-embedding cases tested in Experiment 1B are consistent with this theory's prediction.

But while the findings of Experiment 1 support some previous claims, they disagree with others. First, Kimball's (1973, 1975) Principle of Two Sentences states that processing difficulty will result whenever there are more than two open clauses. Thus, the principle predicts that all the doubly center-embedded sentences tested in Experiment 1 should be unprocessable, across the board, regardless of the presence or absence of any 3ga sequence. This is generally inconsistent with what was shown.

Second, Cowper's (1976) Parallel Processing Model, which assumes parallel memory tracks, predicts 3ga doubly center-embedded sentences to be unprocessable in the following way: Under the Clause Integrity Constraint of this model, in languages with clause-final complementizers, "any non-topic

constituent that occurs to the left of its own clause, separated from that clause by one or more embedded sentences" (Cowper 1976: 88), overloads the parallel memory tracks. Thus, under this model, no difference should be predicted between non-topic NPs. However, the results of comparison in the *-ga/-no* pairs of Experiment 1 showed a significant processability difference, even though only non-topic NPs were involved. Therefore, the findings in Experiment 1 cannot be explained in terms of the topic/non-topic difference.

Third, Stabler's (1994) Finite Connectivity Hypothesis does not make predictions that are entirely consistent with what we have seen. Under this hypothesis, a significant increase in complexity is expected when more than one connecting relation of any kind crosses a constituent boundary, and three or more connecting relations should always result in unprocessability. A particularly relevant factor is the number of relations connecting nodes in any partial structure to nodes not yet integrated in that partial structure, such as case-assignment relations. Crucially, however, Stabler's hypothesis does not incorporate the distance between the connecting relations it refers to. In contrast, the results of the adverb placement pairs in Experiment 1 show that the adjacency between nominatively-marked NPs is important. Thus, the predication made by this hypothesis disagrees with the results of Experiment 1.

Fourth, under Babyonyshev & Gibson's (1995) Processing Overload Metric (see Footnotes 99 and 100), each structurally case-marked NP as well as each self-embedding is assumed to accrue processing cost, each being computed as 1 PLU, and it is predicted that a sentence becomes unprocessable when it is associated with more than 4 PLUs. In Experiment 1, each of the

double embedding test sentences was associated with 5 PLUs, but only the sentences containing a *3ga* sequence proved to be unprocessable. Moreover, since the metric assumes inherently case-marked NPs to be costless, both AS-1 and AS-2 count as 3 PLUs. But AS-2, containing two inherently case-marked NPs (i.e., NP-*ni* 's), turned out to be harder than AS-1 that did not contain any such NPs. Thus, the pattern of findings in the experiment is not captured by Babyonyshev & Gibson's (1995) metric.

Finally, Gibson's (1998, 2000) Dependency Locality Theory measures the distance between dependencies that await structural assignment in terms of elements that introduce discourse referents. Thus, there is no change in the distance between dependencies introduced by an adverb (which does not introduce a discourse referent), and hence no prediction of an effect of adverb position on the processability of a sentence. Also, since the *-ga* / *-no* comparison in Experiment 1 involved the same number of incomplete dependencies and the same distance between them, there should be no difference under this theory. Finally, this theory assumes that the integration of the dependency in the matrix clause is cost-free (because it is always expected); thus, the *-ga* / *-wa* comparisons in Experiment 1 are also predicted to show no difference. None of Dependency Locality Theory's (null) predictions is consistent with the findings of Experiment 1.

Now let us consider what should be clarified in the next step of our investigation, and how that might be best achieved. The results of Experiment 1 suggest that *3ga* cost may arise in both double and single center-embedding contexts, but the *3ga* effect was tested in just one instance of single

center-embedding (and that in the less informative relative judgment task). It is therefore important to examine the existence of 3ga costs more systematically in double and single center-embedding contexts.

With respect to how we perform a systematic investigation of the 3ga effect, there are two things to consider: First, the adverb placement manipulation, which used the same adverb in different positions within each pair, might have affected the ratings, because of the way that canonical/non-canonical position was confounded with 2ga/3ga comparison. Thus, this manipulation needs to be modified if we are to investigate whether the adjacency of ga-phrases really matters. Second, since Experiment 1 was performed with off-line measures, the results might have been too “informative”, providing not only information about early parsing stages, such as the syntactic parsing that we are most interested in, but also information about a very late parsing stage, i.e., the stage that the central processor is responsible for, at which discourse, pragmatic, and stylistic constraints are invoked, as well as constraints arising from knowledge of the world (see Section 1.2). In particular, the parser’s sensitivity to the repetition of surface form is not only recognized technically but also articulated in the non-technical advice offered in writing style guides:

If you do not use particles in a suitable way, it makes the meaning of sentences unclear. Sentences in which particles are not used well are those on which you get stuck just as you trip over stones on the street. Even though such sentences can be understood, they are nothing but bad sentences, far from being rhythmical because of those stones ... the entire meaning of the sentence becomes difficult to grasp ... You should avoid using the same particle more than two times in a sentence, conjunctive particles, *-ga* and *-te*, in particular ... For example,

Niwa-ga aru ie-ga hosii-ga kane-ga nai
 Garden-Nom exists house-Nom want-but money-Nom have-not
 "(I) want a house with a garden, but (I) don't have money."

(Okuma 1991: 182-183, translation and gloss by KU)

Alternatively, we might attribute the 3ga cost to one of the functional properties of *-ga* that is ascribed to by the traditional literature (e.g., Kuno 1973a, among others, see Section 3.2): If *-ga* is used to signal new information, too many *-ga* phrases in a 3ga sequence may confront the parser with too much information that is presented as new. Thus, if we want to know more about earlier stages of processing, it is necessary to perform an examination using a task that is more sensitive to those stages. Based on the above considerations, a further investigation on the effect of 3ga was planned, using double and single center-embedded sentences, and employing a self-paced whole-sentence reading task with a modified adverb placement manipulation. This investigation is reported as Experiment 2 in Chapter 5.

A possible source of 3ga cost that might be involved in an early stage of processing is the effect of ambiguity associated with the multiplicity of *-ga*'s syntactic function. Since *-ga* is associated with more than one syntactic

function (see Chapters 3 and 7), ambiguity will grow exponentially as one NP-*ga* is encountered after another in the input, so that ambiguity *per se* might push processing load beyond the parser's capacity. As reviewed in Chapter 2, the processing difficulty with English double center-embedding is standardly considered as independent of structural ambiguity. But unlike English, the difficulty with Japanese double center-embedding could be tied to the syntactic ambiguity of -*ga*, and we have no information about whether NP-*ga* encountered in input is syntactically ambiguous. Therefore, it is important to investigate this possibility, and this undertaking is reported as Experiment 3 in Chapter 7.

4.6 Summary of Chapter 4

This chapter reported two off-line processability rating experiments that explored the effect of repeated use of NPs marked with the same nominative case-marker, there being three such uses in doubly center-embedded sentences in Japanese. The experiments have shown that the parsing mechanism for Japanese does experience a particular difficulty with double center-embedding whenever there is a sequence of three consecutive NP-*ga*'s. This suggests that there is a special processing cost associated with a 3*ga* sequence, above and beyond the cost associated with double center-embedding *per se*. One instance of the 3*ga* cost in single embedding indicated, further, the possibility that the 3*ga* cost is quite general, arising regardless of the level of center-embedding.

In discussing consequences of the findings to date, some possible explanations of the 3ga cost have been considered. At this point, the outcomes in the current study suggest that the 3ga cost arises, specifically, when there are case-assignment relations in which case-assignees are adjacent. None of the standard explanations in terms of the following factors are consistent with the findings: more than two open clauses, more than two case-assignment relations alone, incomplete thematic relations, and dependency locality.

CHAPTER 5

GENERALITY OF 3ga COST

5.1 Introduction

The ratings data of Experiment 1 build a strong preliminary case for the existence of a processing cost associated with 3ga sequences, with the result that Japanese speakers report marked difficulty for double center-embeddings whenever these contain three adjacent NPs marked with -ga (Nom). One further instance involving a comparison of single center-embeddings suggests the possibility that the 3ga effect is quite general.

We take the view, however, that the case for a broadly applying 3ga cost should only be considered preliminary, both because the evidence relating to single center-embeddings is very limited, and because the unspeeded judgment tasks of Experiment 1 are potentially sensitive to a wide range of influences, including those well beyond the structure-building operations of the sentence processing mechanism. What is now required, therefore, is a more systematic investigation that explores the single embedding cases just as thoroughly as the double embeddings, and does so while employing a paradigm that plausibility is more restricted in its sensitivity.

This chapter reports on a self-paced reading study undertaking exactly that systematic investigation.¹⁰³ To find out whether the 3ga cost revealed in Experiment 1 is indeed general to double and single center-embedding, Experiment 2 incorporates two full materials designs: In one design, sentences involving double center-embeddings are manipulated, and in the other, sentences involving single center-embeddings.

These materials sets are both constructed with the same general logic (as interaction designs), and the experimental task is performed with the same subjects. This allows statistical tests to be run, not only for the data of each of the double- and single-embedding designs, independently, but also across levels of embedding.

Section 5.2 sketches the logic underlying Experiment 2, spells out each of the materials designs, and explains why a self-paced reading technique is used, taking primary measures at the level of whole sentences. Section 5.3 describes the experimental method fully, and then presents the results in three parts: The first two parts present data separately, for each of the double- and single-embedding designs, while the third part presents the outcome of a comparison between them. Section 5.4 discusses findings of Experiment 2 as a whole, and Section 5.5 summarizes the chapter.

¹⁰³ This experiment has been briefly reported as Uehara & Bradley (2001), in a poster presentation.

5.2 Experiment 2: Overview of Design and Paradigm

Our investigation of the generality of the *3ga* cost relies on an isolation of the effect in each of double and single center-embedding contexts, and a comparison across contexts. To isolate the *3ga* cost in either context, experimental materials are constructed in an interaction design, i.e., one in which that cost is estimated via the interaction term of a 2x2 factorial.

In the explication that follows, we refer to the matrix, middle, and innermost clauses of the double center-embedding structure as IP1, IP2, and IP3, respectively. Likewise, we refer to the matrix and embedded clauses of the single center-embedding as IP1 and IP2, respectively. Subject NPs and VPs inherit the numbering of their clauses, as illustrated in (5.1):

- (5.1)
- | | |
|---------------------|--|
| Double
Embedding | [IP1 NP1 [IP2 NP2 [IP3 NP3 VP3] VP2] VP1] |
| Single
Embedding | [IP1 NP1 [IP2 NP2 VP2] VP1] |

The discussion that now follows focuses on the ideas underlying the design of materials, for each of the double- and single-embedding components of Experiment 2. Full details of materials construction is deferred to Section 5.3.

For double center-embeddings, the *3ga* cost can be isolated in a design fully crossing two factors: Adverb Position, and NP1 Particle Type. The four different sentence types that result are schematized in Table 5-1 below.

**Table 5-1: Sketch of Double Center-Embedding Design,
Adverb Position x NP1 Particle Type (Experiment 2)**

	NP₁-ga	NP₁-wa
AdvP in IP3	[NP ₁ -ga [NP ₂ -ga [NP ₃ -ga AdvP ₁ ...	[NP ₁ -wa [NP ₂ -ga [NP ₃ -ga AdvP ₁ ...
AdvP in IP2	[NP ₁ -ga [NP ₂ -ga AdvP ₂ [NP ₃ -ga ...	[NP ₁ -wa [NP ₂ -ga AdvP ₂ [NP ₃ -ga ...

The Adverb Position manipulation is exemplified by the contrast of rows 1 and 2 in Table 5-1. For the two sentence types in row 1, an adverbial phrase (hereafter, AdvP) is positioned at the top of IP3's VP, where it does *not* interrupt the sentence-initial sequence of subject NPs. For those in row 2, however, AdvP is positioned at the top of IP2's VP, where it intervenes between NP2 and NP3.

The NP1 Particle Type manipulation is exemplified by the contrast of columns 1 and 2 of Table 5-1. For the sentence types of column 1, NP1 takes the nominative marker *-ga*; for those of column 2, NP1 is topicalized and takes the topic marker *-wa*.

These two manipulations, *applied in combination*, mean that just one of the four sentences types in Table 5-1 contains the *3ga* sequence which is hypothesized to induce a processing cost: This is the sentence type in which the sequence of subject NPs is not interrupted by AdvP *and* NP1 at the same time takes *-ga*. The interaction term of the analysis detects any cost due to *3ga*; that term (in effect) considers the difference between NP1-*ga* sentences with non-interrupting IP3 placement of AdvP versus interrupting IP2 placement,

subtracting out any difference attributable to adverb position *per se* as estimated in NP1-*wa* sentence types (in which 3*ga* can never be at issue, necessarily).

While the manipulation of substituting -*wa* (Top) for -*ga* (Nom) as the marker of NP1 is exactly the same as one employed in Experiment 1, the AdvP placement manipulation is differently implemented here. Recall that two potential problems were identified with respect to the way that adverb placement was used in Experiment 1, in which the same adverb was placed both within IP2: A post-subject position put AdvP at the top of IP2, while a verb-adjacent position put AdvP VP2-internally. One problem concerned temporary ambiguity, and the other, unnaturalness due to unintended focus effects (see Sections 3.4 and 4.5 for discussion).

To minimize these problems as much as possible, AdvPs that typically modify the entire VP were selected, uniformly, and these were inserted in their canonical post-subject position (at the top of VP), regardless of whether that placement was in IP2 (interrupting the NP sequence) or in IP3 (maintaining the NP sequence, uninterrupted). Further, the AdvP to be inserted into IP2 differed from that for IP3, and this fact is indicated by the AdvP1 ~ AdvP2 notation in Table 5-1 above.

The lexical items selected for the AdvP1 always matched their AdvP2 counterparts both in length (characters) and phonological weight (morae),

within the sentence sets.^{104,105}

Note that the problem of temporary ambiguity, when AdvP is positioned in IP2 (between NP2 and NP3, see row 2 of Table 5-1) is *not* solved: That positioning remains temporarily ambiguous in the materials of Experiment 2. A first-pass parse could assign AdvP2 to either the current clause, IP2, or to an upcoming new clause, IP3, though this latter assignment would be most likely non-canonical, and would subsequently be disconfirmed by the content of VP3.¹⁰⁶

While in double center-embeddings, the NP-*ga*'s in a 3*ga* string are all subject NPs, this is not so in single center-embeddings; there, the third of a 3*ga* string is a nominative object. This makes the possibility of using the Adverb Position manipulation of the double-embedding design tricky since the available positions for contrasting placements (to interrupt the NP sequence, or

¹⁰⁴ It is in general assumed that Japanese is primarily a mora-based language, and the notion of mora is predominantly used to account for various phonological phenomena, such as accentuation/pitch patterns and the number of smaller phonological units within a word (see e.g., Kubozono 1995 and Tsujimura 1996). In this sense, phonological length of Japanese words is often measured in terms of the number of morae rather than syllables. Although there is a dialect more sensitive to syllables than morae (e.g., the Takajocho dialect in Shibatani (1990)), subjects who participated in Experiment 2 were all from areas of the standard (Tokyo) dialect, which is mora-based. For this reason, adverbial phrases used in the experiment's test sentences are controlled in terms of the number of morae. For details of phonological characteristics of and the role of morae and syllables in Japanese, see Kubozono (1985, 1989, 1993, 1995), Shibatani (1990), and Tsujimura (1996), among others.

¹⁰⁵ Within a quadruple, lexical items are the same except for AdvPs, but the use of two different AdvPs affects the length of the middle and the innermost clause.

¹⁰⁶ It is of interest that the reading time data exhibit *no* statistical difference as a function of adverb position, in the "control" NP1-*wa* sentence types (for which 3*ga* is never at issue).

to leave that sequence uninterrupted) involve at least one placement in a position other than the canonical post-subject point. As discussed above, there is reason to believe that such adverb placements may incur unintended focus effects.¹⁰⁷ For this reason, the design used to isolate any 3ga effect in single center-embeddings employed a device other than Adverb Position as its first factor, and the design is therefore *parallel* (rather than *identical*) to that for double center-embeddings. As first factor, it employed the IP2 Construction manipulation through which preliminary evidence was achieved in the exploratory instance of Experiment 1, and this factor was fully crossed with NP1 Particle Type. The resulting four sentence types are schematized in Table 5-2 .

¹⁰⁷ Note that in a single-embedding, the contrast between an interrupted and uninterrupted NP sequence could involve a comparison between post-subject placements of an adverb as in either (i) or (ii) below (differing in whether that adverb occurs in IP1 or IP2) with pre-verbal placement of an AdvP as in (iii).

(i)	[_{IP1} NP1 AdvP [_{IP2} NP2 NP3 V2] V1]	INTERRUPTED
(ii)	[_{IP1} NP1 [_{IP2} NP2 AdvP NP3 V2] V1]	INTERRUPTED
(iii)	[_{IP1} NP1 [_{IP2} NP2 NP3 AdvP V2] V1]	UNINTERRUPTED

While AdvPs felicitous in contexts (i) and (ii) are sentential or VP modifiers, e.g., temporal or manner adverbs, a different kind of AdvP is required for felicity in the VP-internal context of (iii), e.g., degree adverbs compatible with an NOC's [+stative] predicate, e.g., *totemo sukida* (be very fond of). The unknown consequences of a confound between adverb position and adverb type therefore prompted the use of an alternative device (IP2 variation between NOC and AOC), as described in the text.

**Table 5-2: Sketch of Single Center-Embedding Design,
IP2 Construction x NP1 Particle Type (Experiment 2)**

	NP₁-ga	NP₁-wa
NOC in IP2	[NP₁-ga [NP₂-ga NP₃-ga ...	[NP₁-wa [NP₂-ga NP₃-ga ...
AOC in IP2	[NP₁-ga [NP₂-ga NP₃-o ...	[NP₁-wa [NP₂-ga NP₃-o ...

Just as Table 5-1 did earlier for the double center-embedding design, the sketch for the single center-embedding design in Table 5-2 displays its first manipulation via a contrast across rows, and its second via across columns. That is, the IP2 Construction factor placed either a nominative object in the embedded clause (giving NP3-ga accompanied by an appropriate [+stative] verb), or an accusative object (giving NP3-o with a [-stative] verb). The second factor of the design, NP1 Particle Type, again varied the marker on NP1 between -ga (Nom) and -wa (Top).

As before, the combination of these manipulations has the result that just one of the four sentence types in Table 5-2 contains a 3ga sequence (NOC, NP1-ga). And again, any processing cost due to 3ga is detected by the interaction term of an analysis, where the interaction term considers the difference between NOC and AOC versions of NP1-ga sentences, relative to that of NP1-wa sentences (and so abstracts away from any difference attributable to NOC/AOC variation, *per se*).

In creating materials differing in the construction used in IP2, different lexical items were selected for NOC and AOC counterparts.¹⁰⁸ Instead, the NOC sentences used [+stative] predicates, and the AOC sentences, [-stative] predicates. To maintain naturalness, it was not always possible to match lexical items in length and phonological weight, but the character and mora counts never differed by more than two units, within sentence sets.

Finally, it must be noted that in NOC sentences, there is a temporary ambiguity when NP3-*ga* is encountered, that ambiguity between subject and nominative object roles being resolved (in favor of object interpretation) when the verb in IP2 is encountered.¹⁰⁹

We now turn to a consideration of the task and data collection methods in Experiment 2, recalling that the goal of the experiment is to discover whether the 3*ga* costs found earlier with off-line methods would also emerge in a task that presumably taps an earlier stage of processing. An important concern in selecting a paradigm is how facts about the processing of sentences that are undoubtedly difficult might be revealed, without making those sentences unnecessarily *more* difficult. With this in mind, the decision was to employ the self-paced whole-sentence reading paradigm, but to take reading measures at the level of whole sentences.

¹⁰⁸ Although some predicates exist that allow either nominatively or accusatively marked objects, none of these appeared in the materials of Experiment 2.

¹⁰⁹ In fact, the reading time data of Experiment 2 show a small slowdown for NOC sentences, but this is not reliable in the item-based analysis.

With the self-paced reading technique, response times are measured from the onset of the display of some text to the participant's key-press terminating that display. Standard assumptions in psycholinguistic research are that measures such as reading time techniques can tap into early stages of comprehension processes, and that variation in reading times indexes processing complexity, all else being equal.

While self-paced reading texts are often presented on a computer screen phrase-by-phrase (or *bunsetsu-by-bunsetsu* in experiments using Japanese), with successive displays replacing each other at screen-center, all materials in Experiment 2 were presented as whole sentences. The index of processing complexity afforded by the experiment's reading time measures is therefore pitched at the whole-sentence level. This is sufficiently detailed for current purposes, given the questions being asked and the power of the materials design, and has the advantage that inherently difficult materials are presented to participants in the most natural way possible.¹¹⁰ The inclusion in the experimental protocol of a large number of fillers, varying in length and complexity, distracted participants' attention from systematicities in the critical materials. This, combined with the use of YES/NO comprehension questions following every sentence, whether experimental or filler, ensured that the reading time data (and thus the estimates of processing difficulty) were as

¹¹⁰ Future projects asking different questions might require estimates of processing complexity at a grain that is finer than the whole sentence. But even in this instance, native intuition suggests that *bunsetsu-by-bunsetsu* display would be ill-advised — and likely would lead to outright comprehension failure in some instances. Measures of eye movements across sentences presented whole would be the recommended means for locating peaks of processing difficulty to particular sentence regions.

clean as possible.

5.3 Experiment 2: Self-Paced Whole-Sentence Reading, 3ga in Double *versus* Single Center-Embedding

Method

Participants

N = 112 native speakers of Japanese (average age, 20;9 years) participated successfully in Experiment 2, as volunteers; these represented 28 participants in each of 4 versions of the experiment. All were students (variously at undergraduate and graduate levels) at Gunma University in Japan, and were drawn from the School of Education, the School of Technology, the School of Social Information, or the School of Medicine. An additional 19 participants (14.5% of the total pool tested) were rejected and replaced, for excessively slow and/or error-prone comprehension.¹¹¹ Participants were told that the purpose of the experiment was to investigate how native speakers of Japanese understand difficult and easy sentences in Japanese.

¹¹¹ Details of the criteria for exclusion of participants are spelled out in the Data Treatment section below.

Materials

As outlined in Section 5.2, the designs of the experiment created one set of double center-embedding materials and another set of single center-embedding materials. To support the construction of materials, the four sentence types in each design were first realized as a quadruple of four basic skeletons, as schematized in Tables 5-3 and 5-4.

Table 5-3: Four Double Center-Embedding Sentence Types, Adverb Position x NP1 Particle Type

AdvP in IP3; NP1- <i>ga</i>	[NP ₁ - <i>ga</i> [NP ₂ - <i>ga</i> [NP ₃ - <i>ga</i> AdvP ₁ V] V] V]
AdvP in IP2; NP1- <i>ga</i>	[NP ₁ - <i>ga</i> [NP ₂ - <i>ga</i> AdvP ₂ [NP ₃ - <i>ga</i> V] V] V]
AdvP in IP3; NP1- <i>wa</i>	[NP ₁ - <i>wa</i> [NP ₂ - <i>ga</i> [NP ₃ - <i>ga</i> AdvP ₁ V] V] V]
AdvP in IP2; NP1- <i>wa</i>	[NP ₁ - <i>wa</i> [NP ₂ - <i>ga</i> AdvP ₂ [NP ₃ - <i>ga</i> V] V] V]

Table 5-4: Four Single Center-Embedding Sentence Types, IP2 Construction x NP1 Particle Type

NOC in IP2; NP1- <i>ga</i>	[NP ₁ - <i>ga</i> [NP ₂ - <i>ga</i> NP ₃ - <i>ga</i> (Adv) V] V]
AOC in IP2; NP1- <i>ga</i>	[NP ₁ - <i>ga</i> [NP ₂ - <i>ga</i> NP ₃ - <i>o</i> (Adv) V] V]
NOC in IP2; NP1- <i>wa</i>	[NP ₁ - <i>wa</i> [NP ₂ - <i>ga</i> NP ₃ - <i>ga</i> (Adv) V] V]
AOC in IP2; NP1- <i>wa</i>	[NP ₁ - <i>wa</i> [NP ₂ - <i>ga</i> NP ₃ - <i>o</i> (Adv) V] V]

Next, lexical content was inserted into the structural skeletons listed above, to produce 24 sentence quadruples for each of the double and single center-embedding designs. These 192 sentences ($24 \times 4 \times 2$ sentences) were distributed so as to create four counter-balanced versions of the experimental materials, in which no subject would see more than one variant of any sentence quadruple. Appendices F-1 and F-2 present a full list of the double-embedding materials in Japanese script and English translation, respectively; Appendices G-1 and G-2 do likewise, for the single-embedding materials.

The examples set out in (5.2) and (5.3) below are typical of the double and single center-embedding quadruples, respectively. Each quadruple is accompanied by the YES/NO comprehension question that followed presentation of any member of the set; its correct answer is given in parentheses (English translation only, for the reader's convenience).

(5.2) AdvP in IP3; NP1-ga

[kakarichoo-ga [shokuin-ga [Nakamura-san-ga mezasiku
 section chief-Nom employees-Nom Nakamura-Mr./Ms.-Nom unusually
 jimushori-o matigaeta]-koto-o hinansite-iru]-no-o tasinameta.]
 accounting-Acc made error-fact-Acc criticizing-is-fact-Acc reprimanded

"The section chief reprimanded the workers for being critical of the fact that Mr./Ms. Nakamura uncharacteristically made an accounting error."

AdvP in IP2; NP1-ga

[kakarichoo-ga [shokuin-ga itumademo [Nakamura-san-ga
 section chief-Nom employees-Nom endlessly Nakamura-Mr./Ms.-Nom
 jimushori-o matigaeta]-koto-o hinansite-iru]-no-o tasinameta.]
 accounting-Acc made error-fact-Acc criticizing-is-fact-Acc reprimanded

"The section chief reprimanded the workers for being endlessly critical of the fact that Mr./Ms. Nakamura made an accounting error."

AdvP in IP3; NP1-wa

[kakarichoo-wa [shokuin-ga [Nakamura-san-ga mezasiku
 section chief-Nom employees-Nom Nakamura-Mr./Ms.-Nom unusually
 jimushori-o matigaeta]-koto-o hinansite-iru]-no-o tasinameta.]
 accounting-Acc made error-fact-Acc criticizing-is-fact-Acc reprimanded

"As for the section chief, he reprimanded the workers for being critical of the fact that Mr./Ms. Nakamura uncharacteristically made an accounting error."

AdvP in IP2; NP1-wa

[kakarichoo-wa [shokuin-ga itumademo [Nakamura-san-ga
 section chief-Nom employees-Nom endlessly Nakamura-Mr./Ms.-Nom
 jimushori-o matigaeta]-koto-o hinansite-iru]-no-o tasinameta.]
 accounting-Acc made error-fact-Acc criticizing-is-fact-Acc reprimanded

"As for the section chief reprimanded the workers for being endlessly critical of the fact that Mr./Ms. Nakamura made an accounting error."

Question

Did the section chief make an error in accounting?

(NO)

(5.3) NOC in IP2; NP1-ga

[hisho-ga [Morisita Shachoo-ga takusii-ga hituyoo-da]-to
 secretary-Nom Morishita President-Nom taxi-Nom necessary-is-that

uketuke-made ii-ni-kita.]
 reception desk-to tell-to-came

“The secretary came to the reception desk to report that President Morishita needs a taxi.”

AOC in IP2; NP1-ga

[hisho-ga [Morisita Shachoo-ga takusii-o yonde-arui]-to
 secretary-Nom Morishita President-Nom taxi-Acc called-has-that

uketuke-made ii-ni-kita.]
 reception desk-to tell-to-came

“The secretary came to the reception desk to report that President Morishita had called a taxi.”

NOC in IP2; NP1-wa

[hisho-wa [Morisita Shachoo-ga takusii-ga hituyoo-da]-to
 secretary-Top Morishita President-Nom taxi-Nom necessary-is-that

uketuke-made ii-ni-kita.]
 reception desk-to tell-to-came

“As for the secretary, she came to the reception desk to report that President Morishita needs a taxi.”

AOC in IP2; NP1-wa

[hisho-wa [Morisita Shachoo-ga takusii-o yonde-arui]-to
 secretary-Top Morishita President-Nom taxi-Acc called-has-that

uketuke-made ii-ni-kita.]
 reception desk-to tell-to-came

“As for the secretary, she came to the reception desk to report that President Morishita had called a taxi.”

Question

Did the secretary go to the receptionist?

(YES)

In preparing the experimental quadruples, considerable care was taken in selecting appropriate lexical content so as to maximize the felicity of the test items, while at the same time achieving as much variety as was possible within the constraints imposed by structural requirements.

Since Japanese center-embedded sentences of the type used here rely heavily on verbs of report, the pool of available verbs varies in a rather narrow range. In particular, doubly self-embedded sentences must close with at least two such verbs, consecutively. To avoid undue repetition and to increase naturalness, the class of verbs directly selecting was supplemented, to fill the matrix and middle VP positions, by verbs that select such complements only indirectly. These latter verbs (obligatorily or optionally) select a sentential NP, e.g., *-no-ni* (fact-at), *-no-o* (fact-Acc) rather than a complementizer clause, e.g., *-to* (that). In the quadruple in (5.2), for example, *hinansite-iru* ("criticizing is") is used in the VP2 position, and *tasinameta* ("reprimanded") in the VP1 position. In this example, the latter takes a nominalized clause as its object, so that the former is followed by *-no* ("fact") to nominalize IP2. In addition, the doubly center-embedded test sentences in Experiment 2 all contained an object NP in the innermost clause (IP3), to avoid inevitably monotonous sentences in which three subject NPs would uniformly be followed by three bare VPs, all lined up.

NP content in the double center-embedding materials was chosen in the light of the following consideration: A variety of studies (e.g., Bever 1970; Hudson 1996, among others) have reported that repeated use of NPs of the *same kind* in the subject positions of doubly center-embedded sentences may unduly increase processing difficulty (see Chapter 2). For this reason, nouns

were categorized as proper nouns, role-term nouns, kinship-term nouns, and collective nouns, and as a rule-of-thumb no more than two NPs of the same category were permitted in any sequence of three subject NPs. For example, the successive subject NPs used in the example in (5.2) are “section chief” (a role term), “employees” (a collective noun), and “Mr. Nakamura” (a proper noun).¹¹²

The construction of materials filling out the single center-embedding design also attempted to make the test sentences as natural as possible. Here, the lexical items used in the embedded verb position were different for NOC and AOC sentences. This freed up the range of available verbs considerably, boosting naturalness, but morphological length and phonological weight could not always be matched. For example, in the quadruple in (5.3), *hituyoo-da* (“need”) in NOC sentences has two less characters than does *yonde-aru* (“has called”) in AOC sentences, when written in normal Japanese script; but that length variation seems less important than the fact that these different verbs fit equally well with other lexical content.

Further, since the number of NOC predicates is small compared to that of AOC predicates, limitations in creating a sufficiently varied materials set were tight. Therefore, to minimize an unnatural monotony in sentences satisfying the structural constraints, an AdvP or PP was optionally inserted. When that option was taken up, in a give quadruple, the same AdvP occurred

¹¹² Another example of a collective noun actually used in the materials is *Toohokusisha* (“Tohoku Branch”). This type of noun could be temporarily ambiguous between inanimate and human readings, but it would be disambiguated when its verb is encountered.

in the same position for all sentences of the set, and that position was always later than NP3. The phrase *uketuke-made* (“to the reception desk”) in (5.3) is illustrative.

Given the narrow range of applicable verbs, maximizing naturalness in the materials was also a major concern in the selection of NP content in the single center-embeddings. The following strategy was used: NP content for the first and second NPs (the subject phrases of matrix and embedded clauses) was always human. Nouns were categorized as for the double center-embeddings (i.e., proper nouns, role-term nouns, kinship-term nouns, and collective nouns), and NPs of the same type were never used in those two positions. On the other hand, the content in the third NP position referred variously to animate and inanimate entities. Of the 24 quadruples, 5 used animate NP3's, while the remaining used inanimate. Whether this NP3 variation creates a problem for interpretation of the experiment's outcome will be taken up later in discussion.

The complete materials set for Experiment 2 contained pure filler items in addition to the experimental sentences; fillers did not vary across versions of the experiment. Moreover, even within the experimental items proper, double and single center-embedding test sentences can be considered to function in effect as fillers for each other, because the two types of sentence differ markedly in complexity. The purpose of including a large set (N=48) of additional pure fillers was to further increase the variety of sentences that participants would encounter.

Pure fillers contained either two or three clauses but no more than one embedding, and had approximately the same length as the experimental sentences. Since half of the experimental materials involved doubly center-embedded structures, inherently difficult to process, including overly short or overly easy fillers might have thrown these experimental cases into too stark a contrast. Thus, the types of fillers were extremely important, and the filler set included eight subtypes, as follows: Complex sentences with a sentential subject beginning with NP1-*ga* or with NP1-*wa*, sentences containing subject or object relative clauses, conjoined sentences containing two or three clauses, and conjoined sentences with a relative clause in either the first or second conjunct. NP content in these fillers was of various kinds, including animate and inanimate terms. A full list of the pure fillers and their English translations are shown in Appendices H1 and H2, respectively.

For each of the 48 experimental quadruples as well as for each of the 48 filler sentences, a YES/NO comprehension question was created. That is, every sentence presented was accompanied by a question, regardless of its status in the design. The comprehension questions served three functions: First, they sharpened participants' attention to the necessity of fully reading and comprehending each presented sentence; second, error rates in participants' answers provide information as to how well the target sentence was understood; finally, they gave a basis for rejection of those few participants who failed to take the experimenter's instructions seriously, and in consequence were error-prone.

Within every materials subtype of the entire experimental list, half of the comprehension questions were written so as to be correctly answered YES, and half so as to be correctly answered NO.

For experimental sentences in particular, comprehension questions were written to probe aspects of the presented sentence's full meaning, however difficult the comprehension of that sentence might prove to be. Thus, for double center-embeddings, in particular, questions checked the subjects and predicates of particular clauses were "matched up" correctly. Many studies (e.g., Bever 1970, 1974; Fodor et al. 1974; Hudson 1996; Kac 1981; Lewis 1993, 1994; Lewis & Nakayama 2002; Miller and Isard 1964, among others) have claimed that the processing difficulty with doubly center-embeddings is so severe that comprehension fails entirely. The questions therefore assessed whether participants really understood who had done or said, and to whom. The majority of questions hence queried the content of more than one clause: The subject of one clause was combined with the predicate of the same or a different clause in a target doubly center-embedded sentence. However, some questions asked only the content of the most deeply embedded clause, so that it would be difficult for participants to develop artificial strategies to cope with set question patterns. Moreover, to minimize the possibility that straightforward memorization would afford a correct answer, no question ever directly repeated expressions drawn from the test sentences. Instead, test-sentence content was captured in expressions that either completely or partially paraphrased the source. And while questions were written to be as felicitous as possible, and any question for which an answer could be derived

from world knowledge (i.e., from common sense) was avoided.

Comprehension questions for single-embeddings and for fillers were written with the same considerations in mind as those for the double center-embeddings. That is, questions sometimes probed the content in one clause, and other times, more than one clause. Questions of these two types were equally likely for the experimental single center-embeddings — questions for 12 quadruples asked about sentence content across two clauses, while those for the remaining 12 asked about the content of one clause only.

Procedure

The self-paced task was run, and data were collected, using the DMASTR Software for Mental Chronometry, Version 2.6.¹¹³ Four desktop computers were programmed for the experiment, so that at the same time up to four participants were able to receive instructions and perform the reading test, each at an individual workstation. Each participant was assigned randomly to one of four versions of the counterbalanced experiment, and in any such version read and answered a comprehension question for 96 items in an experimental list (plus an additional 20 overt and covert practice items, see below). Those 96 were made up as follows: 24 doubly center-embedded sentences (6 exemplars each for the 4 sentence types of the Adverb Position x NP1 Particle Type design); 24 single center-embedded sentences (6

¹¹³ The DMASTR software was developed by K. I. Forster and J. C. Forster at Monash University and the University of Arizona.

exemplars each for the 4 sentence types of the IP2 Construction x NP1 Particle Type design); and 48 fillers. Note that only 12 of 96 sentences read by any participant contain the 3ga string which may induce marked processing difficulty (12.5%); and only 6 of 96 sentences present a 3ga sequence in the double-embedding context (6.3%) A separate pseudorandomization of the materials list was generated for each participant.

The experimenter waited for a group of participants to arrive, and observed them discreetly during performance of the task until every person's individual experimental run was completed; whereupon the group left the laboratory together. The entire experiment was performed in Japanese, including oral instructions as well as on-screen presentations.

Before beginning the reading task, participants first completed a questionnaire that asked basic demographic information such as age, gender, and the university with departments with which they were affiliated. A sheet of written instructions explaining the on-line reading task was then offered for study. These instructions were reviewed orally by the experimenter, and repeated at the beginning of the on-screen presentation. The original basic-demographic questionnaire used for Experiment 2 was the same as that used for Experiment 1 (see Appendices A-1 and A-2). The written instructions for Experiment 2 and its English translation are given in Appendices E-1 and E-2, respectively.

Participants usually spent two to three minutes filling out the demographic questionnaire, and approximately five minutes studying the written instructions and listening to their oral review. A practice session then

followed, under conditions exactly the same as the subsequent test session.¹¹⁴

After confirmation that each participant was performing correctly and had no questions, all participants in a group began the test session at the same time.

An opportunity to take a break was offered mid-way through the procedure.

Even though all participants in a given test session started at the same time, completion times varied. To avoid distracting those who had not finished, members in a group waited quietly for others to complete the task. It usually took subjects between 20 and 25 minutes to complete the test session, and the entire experimental run usually took no more than a total of 40 minutes.

In all presentations on the computer screen, a whole sentence was presented in a first frame, followed by a YES/NO comprehension question in a second frame. The sentence and question shown in Japanese script in (5.4) illustrate this materials presentation, using the 3ga test sentence and its associated question previously given as an example in (5.2).

¹¹⁴ Sixteen sentence-plus-question items of the practice session fully exemplified the types and difficulty range of the upcoming test session (with lexical items different from those used in the real experimental materials), except that NP1-ga versions of double center-embedded structures were excluded. Four additional covert practice items were included in the reading test proper, split equally between test-start and a resumption point after a mid-way optional break (i.e., at the beginning of the second half of the test). See Appendices I-1 and I-2 for a list of practice items and their English translations, respectively.

(5.4) Frame 1: Sentence

係長が職員が中村さんがめずらしく事務処理を間違えたことを非難しているのをたしなめた。

Frame 2: YES/NO Comprehension Question

係長は誤って事務処理をしましたか。

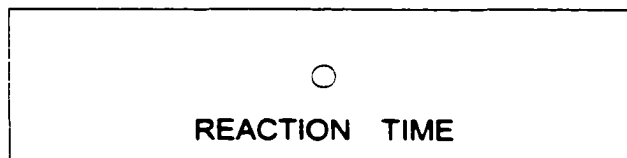
The task was performed using three keys on a computer keyboard: a yellow key (the space bar marked with a yellow sticker), a green key (the right shift-key marked with a green sticker), and a red key (the left shift-key marked with a red sticker). At the participant's request, signaled by pressing the yellow key, a first frame (i.e., a whole sentence) appeared in the center of the screen. A second request (indicated by pressing the green key) erased the sentence and immediately replaced it with a second frame (i.e., the associated YES/NO question). The comprehension question was answered YES via the green key, and NO, via the red key. For each YES/NO response, response accuracy feedback was presented along with the time (in milliseconds) it had taken to answer the question. (No such feedback was given for reading time of Frame 1.)

Feedback for correct and incorrect question responses is illustrated in (5.5a-b) below, as it appeared on the screen. In that feedback, the symbols ○ and × were used to represent “correct” or “incorrect”, respectively.

These symbols are frequently used in the Japanese culture to represent “good” or “not good”.

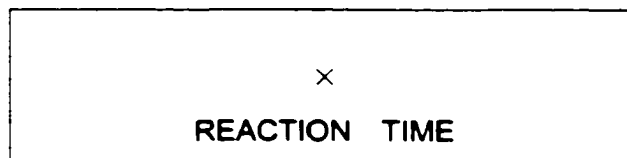
(5.5) a.

**Feedback for
correct response**



b.

**Feedback for
incorrect response**



In the task, a timeout was set limiting the display time of any to 30 seconds at maximum. Thus, if no key-press had been registered in response to a Frame 1 whole-sentence presentation, that sentence would automatically disappear from the screen after 30 seconds, and be replaced by the comprehension question. And if a participant did not respond within 30 seconds to a Frame 2 YES/NO question, it would disappear from the screen automatically, and a symbol × would appear with a Japanese phrase “タイムアウト” (“timeout”). For a given frame, timed-out responses were recorded as errors and thus excluded from the analysis.

The timeout was set for 30 seconds (undoubtedly, an unusually generous setting) to allow for the rereading of difficult items, if this proved necessary, without creating any undue pressure.¹¹⁵ However, instructions

¹¹⁵ This timeout is much longer than is standard, but it was set based on a pilot study in which displays timed out after 20 seconds. Participants' reactions in that pilot suggested that timeouts that were other than very rare occurrences were very disturbing.

prior to the experiments emphasized that reading at a natural speed was important. Those instructions also sketched the idea of a speed-accuracy tradeoff — that overly fast reading impairs understanding and leads to errors in question-responses, while too much time spent reading (in pursuit of entirely error-free responding) risks reaching the timeout.

Response times (reading times for Frame 1 sentences; reaction times for Frame 2 questions) were collected by the computer in centiseconds.

Accuracy data were also recorded, for question responses.

Results I: 3ga Effects in Double Center-Embedding

Data Treatment

Prior to the calculation of subject- and item-based summary values, the raw data were trimmed of wild values; in particular, response times less than 0.5 seconds were rejected as premature key presses. (Recall that the system's timeout device eliminates responses longer than 30 seconds.)

As a second step, 19 of 131 original participants were rejected because their data arrays suggested their performance was unsatisfactory in one or more of the following ways: (i) error rates greater than 20% for questions following 48 fillers; (ii) Frame 1 timeouts for more than 3 of 96 sentences, i.e., all materials types taken together; (iii) mean reading time for doubly-embedded sentences greater than 15 seconds. This procedure reduced the number of participants to 112, 28 in each of the four versions of the experiment.

For 112 accepted participants, data values falling beyond cutoffs established for each participant at mean plus-or-minus two standard deviations (with the double-embedding components of the data array, for each of Frames 1 and 2, separately) were replaced with those cutoff-values, to limit the extent to which occasional extreme values might distort the mean. This replacement procedure affected 4.4% of the data.

Subject- and item-based calculations of summary values were cast in terms of reading times for Frame 1, and reaction times and percent errors for Frame 2, for each of the cells of a design factorially combining Adverb Position (IP3 versus IP2) and NP1 Particle Type (-ga versus -wa). An additional dummy factor, Design Groups (participant groups in the subject-based analysis, item groups in the item-based analysis), took into account the assignment of subjects to the four versions of the experimental list over which materials were counterbalanced. Although this factor was included in the analyses of variance design to extract irrelevant variance, it is not reported in what follows.

Results

Figure 5-1 below presents mean sentence reading times for the four sentence types of the double-embedding design.

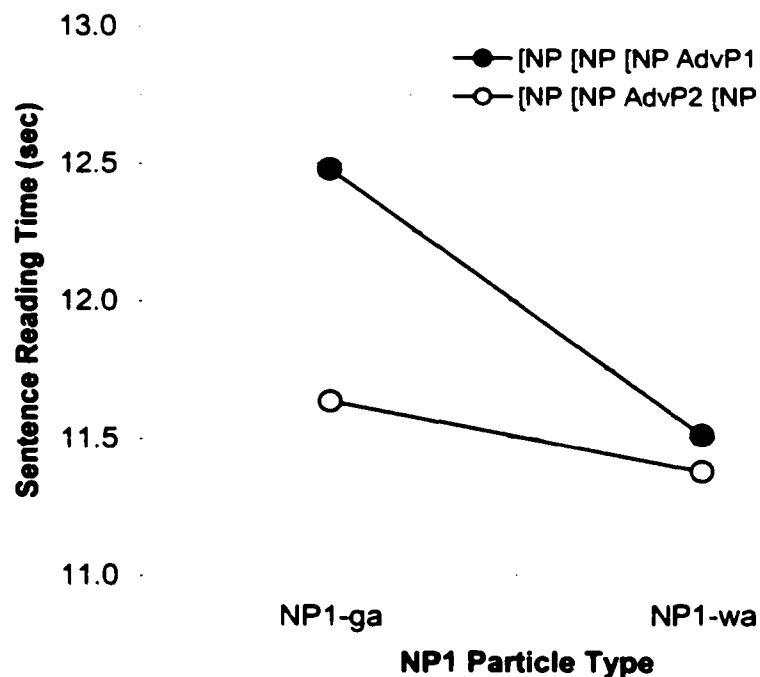


Figure 5-1: Mean whole-sentence reading times for doubly center-embedded sentences as a function of the position of an adverbial phrase, and the case-particle marking NP1

Inspection of Figure 5-1 suggests, immediately, that reading times differ dramatically across the two sentence types in which NP1 takes the nominative marker *-ga*, but differ only a little for the NP1-*wa* counterparts. The analyses of variance confirm the interaction between Adverb Position and NP1 Particle Type that these observations suggest, $F_1(1,108)=7.98$, $p<.01$; $F_2(1,20)=8.03$, $p<.025$.

The presence of that interaction means that any main effects for Adverb Position and NP1 Particle Type are not straightforwardly interpretable.

Subanalyses were therefore carried out, separately within levels of the NP1 Particle Type factor. Planned comparisons here show the 0.844 second difference between NP1-*ga* sentences with an adverbial phrase placed in IP3 (hence, not interrupting the sequence of *ga*-marked phrases) and those with an adverbial phrase in IP2 (hence, interrupting the sequence) to be highly significant, $F_1(1,108)=18.06$, $p<.001$, $F_2(1,20)=9.16$, $p<.01$. The same comparison for their NP1-*wa* counterparts, in contrast, show the corresponding 0.133 second difference to be not reliable, $F<1$ in both subject- and item-based analyses.

In short, the experiment finds markedly greater processing cost (as indexed by elevated whole-sentence reading times) in exactly the instance in which 3*ga* is at issue — when NP1 takes -*ga*, and no adverbs intervenes to break up the sequence of subject NPs. No such elevation is seen for the control comparison in which 3*ga* is never at issue, because NP1 is topicalized and so marked with -*wa*. By the logic outlined in Section 5.2, we may estimate the 3*ga* processing cost as one which adds some 0.7 seconds to overall reading times in the double center-embedded materials of Experiment 2.

Therefore, the 3*ga* cost discovered in the off-line processability rating tasks of Experiment 1 has been replicated in the self-paced reading task of the current experiment: When the degree of -*ga* repetition is increased from two to three in a doubly center-embedded sentence, there is a decrement in processability of the sentence.

The self-paced reading task allows us to ask further questions about the processing of double center-embedded sentences. It is certainly the case that these double-embeddings are not speedily read — average reading time is of the order of 11.5 seconds, even if attention is restricted to those sentence types *not* containing a 3ga sequence — in which case it seems relevant to ask whether any of the double-embeddings are actually *understood*. For answers to such question, we can turn to the data for Frame 2, and in particular to those data which speak to the accuracy (or inaccuracy) with which questions probing sentence meaning are answered by Japanese speakers.¹¹⁶

The graph in Figure 5-2 below plots the mean percentage errors for the four sentence types of the double-embedding design.

¹¹⁶ Response time for questions showed absolutely no sensitivity to the manipulations of the design, $F < 1$ for main effects and interactions in both subject- and item-based analysis.

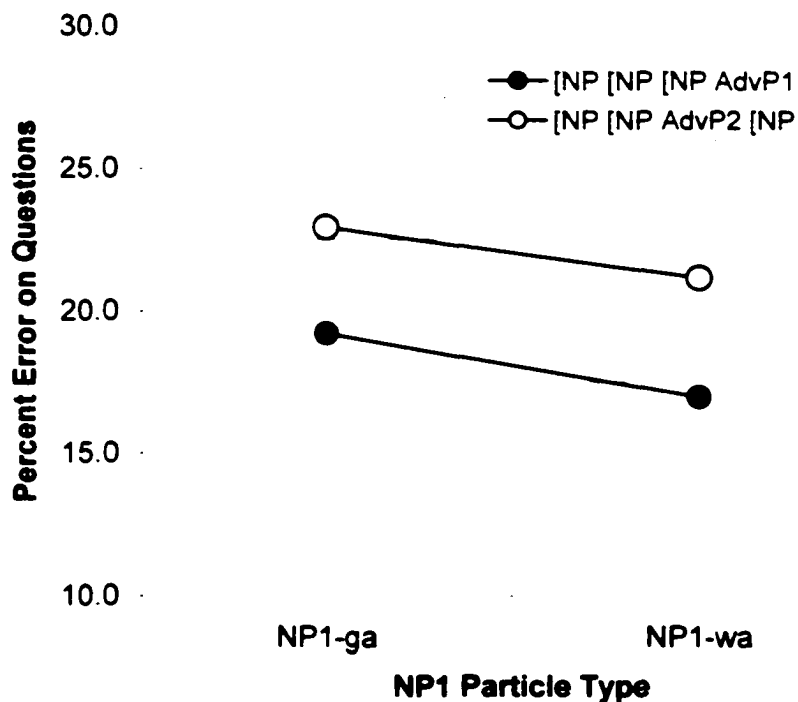


Figure 5-2: Mean percent error on questions for doubly center-embedded sentences as a function of the position of an adverbial phrase, and the case-particle marking NP1

Preliminary inspection of the error data for question-answering suggests these things: first, that *inaccuracy* is not so great (averaging some 20%) as to suggest wholesale processing failure; second, that there is perhaps less accuracy when an adverb breaks the sequence of subject NPs than when it occurs lower in the tree; and third, that there is no suggestion whatsoever that the processing complexity engendered by 3ga has any permanent effect on comprehension.

Analyses of variance for these data confirm the absence of any interaction between Adverb Position and NP1 Particle Type, $F < 1$ in both subject- and item-based analyses. Nor is there any reliable main effect of NP1 Particle Type, $F_1(1,108)=2.58$, $p>.10$, $F_2(1,20)=1.67$, $p>.10$. However, the apparent disadvantage for accuracy of the positioning of an adverbial phrase within the subject NP sequence (error rate 22.0%, cf. 18.1% when the adverbial phrase is positioned after the sequence) is confirmed in a main effect of Adverb Position that is reliable in the subject-based analysis, $F_1(1,108)=8.95$, $p<.01$, although evident only at the level of a trend in the item-based analysis, $F_2(1,20)=3.05$, $.05<p<.10$.

An outcome for errors reliable by subjects but only marginal for items suggests the likelihood that only a subset of items engages in the relevant effect — or that the picture, as cast in terms of averages, is distorted by a few extreme instances.

To summarize the outcome of the double center-embedding design, an increase of the degree of *-ga* repetition from two to three significantly decreased processability of doubly center-embedded sentences, compared to NP1-*wa* sentences in which such repetition had no effect. The *3ga* effect found in Experiment 1 was also confirmed in a self-paced whole-sentence task. However, the existence of a *3ga* sequence in a sentence affected neither reading speeds nor response accuracies of comprehension questions.

Results II: 3ga Effects on Single Center-Embedding

Data Treatment

Data for the single-embedding component of the design were treated like those for double-embedding with one noticeable exception: IP2 Construction NOC versus AOC) replaces the Adverb Position factor of the latter design.¹¹⁷

Results

Figure 5-3 on the next page presents the mean sentence reading times for the four sentence types of the single center-embedding design.

¹¹⁷ The lower limit for extreme values in single-embedding sentences was set at 2.5 seconds (cf. 3.0 seconds for double-embeddings). This time, the replacement procedure affected 4.8% of the data.

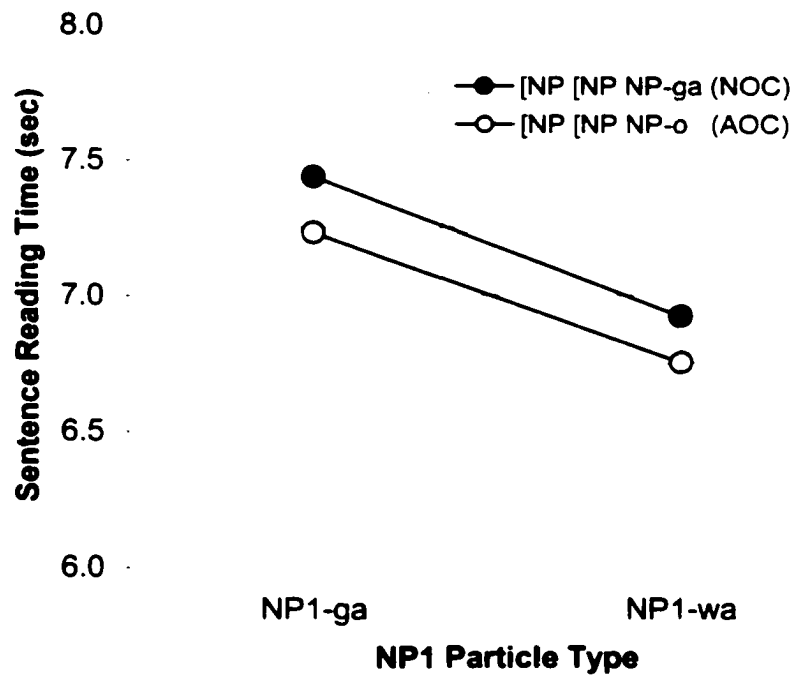


Figure 5-3: Mean whole-sentence reading times for singly center-embedded sentences as a function of the construction type of the embedded clause, and the case-particle marking NP1

Inspection of the figure reveals two relevant facts: first, that whole-sentence reading times for the simpler single-embedding structure (grand mean, 7.1 seconds) are much faster than those seen for double embedding; and second, that there is no suggestion whatsoever of the *interaction* that was the striking characteristic of the data discussed earlier. The first fact is no way surprising, and merely confirms the intuition behind 50 years of research into the double-embedding “problem”. The second fact speaks to the central issue addressed by Experiment 2, namely whether a 3ga

cost is general. Apparently, it is not, for whereas that cost was estimated for double center-embedded sentences to be of the order of 0.71 seconds, the corresponding estimate here is 0.034 seconds.

Analyses of variance confirm that there was no interaction of IP2 Construction and NP1 Particle Type, $F < 1$ in both subject- and item-based analyses. That is, the difference between the two NP1-*ga* sentence types (where an embedded NOC results in a sequence of three consecutive NP-*ga*'s, while an embedded AOC does not) is not detectably greater than that between the corresponding NP1-*wa* sentence types (where the presence or absence of a 3*ga* sequence is not at issue).

Other terms of the analyses of variance are not of immediate interest, but are reported here for completeness. The main effect of IP2 Construction was reliable only in the subject-based analysis, $F_1(1,108)=4.21$, $p<.05$, and did not reach conventional levels of significance in the item-based analysis, $F_2(1,20)=1.56$, $p>.10$.¹¹⁸ However, the main effect of NP1 Particle Type did reach significance for single center-embedded sentences, $F_1(1,108)=27.64$, $p<.001$, $F_2(1,20)=17.46$, $p<.001$. The finding was that, across the board, sentences with NP1-*ga* were read more slowly than their counterparts with NP1-*wa*, the magnitude of the effect being 0.50 seconds.¹¹⁹

¹¹⁸ The numerical disadvantage for NOC sentence types (read some 0.19 seconds more slowly on average than their AOC counterparts) may reflect either a cost associated with the temporary ambiguity encountered at NP3-*ga*, or the fact that the embedded verb in NOC occasionally had greater length (in characters).

¹¹⁹ In the double-embedding design, a compatible disadvantage for NP1-*ga* relative to NP1-*wa* can be estimated only in those sentences where the 3*ga* cost is not a contaminant, i.e., those sentences having an adverbial phrase in IP2 to break up the

For evidence about the (in)accuracy with which single center-embedded sentences were understood, we turn to the error data in answers to the comprehension questions which followed each sentence. Figure 5-4 displays the mean percentage errors in responses to these questions.

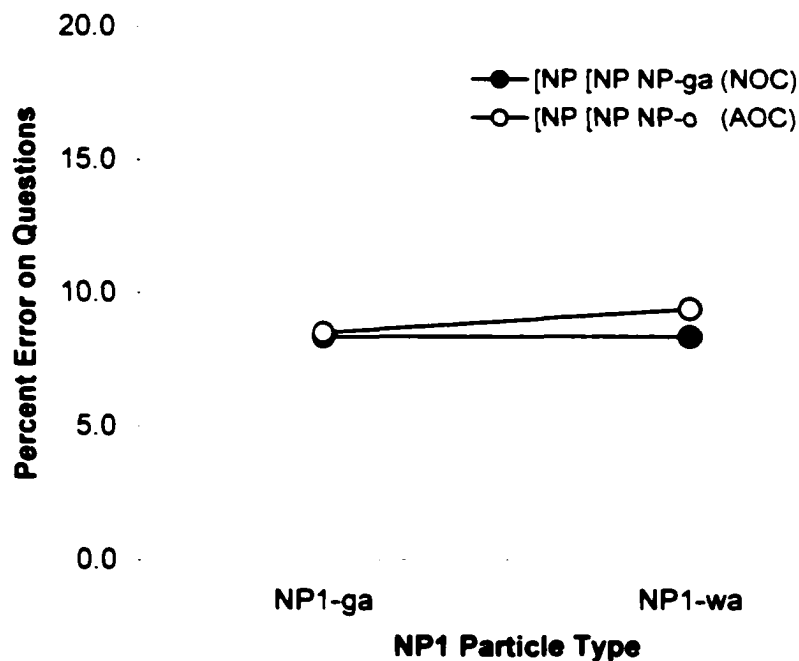


Figure 5-4: Mean percent error on questions for singly center-embedded sentences as a function of the construction type of the embedded clause, and the case-particle marking NP1

sequence of NPs. For those sentence types, in particular, an analysis of the simple effect suggested that NP1-ga sentences might be read more slowly (effect magnitude 0.26 seconds), but that suggested slowdown is not reliable in the double-embeddings, $F_1(1,108)=1.74$, $p>.10$, $F_2(1,20)=2.16$, $p>.10$.

As for the equivalent data in the double-embedding design, the error data for responses to questions showed no sensitivity to the factors manipulated in the materials design. The analyses of variance showed no main effects nor any trace of an interaction, $F < 1$ for all terms in both subject- and item-based analyses.

The only fact worth noting here is the error rates (grand mean, 8.6%) for single embeddings are lower than those found earlier for double embeddings (see Results I: grand mean 20.1%). These data accord both with the field's standing assumptions about the processability of these different sentence types, and with the difference noted in reading times.

To summarize: The critical finding for the single center-embedding design is that there was no detectable decrease in the processability of a singly center-embedded structure when a 3ga sequence exists in the sentence. This result denies the suggestion that emerged (for a single exploratory instance) in the relative processability ratings in Experiment 1.

Results III: 3ga Effects in Double versus Single Center-Embedding

In order to confirm, statistically, that there is a reliable contrast between the finding, on the one hand, that the 3ga cost is substantial for whole-sentence reading time in the double center-embedding design (interaction term estimated at 0.71 seconds), and the finding, on the other, that the 3ga cost is effectively null for the same data type in the single

center-embedding design (interaction term estimated at 0.034 seconds), the data from the two separate but parallel designs must be gathered together for a single, over-arching analysis.

For that analysis, a new Test Case factor contrasts embedding designs (double, single). Factors that were common to these two designs remain as before, these being NP1 Particle Type (-ga, -wa), and the four-level Design Groups factor which extracts irrelevant variance arising from the distribution of sentences and participants over an experiment in four versions. Finally, a newly named factor, now termed Manipulation, takes levels (AdvP in IP3, AdvP in IP2) for double embedding but (NOC, AOC) for single embedding. Commonality here lies in the *possibility* that a string of three consecutive NP-ga's can emerge (as it does both for AdvP in IP3 and for NOC, under the circumstance that NP1 takes -ga), or can never emerge (as is the case both for AdvP in IP2 and for AOC).

In this analysis across parallel designs, the *only* term of any possible interest is that for the three-way interaction, i.e., Test Case x Manipulation x NP1 Particle Type. Significance here permits a fully confident statement of the claim implicit in the report of *different* interaction outcomes in each of the designs considered separately (Results I: substantial interaction for double embedding; Results II: effectively null interaction for single embedding).

And indeed that crucial three-way interaction term is revealed in the over-arching analysis as being appropriately significant, $F_1(1,108)=6.02$, $p<.025$, $F_2(1,40)=4.94$, $p<.05$. The case that a detectable 3ga cost is specific to the double-center embedding construction is thereby firmly made.

5.4 Implications of a Non-General 3ga Cost

5.4.1 Double center-embedding

Experiment 2 has demonstrated that a 3ga sequence is costly in the processing of doubly center-embedded sentences, and not in the processing of singly center-embedded sentences. In the more definitive data of the self-paced reading paradigm, then, the 3ga cost revealed in Experiment 1's off-line processability ratings was replicable only for two-level embeddings.¹²⁰ This finding suggests that it is the same *actual* structural assignment of three surface-adjacent NP-*ga*'s that is the source of the 3ga processing difficulty: in double-embedding, each of those -*ga* phrases receives subject assignment, cf. two subject assignments and one object assignment in single-embedding.

The working hypothesis we adopt is that the processing problem identified in the 3ga cost represents an *exacerbation* of the source of the double center-embedding problem, more generally. We therefore view the problem with the doubly center-embedded structure in Japanese as one that stems from an interference which arises when structurally similar assignments are to be repeatedly established for each of a series of positionally similar

¹²⁰ One concern that might be raised with respect to Experiment 2 is that while the NPs of the 3ga sequences in double center-embeddings were all animate (human), NP3's of those sequences in the single center-embedding materials varied, i.e., less than one-fourth were animate, the remainder being inanimate (cf. NP1 and NP2, uniformly animate). Thus, it remains possible that the lack of a 3ga effect in the single center-embedding design is an artifact arising from semantic discriminability. However, Nakayama et al. (2003) show that (in)animacy has no reliable (let alone large) effect on the processability of center-embeddings. Therefore, it seems unlikely that a 3ga effect was undetectable in the single center-embedding design because of a materials artifact.

constituents. That is, the worst-case scenario for a resource-limited processing mechanism occurs when, during the course of processing, maximally structurally similar (*identical*) configurations must be assigned to maximally positionally similar (*adjacent*) constituents which are separated from the later-encountered material with which they enter into dependencies.

Among existing accounts of the double center-embedding problem, Lewis's (1998) Similarity-Based Interference Hypothesis points to something very like this scenario. However, "structural similarity" in Lewis's proposal is intended to refer to *potential* structural positions. The prediction for Lewis, then, is that any structural position associated with the use of the nominative marker should count as similar, regardless of whether the realization is as subject or object (i.e., with different syntax). The findings of Experiment 2 show, however, that it is identity of actually realized positions that matters; there is a 3ga cost when NP3 is a subject (double-embedding) but not when NP3 is a nominative object (single embedding). In other words, the problem arises not merely because potentially similar material must be held in memory, but because that material, initially incomplete, must repetitively be entered into dependencies requiring the same *actual* structural role.

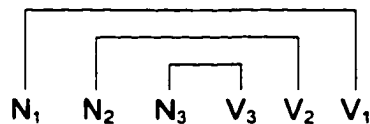
In Experiment 2, the problem with "three identical and adjacent structural positions" emerged for subject position. This surface configuration arguably occurs not only in the Japanese double center-embedding construction but also in the notably problematic English double center-embedding construction. Consider sentences such as the classic example in (1.1), now repeated as (5.6).

(5.6) # The rat the cat the dog chased ate died.

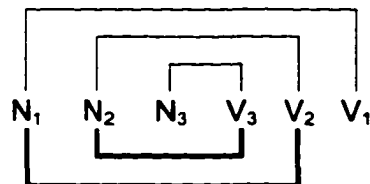
(Chomsky & Miller 1963: 286)

While relative pronouns are not overtly present in this example, they can be made overt without any improvement for processability. However, in sentences with overt relative pronouns, the three NPs are still associated with identical structural positions, and each is paired on the surface with its co-indexed relative pronoun or complementizer, i.e., no independent constituent containing major-category (N, V, A) lexical elements intervenes. In this sense, then, surface-adjacency (or effective surface-adjacency) in subject position *is* indeed general to difficult double center-embedding structures in both Japanese and English, as schematized in (2.7) and (2.8), repeated as (5.7) and (5.8), respectively. (Links shown as darker lines below the N-V skeleton represent filler-gap dependencies.)

(5.7) Japanese



(5.8) English



Less problematic sentences involving multiple embeddings, such as those in (5.9), do not share this characteristic, as shown below.

- (5.9) a. That the man who said that the book was finished didn't know his business is clear to everyone.

Cowper (1976: 52)

- b. That the food that John ordered tasted good pleased him.

Gibson (1991: 229)

- c. What the woman that John married likes is smoked salmon.

Gibson (1991: 242)

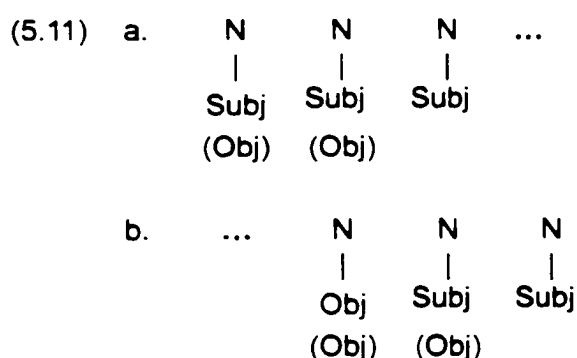
As reviewed in Section 2.3, Eady & Fodor (1981) demonstrate that sentences like those in (2.28a-b), repeated as (5.10a-b), are very difficult to process, but at the same time (5.10a) is noticeably more difficult than (5.10b). The examples are drawn from Eady & Fodor (1981: 13); underlining indicates the object gap ultimately co-indexed with the head noun of the relative clause.

- (5.10) a. # [The patient [the nurse [the clinic had hired _] sent _ to the doctor] met Jack].

- b. # [Jack met the patient [the nurse [the clinic had hired _] sent _ to the doctor]]

Eady & Fodor point to two properties of the above structures that possibly contribute to processing difficulty, these being the existence of nested filler-gap relations, and the adjacency of three consecutive NPs. Note that in the less

difficult (5.10b), the first of three consecutive NPs is not a subject, so that the number of structural positions that are identical *and* surface-adjacent in this structure is two, one fewer than in (5.10a). This difference is schematized in (5.11) below (where the additional structural roles noted in parentheses are those arising from the filler-gap dependencies of the relative clause construction).



This difference (two rather than three subject positions, adjacently) is likely contributing to the improvement of processability of (5.10b), and what difficulty persists might arise from the fact that there are additional similarities in successive filler-gap dependencies (object positions) that the parser must handle, simultaneously.¹²¹

The latter consideration may be relevant to a second finding of Experiment 2, namely that while the 3ga sequence in Japanese doubly center-embedded sentences undoubtedly made participants spend a longer time reading, the presence of that 3ga sequence did not further impair the

¹²¹ See Bever (1970) and Just & Carpenter (1987).

accuracy with which comprehension questions were answered. In the previous section, we saw that the level of accuracy observed in question-answering suggests that doubly center-embedded sentences in Japanese are processed successfully, a good deal of the time, whether or not a 3ga sequence is present: Error rates were approximately 20%, across the board, and this is well away from chance performance (albeit noticeably worse than error rates for single-embeddings). This contrasts with native-speaker judgments about the typical English doubly center-embedded construction (involving object-extracted relative clauses), which is usually said to be incomprehensible (see e.g., Eady & Fodor 1981, among others). One possibility is that while the Japanese and English structures in (5.7) and (5.8) above both involve three nested subject-verb dependencies, English has two additional dependencies involving filler-gap dependencies, to further increase the processing load.

Since the current study focuses on the effect of 3ga repetition as a means of investigating the center-embedding problem, we have been concentrated on subject position. However, the problem with “three surface-adjacent and identical structural positions” appears not to be restricted to subjects, as illustrated in the contrast in English between (2.21a-b), repeated as (5.12a-b) below. Here, repetition involves clausal modifiers, i.e., adjuncts rather than arguments.

- (5.12) a. If when the baby is crying, the mother gets upset, the father will help, so the grandmother can rest easily.

Gibson (1998: 4)

- b. # Because if when the baby is crying, the mother gets upset, the father will help, the grandmother can rest easily.

Gibson (1998: 4)

As summarized in Section 1.2, the standard assumption is that the parser computes the structure of incoming linguistic input incrementally, and that this process needs to run with real efficiency because the resources on which the parser may draw are limited (e.g., Frazier 1978; Frazier & Fodor 1978, among others). In this situation, successive computation of the three structural dependencies of exactly the same kind, for arguments (and perhaps adjuncts, see above) that are adjacent in the input but separated from their associates, seems to push the comprehension mechanism close to its limit. And where structure-building fails — the parser cannot settle on a hypothesis about some crucial part or parts of the input — further computation to reach meaning is necessarily compromised. That is, where the parse is incomplete, the next-stage interpretive module cannot receive a syntactic input that wholly readable. If first-pass parsing crashes in this way, the comprehension mechanism would then have to rely on information from some kind of second-pass process.

Recall, for example, the modular model proposed by Frazier (1999), repeated as (5.13) below, for convenience:

(5.13)

central system	reference	binding	c-command
	Θ -prediction	c-structure	sisterhood
	pseudo-encapsulated modules		encapsulated input system

(Frazier 1999: 133)

In Frazier's model, it is assumed that syntactic modules are informationally encapsulated whereas interpretive modules are not, in the sense that during second-pass parsing the latter may consult information which falls in the central system's domain, e.g., discourse information, or knowledge about the world. If so, it might be that semantic/pragmatic "cues" which, of themselves, can pick out linkages between subject NPs and their corresponding verbs can support the comprehension of some doubly center-embedded sentences *in the second-pass stage*, feeding into a parsing repair process as top-down rather than bottom-up information. This would be realized as an effect of semantic/pragmatic discriminability of the kind that has often been discussed in the literature (e.g., Bever 1970; Fodor et al. 1968; Fodor & Garrett, 1967; Hudson 1996; Schlesinger 1968; Stolz 1967) (see Section 2.6.2 for discussion and examples). Thus, our consideration here agrees with proposals that increased semantic discriminability has an effect that is secondary to an effect of syntactic and positional discriminability during first-pass parsing (see e.g., Gibson 1998; Nakayama et al. 2003; Nakayama & Lewis 2002), and assigns semantic or pragmatic effects to the repair process.

5.4.2 Other Considerations

The findings of Experiment 2 are not consistent with any existing theory that does not predict a particular difficulty arising in the course of the parser's making *identical* structural assignments for NPs that are *adjacent* in the surface string. Some existing theories recognize neither of these factors, while others recognize only one or the other of them.

Kimball's (1973, 1975) Principles of Two Sentences correctly predicts that doubly center-embedded sentences will be more difficult to process than singly center-embedded sentences, but fails entirely to predict the kind of variation among doubly embedded sentences that was found in Experiment 2, when identity (subject, topic) and adjacency were independently manipulated. This also applies to Gibson's (1991) Processing Overload Metric (see also Babyonyshev & Gibson 1995).

Under Stabler's (1994) Finite Connectivity Hypothesis, all sentences with three NP-*ga*'s are predicted to be unprocessable, whether doubly or singly embedded, which is not consistent with our findings.

Under Gibson's (1998, 2000) Dependency Locality Theory, the matrix clause is assumed to be integrated without any cost — hence no variation turning on *-ga/-wa* marking of matrix subject is predicted — and an adverbial phrase (affecting adjacency) is wrongly predicted to have no impact on processability, because it does not introduce a discourse referent.

Finally, Mazuka et al. (1985) attribute the processing difficulty of the usual doubly center-embedded sentences only to the surface adjacency of the

three subject NPs, and not to processes involved in the assignment of argument structures in any deep sense. Their claim is based on the observation that doubly center-embedded sentences seem to become easier, when one (or two) of the three consecutive NPs are null. There are at least two reasons to reject this claim: First, it is not clear whether a null NP is an NP-*ga* or NP-*wa*. Second, without context, if any of the three subject NPs is null and the remainder overt in a doubly center-embedded sentence, a higher overt subject is most naturally interpreted as controlling lower null subject(s), i.e., these are not in the usual sense instances of three *separate* subject phrases.¹²²

If identity and adjacency of actual structural positions impair the processing of a doubly center-embedded sentence, lack of either or both of these source of difficulty should improve processability, all else being equal. In proposing her Parallel Processing Model, Cowper (1976) observed that a doubly center-embedded sentence with a 3*ga* sequence is difficult to process whereas a doubly center-embedded sentence with a 3*wa* sequence is not (see Chapter 2 for further detail). Since there have been no empirical studies on the 3*wa* effect, (to the author's knowledge), it is unknown to what extent naïve participants actually do find it easier to process 3*wa* doubly center-embedded

¹²² Mazuka et al. (1985: 198) note the unnaturalness of dropping all NPs without context. An alternative is that the matrix subject/topic might be taken as "I". However, for the test sentences that Mazuka et al. discuss, the author's intuition suggests that an interpretation in which control involves the matrix subject is likely.

sentences, cf. their 3ga counterparts.¹²³ If the former are indeed easier, one possible reason is the following: As was noted in Chapter 3, *-wa* is associated with two roles, topic *-wa* and contrastive *-wa*; and in a series of NP-*wa*'s, only the first receives the topic reading, and any others receive the contrastive reading (Kuno 1973a). Hoji (1985) draws a syntactic distinction between those two kinds of *-wa*: Topic *-wa* is base-generated, whereas contrastive *-wa* involves movement (see also Saito 1985). Thus, the first NP-*wa* of a 3wa sequence can be assumed to differ syntactically from the remainder, cf. all NP-*ga* subjects in a doubly center-embedded sentence are assumed to have the same syntax. If we assume Hoji's analysis, the problem of identical structural roles for surface-adjacent NPs applies to 3ga but not to 3wa sequences, in double center-embeddings.

5.5 Summary of Chapter 5

Experiment 2 has shown that a processing difficulty turning on the presence of a 3ga string arises only in double center-embedding and not in single center-embedding. This suggests that the mechanism underlying the double center-embedding problem in Japanese has its source in three identical structural positions that are adjacent in surface form — if the parser

¹²³ The author's intuition about 3wa sentences does not agree with that of Cowper's (1976) informants. They are difficult to process, but probably for reasons different from those applying in 3ga sentences. Without context, it is simply the case that two *contrastive* NP-*wa*'s are hard to sustain.

encounters such a situation during the course of its structure-building, identity plus adjacency in structural assignments that are incomplete plunge the processing into a situation where discriminating among partially processed structures carries severe cost. This seems to be common to Japanese and English.

There is another view of the situation which will be explored as the final piece of the current study. What is at issue here is the possible impact on the processing of doubly center-embedded sentences of an ambiguity arising from *-ga*'s multiple syntactic roles. This investigation is reported as Experiment 3 in Chapter 7.

CHAPTER 6

PROPERTIES OF NP-*ga*, PART II

6.1 Introduction

Experiment 2 has revealed that the processing cost associated with a 3ga sequence emerges only in double center-embedding structure. This finding suggests that a most likely source of the center-embedding problem lies in three actual structural positions that are adjacent in surface form. While there is a consensus that the processing problem with English doubly center-embedded sentences is not caused by structural ambiguity effects, there is no information available as to whether the difficulty with Japanese center-embedding is due to ambiguity. Also, there is no information available about how the parser prefers to interpret an NP-*ga* encountered in input. Thus, Experiment 3 reported in Chapter 7 investigates the syntactic ambiguity effect associated with -*ga*.

While the test sentences of Experiments 1 and 2 were designed to avoid permanent ambiguity, the materials for the sentence completion task in Experiment 3 were syntactically ambiguous sentence-initial fragments with one or more NP-*ga*'s. In a sentence completion experiment, participants are asked to devise a natural and well-formed sentence with each sentence-initial fragment by adding anything they want. To do so, they must first interpret the ambiguous fragment. If analyses of the structures imposed on completed sentences show any systematic pattern, it would indicate the parser's preferred interpretation of

NP-*ga*.

Besides the two functions of -*ga*, the single subject marker and the nominative object marker (summarized in Chapter 3), two more of -*ga*'s functions were relevant in the creation of the materials for Experiment 3. This chapter discusses the additional functions of -*ga* as the external possessor marker and as the parallel subject marker, in Sections 6.2 and 6.3, respectively. Section 6.4 summarizes the chapter.

6.2 NP-*ga* as Possessor: External Possession Construction

The nominative marker -*ga* can mark the possessor NP in the so-called External Possession Construction (hereafter, EPC). In the EPC, the NP representing the possessor (hereafter, PR) and that representing the possessum (hereafter, PM) are both marked with -*ga*, resulting in the form [NP1-*ga* NP2-*ga*]. Thus, if an [NP-*ga* NP-*ga*] sequence such as the one in (6.1) is encountered at the beginning of a sentence, the sentence may involve a one-clause structure with the subject phrase "NP1's NP2", as illustrated in (6.2a), or a singly center-embedded structure with two Single Subject Constructions (i.e., SSCs), as in (6.2b).

(6.1) NP₁-***ga*** NP₂-***ga*** ...

- (6.2) a. [_S NP₁-**ga** NP₂-**ga** VP] **NP1's NP2; No embedding**
 b. [_S NP₁-**ga** [_S NP₂-**ga** VP] VP] **2 SSCs; 1 single embedding**

In this way, *-ga*'s role as the external possessor marker is one possible candidate for the parser's structure-building in processing NP-*ga* sequences.

Let us now summarize what the EPC is like. While the PR is marked with *-ga* in the EPC, it is marked with the genitive-marker *-no* in the so-called Internal Possession Construction (hereafter, IPC), as shown in (6.3a) and (6.3b), respectively.

- (6.3) a. Jon-*ga* okaasan-*ga* totemo kirei-da. **EPC**
 John-Nom mother-Nom very pretty-is
 "John's mother is very pretty."
 b. Jon-*no* okaasan-*ga* totemo kirei-da. **IPC**
 John-Gen mother-Nom very pretty-is
 "John's mother is very pretty."

Both constructions are interpreted to mean that the entity represented by NP1 possesses the entity represented by NP2. It is felt, however, that the *ga*-marked PR in the EPC is focused whereas the *no*-marked PR in the IPC is not. Thus, in a situation in which the PR does not need to be focused, it is generally marked by *-no*. The English translations in (6.3) above and in (6.4) to (6.6) below do not attempt to capture focus effects associated with the EPC, but we discuss them shortly.

The EPC is in fact a type of the Multiple Subjects Construction (hereafter, MSC),¹²⁴ which is famously illustrated by Kuno's example given in (6.4).

- (6.4) bunmeikoku-ga dansei-ga heikinjumyoo-ga mijikai.
civilized country-Nom male-Nom life expectancy-Nom short
"Civilized countries' men's life expectancy is short."

(Kuno 1973a: 34, gloss and translation added)

The MSC is often classified into two kinds, the genitive type and the non-genitive type (Tateishi 1991),¹²⁵ and the EPC is the former type. The sentence in (6.5a) represents the genitive type of MSC (i.e., the EPC), whereas that in (6.5b) represents the locative type, a kind of non-genitive type.

- (6.5) a. Mearii-ga kami-ga totemo utokusii.
Mary-Nom hair-Nom very beautiful
"Mary's hair is very beautiful."

b. Nyuuyooku-ga koosobiru-ga takusan aru.
New York-Nom skyscraper-Nom many exist
"There are many skyscrapers in New York City."

¹²⁴ For analyses of the MSC, see Heycock (1993), Kubo (1992), Kuno (1973a), Kuroda (1978, 1992), Saito (1982, 1985), Takahashi (1996), Takezawa (1987), Tateishi (1991), and Whitman (1991a, b, 1993).

¹²⁵ Tateishi (1991) classifies the MSC into genitive-type and non-genitive type, and includes locative and temporal types in the latter. He takes the view that there is no restriction on the number of subjects within a single sentence for the genitive type, whereas no more than two are allowed in a single sentence for the non-genitive type (Tateishi 1991: 30, see also Ura 1996: 104, Footnote 4).

Let us look at the difference between the genitive-type and the locative type of MSC more closely. As we see in (6.6a-b) below, respectively, the genitive type allows the PR to be marked with *-no* but not with *-ni* (Dat). Conversely, the locative-driven type disallows the *no*-marked PR but allows the first NP to be marked with *-ni*, as shown in (6.7a-b), respectively (see Takahashi 1996: 29-30; Tateishi 1991; Whitman 1993).¹²⁶

- (6.6) a. [Mearii-no kami]-ga totemo utokusii.
 Mary-Gen hair-Nom very beautiful
 "Mary's hair is very beautiful."
- b. * Mearii-ni kami-ga totemo utokusii.
 Mary-Dat hair-Nom very beautiful
 "(intended) Mary's hair is very beautiful."
- (6.7) a. * [Nyuuyooku-no koosobiru]-ga takusan aru.
 New York-Gen skyscraper-Nom many exist
 "(intended) There are many skyscrapers in New York City."
- b. Nyuuyooku-ni koosobiru-ga takusan aru.
 New York-in skyscraper-Nom many exist
 "There are many skyscrapers in New York City."

The contrast between the above two sets indicates that the relationships between the *ga*-marked NPs in (6.5a) and (6.5b) are of different types, and that only the former involves a genitive relationship.

¹²⁶ In particular, unergative and transitive Stage-Level predicates completely disallow the locative type of multiple subject (for example sentences, see Takahashi 1996:43-45).

In order to investigate the ambiguity effect associated with *-ga*'s multiple syntactic roles in double center-embedding, NP-*ga* sequences that were syntactically ambiguous were created as test materials for Experiment 3. These materials were 34 sentence-initial fragments, each of which respondents used to devise a natural and grammatically well-formed sentence. Two of the 34 fragment stimuli involved EPCs, and they consisted of a sequence of three NPs. To create this environment, only the genitive-driven MSC was used for the following reasons: First, in the genitive-driven MSC, it is possible, in principle, to have infinitely many *ga*-marked PRs without any strict restrictions on the predicate. In contrast, the non-genitive type appears to allow at most two NP-*ga*'s (prohibiting a genitive relationship holding between the entities represented by those NPs (Tateishi 1991: 29-30)). Moreover, in the non-genitive type, typical NP content except for that of the rightmost NP are places (for the locative type) or time expressions (for the temporal type). Such expressions are unlikely to become the subjects of sentences. Since the ambiguity to be created for Experiment 3 includes subjects, the non-genitive type was not really a helpful tool. For the above reasons, the experiment employed only the genitive type of MSC (i.e., EPC), and not the non-genitive type.

In Japanese, EPCs occur only with nominative NPs (contra Korean¹²⁷). The examples in (6.8a) and (6.9a) show that EPCs are impossible in Japanese

¹²⁷ Unlike Japanese, Korean EPCs occur not only with nominative NPs but also with accusative and dative NPs, and the PR assumes the same case as the PM (Nakamura 1997). In Japanese, the EPC also occurs in the object position only if the object is *-ga* marked (i.e., the NOC), but this study does not involve this type. For details of the Japanese EPC in the object position, see Morikawa (1993).

when the intended PR is marked as accusative or dative, respectively, to coincide with the PM's case-marking. In contrast, their IPC counterparts (6.8b) and (6.9b) are perfectly grammatical.

- (6.8) a. * Jon-ga Mearii-o okaasan-o tetudatta.
John-Nom Mary-Acc mother-Acc helped

“(intended) John helped Mary’s mother.”

- b. Jon-ga Mearii-no okaasan-o tetudatta.
John-Nom Mary-Gen mother-Acc helped

“John helped Mary’s mother.”

- (6.9) a. * Jon-ga Mearii-ni okaasan-ni atta.
John-Nom Mary-Dat mother-Dat met

“(intended) John met Mary’s mother.”

- b. Jon-ga Mearii-no okaasan-ni atta.
John-Nom Mary-Gen mother-Dat met

“John met Mary’s mother.”

In EPCs, the possessor NP and its possessum NP(s) are usually surface-adjacent (see Takahashi 1996¹²⁸). Thus, the nominativization¹²⁹ of the possessor NP results in the repetitive use of NP-*ga*, and each nominativized

¹²⁸ In Takahashi’s (1996) study, the EPC is referred to as the genitive-driven MSC.

¹²⁹ “Nominativization” is originally Shibatani (1977)’s term. Kuno (1973a) uses “subjectivization”. The two terms reflect a difference of the properties of the data observed. Tateishi (1991) avoids both terms and uses “genitive raising” instead for the following two reasons: First, “nominativization” does not distinguish between the processes of the MSC and other types of nominativization in Japanese (e.g., passives); second, “subjectivization” is confusing since it is also used for the nominative object marking (Kuno 1973a, b). Note that this study uses “nominativization” only because the NPs are marked with the nominative marker *-ga*. We are neutral with respect to these other issues.

phrase binds the position to its right. Logically, nominativization can iterate without limit (cf. the limit on the iteration of nominativization in the non-genitive type of MSC), as long as there is a PR-PM relationship between adjacent NPs. Thus, iterated nominativization may result in a sequence of many NP-*ga*'s, as schematized in (6.10).

(6.10) NP₁-*ga* ... NP_{*n*}-*ga* NP_{*n*+1}-*ga* VP

The possessor NP-*ga* in the EPC is often categorized as a major subject,¹³⁰ and the rightmost possessum NP-*ga* is referred to as a minor subject (see Kuroda 1992: 248). Thus, each nominativization in the EPC creates a new major subject. In the schematized EPC in (6.10) above, NP1 to NP_{*n*} are all major subjects and the rightmost NP_{*n*+1} is the minor subject.

¹³⁰ The "major subject" is assumed to play a topic-like role in the sentence, while "minor subjects" refer to the remaining subject(s) following the major subject (including the real subject). Although it is misleading, the term "major subject" is perhaps used to make a distinction between the *wa*-marked regular topic and the *ga*-marked subject that is related to the topic. The term "major subject" is used differently, depending on the researcher. For example, Kuroda (1992: 248) refers to the first and second NP-*ga*'s in (i), which are in a PR-PM relationship with each other, as a major and minor subject, respectively, but he also includes the first NP-*ga* of sentences such as (ii), which does not have a PR-PM relation with the second NP-*ga*, in the class of major subjects. On the other hand, Tateishi (1991) uses the term "major subject" to mean only Kuroda's latter type (cf. Ura 1996). This study follows Kuroda's use of "major subject".

(i) zoo-*ga* hana-*ga* nagai.
elephant-Nom trunk-Nom long

"The elephant's trunk is long."

Kuroda (1992: 248)

(ii) Tokyo-*ga* jiko-*ga* atta.
Tokyo-Nom accident-Nom occurred.

"There was an accident in Tokyo."

Tateishi (1991: 30, gloss and translation modified)

Since the EPC is motivated by focus requirements, a nominativized PR receives the primary focus. Given the possibility of more than one major subject (in the so-called multiple EPC), an obvious consequence is that iterated nominativization creates multiple foci. Kuno (1973a, b) claims that the leftmost NP-*ga* always takes precedence with respect to focus. Takahashi (1996: 62-63) agrees with Kuno but also observes that although it may be difficult, multiple-focus readings are obtainable in the sense that major subjects other than the left-most one can also be part of the contrast or new information. The sentences in (6.11) below illustrate nominativization in the EPC and the possibility of iteration. The English translations now attempt to give some sense of the focus effects. In the Japanese examples, major subjects are italicized for emphasis, and the corresponding NPs in the English translations are capitalized to express the sense of focus. The example in (6.11a) is an instance of the multiple IPC. In each of (6.11b) and (6.11c), nominativization has applied once (though to different positions) to produce a single EPC. In (6.11d), on the other hand, two NPs have been nominativized to produce a double EPC.

- (6.11) a. Ken-no neesan-no shujin-ga kaidan-kara otita.
Ken-Gen older sister-Gen husband-Nom stairs-from fell

"Ken's older sister's husband fell down the stairs."¹³¹

"It is Ken's older sister's husband who fell down the stairs."

(Takahashi 1996: 69, part of translation added)

¹³¹ This translation is added by the author. As we have reviewed in Section 3.3.1, the NP-*ga* subject with [-stative] predicate most typically receives a neutral reading (the "neutral-description" reading in Kuno (1973a)'s term). As Kuno points out, such NP-*ga*'s can be ambiguous between neutral and non-neutral (focused). However, to receive a focused reading, the sentence must be used in a specific context, and generally NP-*ga* is stressed when spoken.

- b. *Ken-ga neesan-no shujin-ga kaidan-kara otita.*
Ken-Nom older sister-Gen husband-Nom stairs-from fell
 'It is KEN whose older sister's husband fell down the stairs.'

(Takahashi 1996: 69, emphasis added in English translation)

- c. *Ken-no neesan-ga shujin-ga kaidan-kara otita.*
Ken-Gen older sister-Nom husband-Nom stairs-from fell
 'It is Ken's OLDER SISTER whose husband fell down the stairs.'

(Takahashi 1996: 69, emphasis added in English translation)

- d. *Ken-ga neesan-ga shujin-ga kaidan-kara otita.*
Ken-Nom older sister-Nom husband-Nom stairs-from fell
 'It is KEN whose OLDER SISTER's husband fell down the stairs.'

(Takahashi 1996: 40, emphasis added in English translation)

Since the motivation for the EPC is a focus requirement, discourse contexts which trigger its use have special characteristics — the PR(s) must be picked out from among possible candidates in the universe of discourse and be emphasized. There are alternatives to the EPC, however, which the speaker can use to achieve the same goal, such as the use of the IPC with a primary stress, or the use of cleft constructions, for example. How often EPCs occur in Japanese daily conversation is unclear because no studies are available (to the author's knowledge) from which we can examine their frequency. There is no information as to how often the double and single EPCs are used on daily basis.

A line of syntactic analysis of the Japanese EPC is that it is derived from the IPC, via overt PR-raising (or genitive-raising).¹³² That is, a PR modifying the

¹³² There are alternative approaches to the PR-raising analysis, and we discuss them below.

PM within a host DP, in which genitive *no*-marking is obligatory, is raised out of that DP, and adjoined to a higher position to create a new nominative argument (Kitagawa, 1986; Kuno 1973a; Kuroda, 1992; Morikawa, 1993; Shibatani, 1977; Tada, 1992; Takahashi, 1996; Tateishi, 1991; Ueda, 1990; Whitman, 1998).

Under this analysis, since an EPC is derived from an IPC [_{DP} NP1-*no* NP2]-*ga* by raising the NP1, a sentence containing an EPC in Japanese always has an IPC counterpart (Kuno 1973a, among others). The examples in (6.3) are now repeated as (6.12), in order to explicitly illustrate the structural difference between an EPC and its corresponding IPC, under the PR-raising analysis.

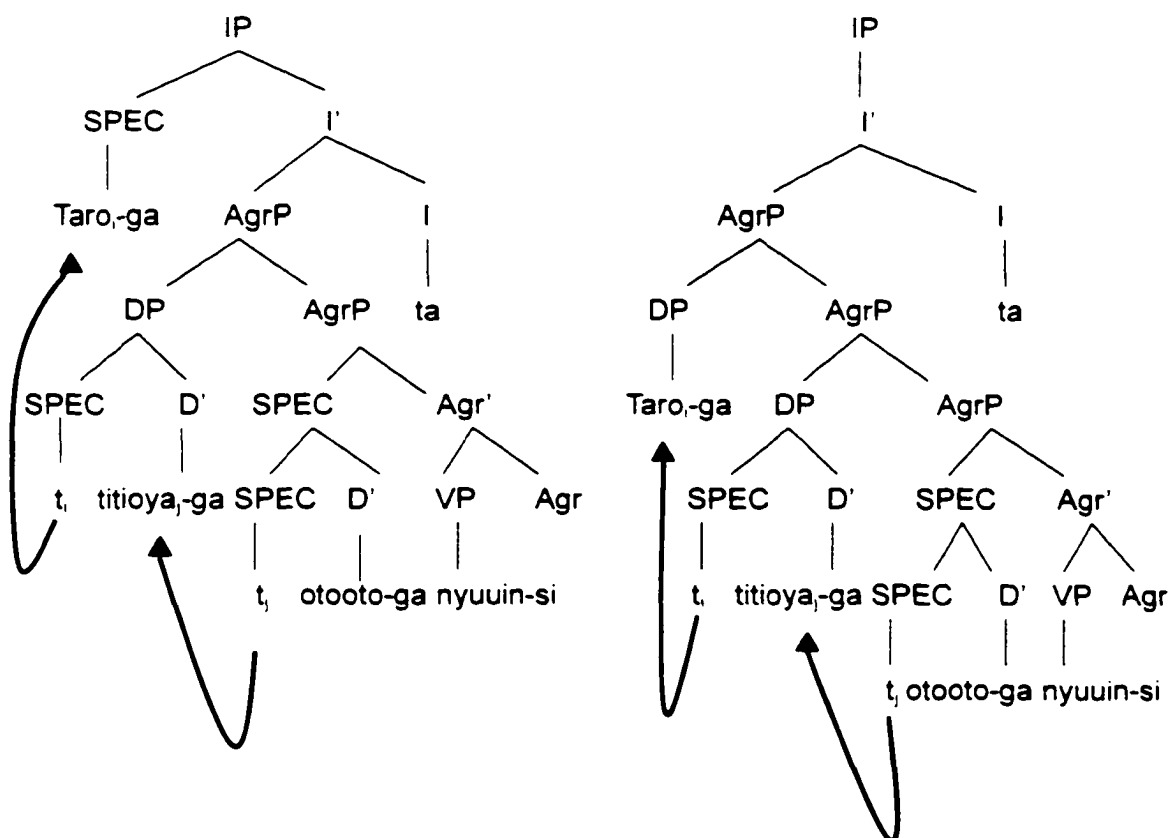
- (6.12) a. Jon-*ga*, [_{DP} *t*, okaasan]-*ga* totemo kireida. **EPC**
 John-Nom mother-Nom very pretty
 "John's mother is very pretty."
- b. [_{DP} Jon-*no* okaasan]-*ga* totemo kireida. **IPC**
 John-Gen mother-Nom very pretty
 "John's mother is very pretty."

Opinions vary, however, as to where the raised PR in the EPC is adjoined, due partly to shifts in syntactic theory. For example, Kuno (1973a) assumes that the PR is adjoined to IP (or S in Kuno's term), while Tateishi (1991) proposes adjunction inside IP, i.e., adjunction to Agr(S)P, with an optional substitution into SPEC(IP), as illustrated in (6.13a) and (6.13b), respectively.¹³³

¹³³ Tateishi states that there is nothing that can differentiate these two derivations from each other. In his analysis, Tateishi focused on four properties of the EPC (derivation from a genitive phrase; no limit on iteration; no barriers created; scrambling of subjects out of an EPC), and concluded that the above two options are equally supported by those properties. For details, see Tateishi (1991: Chapter 7).

(6.13) a. Tateishi's EPC (Option 1)

b. Tateishi's EPC (Option 2)



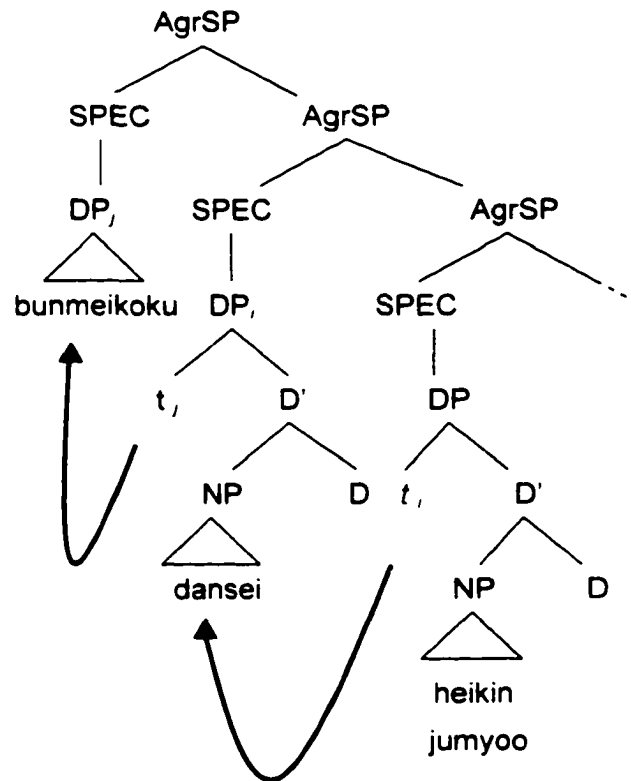
Taro-ga titioya-ga ototoo-ga nyuuin-si.
 Taro-Nom father-Nom younger brother-Nom hospitalized-was
 "It is Taro's father whose brother was hospitalized."

(Tateishi 1991: 290)

On the other hand, Ueda (1990) assumes adjunction to a special focus phrase outside IP, whereas Takahashi (1996) analyzes derivations of the EPC as involving adjunction to Agr(S)P, as schematized in (6.14).¹³⁴

¹³⁴ In her analysis, Takahashi (1996: 57, 68) makes a distinction between Individual- and Stage-Level predicates with respect to where the minor subject originates.

(6.14) Takahashi's EPC



bunmeikoku-ga dansai-ga heikin jumyoo-ga mijikai.
 civilized country-Nom male-Nom life expectancy-Nom short
 "It is civilized countries in which men's life expectancy is short."

(Takahashi 1996: 57, tree diagram partly cited)

Alternatively, some researchers have proposed that the EPC in Japanese is base-generated with the PR in a DP-external position. For example, Saito (1982, 1985) assumes that the EPC is base-generated and that nominative case is assigned to the PR inherently. Ura (1996) argues that a certain type of EPC is base-generated without involving movement (we come back to his idea below).

Another alternative is that the PR could be adjoined to the PM itself — in conjunction with the definition of checking domains proposed by Chomsky (1995, Chapter 3) — and the PR would then find itself in the checking domain of INFL, without physically raising out of the host NP in the subject position (Personal Communication, M. Den Dikken, July, 2000).

Providing that the PM is a subject, the EPC in Japanese is apparently formed freely, under no lexical constraint except for the possibility of an underlying PR-PM relation — roughly, the EPC is allowed if the NP content can support the IPC, “NP-*no* (Gen) NP-*ga* (Nom)” — and a sensible PM-predicate relation. Takahashi (1996) examines the possibilities of the EPC, using various types of predicates, as shown below: The examples in (6.15a-b) contain an intransitive and a transitive Individual-Level predicate, respectively, while the examples in (6.16a-c) contain an unaccusative, an ergative, and a transitive Stage-Level predicate, respectively.

- (6.15) a. kitahankyuu-ga bunmeikoku-ga dansei-ga
 Northern Hemisphere-Nom civilized country-Nom male-Nom
 heikin jumyoo-ga mizikai.
 life expectancy-Nom short
 “It is the Northern Hemisphere where men’s life expectancy is short in
 civilized countries.”

(Takahashi 1996: 38)

- b. raion-ga osu-ga seijuu-ga tategami-o yuusuru.
 lion-Nom male-Nom adult animal-Nom mane-Acc have
 “It is lions among which adult males have manes.”

(Takahashi 1996: 39)

- (6.16) a. Ken-ga neesan-ga shujin-ga kaidan-kara otita.
 Ken-Nom older sister-Nom husband-Nom stairs-from fell
 "It is Ken whose older sister's husband fell down the stairs."

(Takahashi 1996: 40)

- b. Ken-ga imotoo-ga ruumumeito-ga waratta.
 Ken-Nom younger sister-Nom roommate-Nom laughed
 "It is Ken whose younger sister's roommate laughed."

(Takahashi 1996: 42)

- c. Ken-ga gaaruhurendo-ga niisan-ga piano-o hiita.
 Ken-Nom girlfriend-Nom older brother-Nom piano-Acc played
 "It is Ken whose girlfriend's older brother played the piano."

(Takahashi 1996: 43)

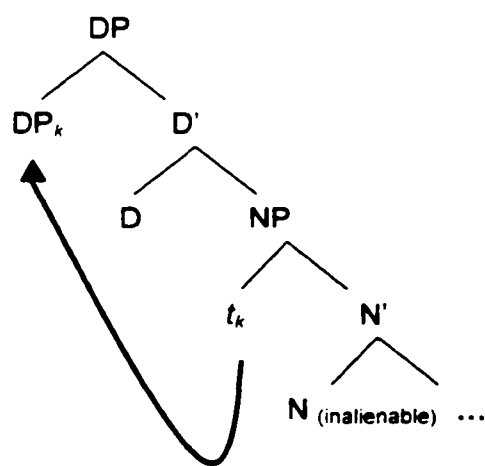
In many other languages, it is not unusual that the EPC exhibits restrictions on the types of predicates that allow the construction (see Payne and Barshi 1999). In the case of Japanese, however, all kinds of predicates appear to allow its occurrence, as shown in the above examples (see also Ura 1996: 109).

Some cross-linguistic evidence has shown that the alienability between the PR and PM plays a significant role in the EPC (see Payne & Barshi 1999; Vergnaud & Zubizarreta 1992). That is, inalienable NPs, which are often defined as being in a permanent relationship¹³⁵ with each other (e.g., kinship or property nouns, such as body parts), host the EPC more easily than alienable ones, and some languages even disallow the EPC without an inalienable relationship between the possessor and possessum NPs.

¹³⁵ See Croft (1990: 175), among others.

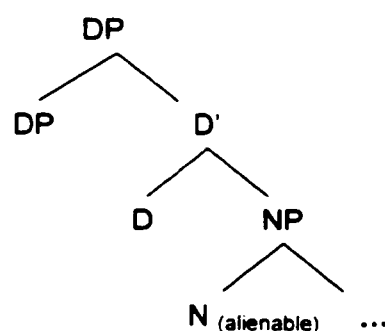
Assuming that an inalienable relationship is a permanent relationship (Croft's 1990: 175), Ura (1996) proposes that PR-raising occurs only when the intended PR-PM relation is inalienable in Japanese, but not when the relation is alienable. He assumes two different PR Θ -roles and two different D's for (in)alienable possession constructions, and further makes a distinction in the Case assignment of inalienable and alienable possession constructions. Under Ura's analysis, the syntax of these constructions differ from each other, even in the IPC: The PR of an inalienable noun is assigned the inalienable PR role and has its structural genitive Case checked off by D(Gen), whereas the PR of an alienable noun receives an alienable PR role and its inherent genitive Case from D(Poss). The underlying structures of inalienable and alienable possessive DPs in the IPC proposed by Ura are illustrated in (6.17a-b), respectively.

(6.17) a. Ura's inalienable possessive DP



(Ura 1996: 113)

b. Ura's alienable possessive DP



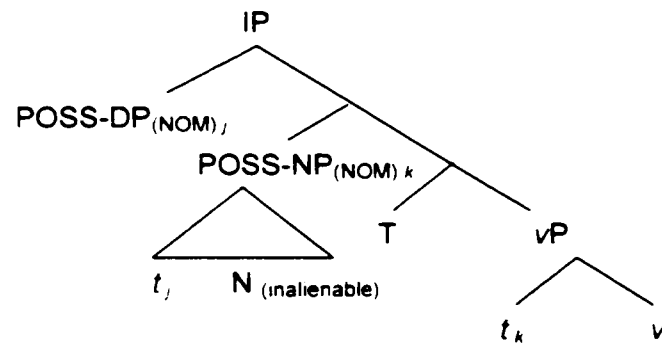
(Ura 1996: 114)

With respect to the derivation of the alienable EPC in Japanese, Ura argues that the nominatively marked DP is base-generated in a position outside of the PM subject. On the other hand, he argues that the possessor DP of the inalienable EPC can move to an outer Spec of T in order to enter into a feature checking relation, because Japanese allows its nominative Case-feature to enter into multiple checking relations, as schematized in (6.18).¹³⁶

¹³⁶ Ura's motivation depends on the contrast he obtains between the change in the acceptability of the alienable EPC from (ia) to (iia) on the one hand, and the inalienable EPC from (ib) to (iib) on the other: He observes a noticeable decrease in acceptability in the former but not in the latter. He treats alienable PRs in the same way as major subjects that do not have a possessive relationship with their PM. However, the author's native intuition completely disagrees with Ura's — (iib) is as bad as (iia), and there is no noticeable difference between the *unacceptability* of the two sentences. Note that the (un)acceptability indicated in (ii) is Ura's. The author's intuition on (i) agrees with his judgment.

- (i) a. John-ga kuruma-ga seibifuryoo-da.
Ken-Nom car-Nom ill conditioned-be
"John is such a person that his car is ill-conditioned."
(Ura 1996: 104)
- b. John-ga imooto-ga utukusi-i.
Ken-Nom younger sister-Nom beautiful-be
"John's younger sister is beautiful."
(Ura 1996: 105)
- (ii) a. * fuyu-ga John-ga kuruma-ga seibifuryoo-da.
winter-Nom Ken-Nom car-Nom ill conditioned-be
"It is in winter that John is such a person that his car is ill-conditioned."
(Ura 1996: 104)
- b. kono kurasu-ga John-ga imooto-ga utukusi-i.
this class-Nom Ken-Nom younger sister-Nom beautiful-be
"It is this class where John's younger sister is beautiful."
(Ura 1996: 105; translation modified)

(6.18) Ura's inalienable EPC



(Ura 1996: 128)

Ura identifies the derivation of the alienable EPC in Japanese with that of a certain type of major subject construction. This idea is based on part of Kuroda's (1978, 1983, 1986, 1987) proposal that in the major subject construction where no PR-PM relationship is involved, the PR subject can be base-generated in a position adjoined to S. While Kuroda assumes PR-raising for the major subject construction which involves PR-PM relationships, Ura treats the PR of the alienable EPC in the same manner as Kuroda's no possession cases. If Ura's point is that the EPC is created (and/or interpreted) more easily with an inalienability relationship than with an alienable relationship in Japanese, just as in other languages, this makes a prediction which is the opposite of what an *a priori* processing principle predicts: Even though the inalienable EPC involves an extra chain, the parser should prefer to hypothesize it in its structure-building over the alienable EPC that involves no extra chain.

Although the (in)alienability factor appears to be important for the EPC cross-linguistically, it is not as clear-cut a notion as we might hope:

[I]t is potentially embarrassing to the formal approach that speakers' judgments about things like External Possession are often not cut-and-dried or categorical in the way that formal accounts seem to predict. For example, it is well-known that in many languages there is some fuzziness in what counts as an inalienable possession, and hence some variability in what elements can feed into an EPC.

(Baker 1999: 319)

What counts as an inalienable relationship is in general considered to be an inherent or non-purchasable relationship. However, in analyzing Mohawk, Baker (1999) shows that even items such as "sock" and "car" can be treated like body-part nouns, if the PR person is wearing the socks or moving in the car in the situation described by the EPC. Thus, "inalienable" relationships can vary, depending on the language, particularly on their social and cultural aspects (Nichols 1988) or on "how a particular lexical item is used in context" (Baker 1999: 319).

The fuzziness of the threshold between inalienability and alienability raises a question with respect to how clear the line in Japanese is between them. Unlike Mohawk, for example, in Japanese, there is no noticeable difference between socks that are being worn and those that are not, in interpreting EPCs. To the author's knowledge, how (in)alienability affects the ease/difficulty of

creating and interpreting EPCs in Japanese has barely been studied. Since our exploration in Experiment 3 involves EPCs, the effect of (in)alienability on processing NP-*ga* sequences are relevant. The above issue on the notion of (in)alienability is thus reflected in our discussion in Chapter 7.

6.3 NP-*ga* as Parallel Subject: Parallel Subject Construction

The last syntactic property of -*ga* relevant to this study is its role as the parallel subject marker. While the nominative case-marker -*ga* is primarily used to mark the single grammatical subject of its own clause in the SSC, it can also be used in the so-called Parallel Subject Construction (hereafter, PSC), in which each of more than one NP-*ga* is separately a subject of the same clause, sharing the same predicate. In the report of Experiment 3 in the next chapter, we will see two types of PSCs: In one type the NP-*ga*'s are not adjacent to each other, while in the other they are adjacent in surface form, as schematized in (6.19a) and (6.19b), respectively.

(6.19) a. [s NP ₁ - <i>ga</i> ... NP ₂ - <i>ga</i> ... VP]	N-PSCs
b. [s NP ₁ - <i>ga</i> NP ₂ - <i>ga</i> VP]	A-PSCs

The reason why we will see the two types of PSCs in Experiment 3 is as follows: The sentence completion task employed in Experiment 3 asked participants to complete a natural and well-formed sentence, beginning with each of fragment

stimuli, without inserting anything in front of and in the middle of it. Participants could add anything after the fragment to complete a sentence that came first to their mind. The schemes in (6.20) are part of those sentence-initial fragment stimuli (and all the fragment stimuli are presented in the next chapter).

(6.20)	Fragment Content	Case-Marker Order	
	All distinguishable orders of {NP- <i>ga</i> , NP- <i>ga</i> , plus either NP- <i>ni</i> or NP- <i>o</i> }	- <i>ga</i> - <i>ni</i> - <i>ga</i>	- <i>ga</i> - <i>ga</i> - <i>ni</i>
		- <i>ga</i> - <i>o</i> - <i>ga</i>	- <i>ga</i> - <i>ga</i> - <i>o</i>
			- <i>ni</i> - <i>ga</i> - <i>ga</i>
			- <i>o</i> - <i>ga</i> - <i>ga</i>
	All distinguishable orders of {NP- <i>ga</i> , NP- <i>ga</i> , NP- <i>ni</i> , NP- <i>o</i> }	- <i>ga</i> - <i>ni</i> - <i>ga</i> - <i>o</i>	- <i>ga</i> - <i>ga</i> - <i>ni</i> - <i>o</i>
		- <i>ga</i> - <i>o</i> - <i>ga</i> - <i>ni</i>	- <i>ga</i> - <i>ga</i> - <i>o</i> - <i>ni</i>
		- <i>ga</i> - <i>ni</i> - <i>o</i> - <i>ga</i>	- <i>ni</i> - <i>ga</i> - <i>ga</i> - <i>o</i>
		- <i>ga</i> - <i>o</i> - <i>ni</i> - <i>ga</i>	- <i>o</i> - <i>ga</i> - <i>ga</i> - <i>ni</i>
		- <i>ni</i> - <i>ga</i> - <i>o</i> - <i>ga</i>	- <i>ni</i> - <i>o</i> - <i>ga</i> - <i>ga</i>
		- <i>o</i> - <i>ga</i> - <i>ni</i> - <i>ga</i>	- <i>o</i> - <i>ni</i> - <i>ga</i> - <i>ga</i>

To create the above fragment stimuli, logical orderings of NP-*ga*'s are considered involving an NP-*ni* (Dat) and/or an NP-*o* (Acc), i.e., "all distinguishable orders of {NP-*ga*, NP-*ga*, plus either NP-*ni* or NP-*o*}" and "all distinguishable orders of {NP-*ga*, NP-*ga*, NP-*ni*, NP-*o*}". This process generated some schemes in which two NP-*ga*'s are non-adjacent, as in the middle column in (6.20), and others in which two NP-*ga*'s are adjacent, as in the right column. Since the NP-*ga*'s were placed adjacent to each other in some fragments while they were not adjacent in

others as shown above, sentence completion responses reflect either of the two kinds of NP-*ga*'s placement at their beginnings.

When we make a distinction between the two types, we refer to the (6.19a) type as Non-Adjacent PSCs (henceforth, N-PSCs) and to the (6.19b) type as Adjacent PSCs (henceforth, A-PSCs). When we do not make an explicit distinction between the two, we simply refer to them as PSCs. In what follows, we summarize some characteristics of the types in turn. Certainly, both types are considered to be limiting cases of a general syntactic ellipsis phenomenon. However, native intuition suggests that the A-PSC is associated with a strong distributive effect. For this reason, its characteristics are summarized separately from those of N-PSCs.

6.3.1 Non-Adjacent Parallel Subject Construction

As shown in (6.20) above, the schemes in which two NP-*ga*'s are non-adjacent contain a variety of orderings of two NP-*ga*'s along with NP-*ni* (Dat) and/or an NP-*o* (Acc). Hence, sentence completion responses involving the N-PSC that started with such a variety of beginnings would result in a variety of sentences. The only commonality of those completion responses would be the two NP-*ga*'s given in a fragment stimuli are in the same clause, being interpreted as parallel subjects sharing a VP.

Let us discuss some characteristics of the N-PSC, using one of the schemes in (6.20), [NP-*ga* NP-*ni* NP-*o* NP-*ga*]. If the two NP-*ga*'s presented in

this fragment are interpreted as overt parallel subjects of the same one-clause structure (and no null elements are imposed in the middle of the fragments), sentence completion responses would include the four types in (6.21), where the NPs given in the fragment are in boldface.

- (6.21) a. {**NP₁-ga NP-ni NP-o**} {**NP₂-ga** NP-ni NP-o} V
 b. {**NP₁-ga NP-ni NP-o_i**} {**NP₂-ga** NP-ni *pro_i*} V
 c. {**NP₁-ga NP-ni_i NP-o**} {**NP₂-ga** *pro_i* NP-o} V
 d. {**NP₁-ga NP-ni_i NP-o_j**} {**NP₂-ga** *pro_i* *pro_j*} V

In (6.21a), there are two “sets” of completely visible {NP-*ga* NP-*ni* NP-*o*}, whereas the second set in (6.21b-d) involves one or more invisible *pro*’s. The sentence in (6.22) is an example of completely visible (6.21a):

- (6.22) {Jon-ga Mearii-ni Jein-o}, {Biru-ga Tomu-ni Deibu-o} shookaisita.
 John-Nom Mary-Dat Jane-Acc Bill-Nom Tom-Dat Dave-Acc introduced
 “John introduced Jane to Mary, (and) Bill (introduced) Dave to Tom.”

In N-PSCs, the two parallel sets, regardless of completely or partially visible, share a VP. For the sake of this parallelism, the sets need to be equal in status i.e., the entire set of arguments, so that they can share the same verb. (cf. this equality in status applies only to NP-*ga*’s *per se* in the A-PSC discussed below).

While sentence completion responses involving N-PSCs in Experiment 3 mostly contained two sets of arguments,¹³⁷ more sets are possible in one sentence, as shown in Kuno's (1973b) example in (6.23), in which the three sets are equivalent to one another in their status.

- (6.23) {Jon-ga Mearii-o}, {Biru-ga Jein-o}, {Tomu-ga Maasa-o} butta.
 John-Nom Mary-Acc Bill-Nom Jane-Acc Tom-Nom Martha-Acc hit
 “(lit.) John hit Mary, Bill hit Jane, and Tom hit Martha.”

(Kuno 1973b:10, gloss, symbols, and translation added)

One way to analyze N-PSCs, such as (6.23), is to consider them as a kind of verbless conjunction involving two (or more) parallel clauses, such as the one in (6.24), where the conjunction *sosite* (“and”) is not overt.

- (6.24) Jon-ga Mearii-ni Jein-o, sosite Biru-ga Tomu-ni Deibu-o
 John-Nom Mary-Dat Jane-Acc and Bill-Nom Tom-Dat Dave-Acc
 shookaisita.
 introduced
 “John introduced Jane to Mary, and Bill (introduced) Dave to Tom.”

Given that (6.24) is an instance of ellipsis involving an asyndetic coordination, we can assume that the slot of the shared element in the first conjunct is initially left empty in the overt syntax, and the shared element generated in the second conjunct is copied into the empty slot in the first conjunct in a leftward manner at

¹³⁷ Since the relevant sentence-initial fragment stimuli presented to respondents in Experiment 3 for completions contained only two non-adjacent NP-ga's, their sentence completion responses mostly contained two sets.

(6.26) NP₁-**ga** NP₂-**ga** ...

(6.27) [_S NP₁-**ga** NP₂-**ga** VP]

2 A-PSCs; No embedding

Alternatively, the sentence may result in a singly-embedded sentence containing SSCs, as in (6.28).¹³⁹

(6.28) [_S NP₁-**ga** [_S NP₂-**ga** VP] VP]

2 SSCs; 1 single embedding

Importantly, the number of clauses in a PSC sentence is minimized even though all NP-*ga*'s are simultaneously subjects, while an SSC sentence must have at least as many number of clauses as it has (overt) subjects.

Not only do adjacent parallel subjects in a sentence share the same verb, but they may also share the same object(s) and/or adjunct(s). The sentence in (6.29) is an example that has two adjacent parallel subjects associated with the same verb and postpositional phrase.

(6.29) [_S Jon-*ga* Mearii-*ga* kuruma-de yatte-kita.]
John-Nom Mary-Nom car-by came

"John and Mary (*each*) came by car."¹⁴⁰

¹³⁹ Recall that, among other possibilities, the sentence may also result in a one-clause structure with one SSC plus one NOC, or a one-clause structure with one EPC, as schematized in (ia-b), respectively.

(i) a. [_S NP₁-**ga** NP₂-**ga** VP]

**1 SSC + 1 NOC;
No embedding**

b. [_S NP₁-**ga** NP₂-**ga** VP]

**1 EPC;
No embedding**

¹⁴⁰ Note that there is no perfect English translation for A-PSC sentences, but the literal translation here is a best attempt. We will discuss this shortly.

This type of sentence is somewhat unnatural and awkward as an utterance in a normal setting. However, sentences such as (6.30) occur in a literary or poetic context.¹⁴¹ Thus, A-PSCs *do* exist in Japanese. However, since A-PSCs are rarely used in conversation, this role of *-ga* seems very exotic.

- (6.30) a. hokano nozomi-no kazukazu-ga hokano akogare-no kazukazu-ga
 other hope-of variety-Nom other longing-of variety-Nom
 watasi-ni tukimato-tte hanare-nai-no.
 I-Dat haunt-and leave-not-Emp

"Other various hopes and other various longings (*each*) haunt me and never leave me."

(Saito 1968: 205, gloss and translation added)

- b. tooi kuni-de misitta huukei-ga tokai-ga too-ga hasi-ga
 far country-in acquainted scenery-Nom city-Nom tower-Nom bridge-Nom
 omoigakenaku magatta miti-ga mukasino kamigami-no seikatu-o
 unexpectedly winding road-Nom ancient gods-Gen life-Acc
 naimazete-ita.
 weaving-were

"The sceneries, cities, towers, bridges, and unexpectedly winding roads that I saw in far countries were (*each*) synthesizing the lives of ancient gods."

(Fujikawa 1967: 169, gloss and translation added)

¹⁴¹ Various kinds of parallel constructions might also be possible, in the special contexts of poetry, speech, advertisement, and so forth. Intuitively, however, the parallelism appears to be limited to subjects, nominative objects, and adjuncts. Parallel objects marked with *-o* or *-ni* are awkward. This intuition is perhaps very subtle because parallel subjects themselves are rarely used in daily life. Some speakers judge parallel NP-*o*/*-ni* objects to be as acceptable as A-PSC (Personal Communication, A. Inoue, September, 2003). During the search for the actual examples, approximately 100 books (mainly poems) were examined, and nine A-PSC examples were found, including the three in (6.30). However, no parallel NP-*o*/NP-*ni* objects were found in this search. This is discussed in our syntactic analysis of the PSC below.

- c. ... arayuru kedamonotati-ga jumokutati-ga shokubututati-ga isseini
 all beasts-Nom trees-Nom plants-Nom all at once
 utai-dasu ...
 sing-start
 "... all beasts, trees, and plants (*each*) start to sing simultaneously ..."

(Ogasawara 1992: 214, gloss and translation added)

For the parallel subjects to share a common verb (and other common elements), referents represented by *ga*-marked NPs in A-PSCs must be equal in their status, as illustrated by *Jon* and *Mearii* in (6.29), "various hopes" and "various longings" in (6.30a), "sceneries", "cities", "towers", "bridges", and "roads" in (6.30b), as well as "bests", "trees", and "plants" in (6.30c). This requirement contrasts with the PR-PM relationship required to support the EPC. This difference in the status of NPs was important in the construction of materials for Experiment 3 (see Chapter 7).

One characteristic of an A-PSC is the distributive effect on its interpretation. Although two (or more) NP-*ga*'s are associated with the same verb, each of them is interpreted as having an independent relation with the verb: For example, the sentence in (6.29), repeated as (6.31a) below, is taken as representing an event in which "John came by his own car" and "Mary came by her own car". In this way, a sentence with A-PSCs is interpreted as if it contains an adverb *sorezore* ("each"), as parenthesized and italicized in the English translation, but the distributive effect it gives is very strong, intuitively even stronger than the sentence in (6.31b), where *sorezore* is explicit.

- (6.31) a. [_S Jon-ga Mearii-ga kuruma-de yatte-kita.]
 John-Nom Mary-Nom car-by came

"John and Mary (*each*) came by car."

- b. [_S Jon-ga Mearii-ga sorezore kuruma-de yatte-kita.]
 John-Nom Mary-Nom each car-by came

"John and Mary each came by car. /John came by car, and Mary came by the car."

Now compare the above A-PSC sentence in (6.31a) with the sentence in (6.32), in which the first NP is marked with a conjunction (particle) *-to*¹⁴² instead of *-ga*, consisting of a larger nominatively marked NP, [_{NP} *Jon-to Mearii*]-*ga*.

- (6.32) [_{NP} *Jon-to Mearii*]-*ga* kuruma-de yatte-kita.
 John-and Mary-Nom car-by came

"John and Mary came by car."

The sentence in (6.32) is typically interpreted as representing an event that John and Mary came by car in a neutral manner, and its sentential meaning is ambiguous between "John and Mary came together in one car" and "John and Mary came in two separate cars".¹⁴³ In contrast, the prominent reading of the

¹⁴² Japanese *-to* is usually translated as "and", but it is a particle. That is, in a strict syntactic sense, *-to* does not completely correspond the English conjunction "and". This characteristic of *-to* is parallel to the Latin conjunction *-que*. For example, it functions to conjoin NPs, but cannot be used to conjoin sentences. Also, *-to* is normally attached to the end of every NP in the sequence, in the form [_{NP} [NP1-*to* NP2-*to* NP3-*to* NP4(-*to*)]-*ga/-wa/-o/-ni*]. It is optionally attached to the last NP of the sequence between that NP and a given particle such as *-ga*, *-wa*, *-o* (Acc), *-ni* (Dat), and so on. Note that Japanese has more than one kind of *-to* that is morphologically identical to the one that is discussed here: the complementizer *-to* ("that"), the postposition *-to* which means "with", and *-to* that roughly corresponds to "when" or "as" in English.

¹⁴³ As the meaning of (6.32), however, "John and Mary came together in one car" is generally preferred over "John and Mary came in two separate cars". This contrasts

A-PSC sentence in (6.31a) is “John and Mary *each* came by car, *separately*”, and the separateness is highly emphasized. For the sentence in (6.32) to be interpreted unambiguously as “John and Mary came in two separate cars”, it is necessary to include a distributive adverb such as *sorezore* or *betubetuni* (“separately”), as shown in (6.33a) and (6.33b), respectively.

- (6.33) a. [_{NP} Jon-to Mearii]-ga sorezore kuruma-de yatte-kita.
 John-and Mary-Nom each car-by came

“Each of John and Mary came by car.”

- b. [_{NP} Jon-to Mearii]-ga betubetuni kuruma-de yatte-kita.
 John-and Mary-Nom separately car-by came

“John and Mary separately came by car.”

The contrast in the (in)compatibility with collective predicates between the A-PSC sentences in (6.34) and the *-to* sentences in (6.35) below clearly confirms the distributive effect associated with A-PSCs:

- (6.34) a. *Jon-ga Mearii-ga Rinkan Sentaa-no mae-ni atumatta.
 John-Nom Mary-Nom Lincoln Center-Gen front-in gathered

“(intended) John and Mary met in front of Lincoln Center.”

- b. *Jon-ga Mearii-ga Rinkan Sentaa-no mae-de atta/butukatta.
 John-Nom Mary-Nom Lincoln Center-Gen front-in met/collided

“(intended) John and Mary met/collided in front of Lincoln Center.”

with “*Jon-mo Mearii-mo kuruma-de yattekita*”, which can also be interpreted in two ways but the latter meaning is preferred.

- (6.35) a. Jon-to Mearii-ga Rinkan Sentaa-no mae-ni atumatta.
 John-and Mary-Nom Lincoln Center-Gen front-in gathered
 "John and Mary met in front of Lincoln Center."
- b. Jon-to Mearii-ga Rinkan Sentaa-no mae-de atta/butukatta.
 John-and Mary-Nom Lincoln Center-Gen front-in met/collided
 "John and Mary met/collided in front of Lincoln Center."

It is rather difficult to find a good English translation of the distributive effect obtained in the interpretation of an A-PSC. In the report of Experiment 3, it is occasionally necessary to make a distinction in the respondents' interpretations between A-PSC sentences *without* an explicit distributive adverb and those *with* an explicit distributive adverb. Therefore, we will use parenthesized and italicized "(each)" for the former type and normal font "each" for the latter type in English translations (or other appropriate translations, according to the distributive adverbs observed in responses).

Given the equivalent NP status requirement, A-PSCs seem to occur irrespective of predicate type, except for the strong incompatibility with collective predicates we saw earlier. However, consider the sentences in (6.36).

- (6.36) a. *Jon-ga Mearii-ga yasaki.
 John-Nom Mary-Nom kind
 "(intended) John and Mary are (each) kind." Intransitive Adj
- b. *Jon-ga Mearii-ga jazu-o suki-da.
 John-Nom Mary-Nom jazz-Acc fond-be
 "(intended) John and Mary (each) like jazz." Transitive Adj

is no existing literature to review. But one possible way to structurally analyze A-PSCs might be to compare them with other listing constructions in Japanese that are associated with distributive interpretations, as shown in (6.37), where the parenthesized particles are optional:¹⁴⁵

- (6.37) a. NP-*ni* NP-*ni* ...NP-*ga*
 b. NP-*ya* NP-*ya* ... NP-*ga*
 c. NP-*mo* NP-*mo* ... NP-*mo-ga*
 d. NP-*to* NP-*to* ... NP(-*to*)-*ga*
 e. NP-*yara* NP-*yara* ... NP(-*yara*)-*ga*
 f. NP-*toka* NP-*toka* ... NP(-*toka*)-*ga*
 g. NP-*dano* NP-*dano* ... NP(-*dano*)-*ga*

If we assume, given its distributive effect, that A-PSCs are a type of listing constructions in which more than one NP is simultaneously listed in the subject position, each of them being marked with *-ga*, we might be able to come up with a preliminary analysis for them. Intuitively, the distributive effect obtained from the A-PSC is much stronger than that obtained from each of (6.37a-g). This is relevant to the analysis proposed below.

Assuming that an NP is marked with *-ga* only if it is Case-licensed in the checking domain of Tense, Koizumi (1994) proposes that the neutral and

¹⁴⁵ While the last NPs in these examples are nominatively marked, these listings can carry other case-markers or postpositions. With a few exceptions, they can generally be used in any appropriate syntactic position.

non-neutral (i.e., focused) interpretations associated with *-ga* come from the structural difference in terms of where the NP-*ga* is Case-licensed, as given in (6.38):¹⁴⁶

- (6.38) a. An NP receives the exhaustive-listing interpretation only if it is Case-licensed in the Broad Checking Domain of Tense.
- b. An NP receives the neutral-description interpretation only if it is Case-licensed in the Narrow Checking Domain of Tense.

(Koizumi 1994: 225)

Koizumi defines the Broad Checking Domain of Tense as the AgrSP-adjoined position(s), and the Narrow Checking Domain as {SPEC of AgrS, SPEC of Tense}. Underlying this idea is evidence adduced by Koizumi that the regular subject in (6.39a) receives the neutral-description reading whereas the major subject¹⁴⁷ in (6.39b) yields the exhaustive-listing reading.¹⁴⁸

- (6.39) a. [AgrSP John-ga [AgrS' ... ← neutral-description
- b. [AgrSP John-ga [AgrSP ... ← exhaustive-listing

(Koizumi 1994: 225, slightly modified)

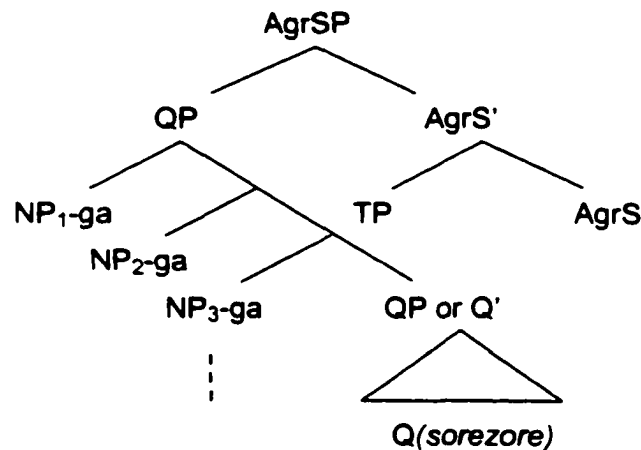
¹⁴⁶ Koizumi argues that (6.38a) applies to major subjects whereas (6.38b) applies to regular subjects and nominative objects. For details of the definitions of Broad and Narrow Checking Domains of T, see Koizumi (1994, p. 223 Footnote 7 and p. 225 Footnote 9, respectively).

¹⁴⁷ For a brief summary of "major subject", see Footnote 130.

¹⁴⁸ It is in general assumed that major subjects are in the AgrSP-adjoined (or S-adjoined) position (see Kuroda 1987; Saito 1982).

Since the interpretation of an A-PSC is very different from what we obtain from the exhaustive-listing NP-*ga*, as discussed earlier with the examples in (6.36), we may want to assume that they are Case-licensed in the Narrow Checking Domain in Koizumi's term, i.e., SPEC(AgrSP). Also, if we assume that A-PSCs are a type of listing construction, their distributive effect leads us to consider the possibility that all the NP-*ga* elements are adjoined to a quantificational phrase QP. Thus, our preliminary analysis of A-PSCs looks like the approximate illustration in (6.40):

(6.40) A-PSCs



The strong emphasis obtained on the individual relationships between each of the NP-*ga*'s and the single predicate might come from the adjoined NP-*ga*'s in an A-PSC, when compared with the other listing constructions in (6.37) which have only one *ga*-marking on the entire QP. Under the analysis proposed here, the QP to which NP-*ga*'s are adjoined in an A-PSC is considered as a Distributive

QP.

If we assume the Multiple Feature Checking Theory (Chomsky 1995; adopted for Japanese by Takahashi 1996; Ura 1996, among others), the nominative Case- and the Φ -features of each subject are checked by a unique T and AgrS, respectively.¹⁴⁹ Since multiple Nom is a function of a property of the nominative Case-feature, it can be checked off either singly or multiply. In this way, the same nominative Case can be checked repeatedly in overt syntax in Japanese. Here we propose that the above notion applies to a series of NP-ga's adjoined to a Distributive QP which sits in the SPEC(AgrS) position.

Finally, it is in general assumed that while the Nom Case-feature is [+multiple] in Japanese, the Acc and Dat Case-features are not. This contrasts with Korean, in which those Case-features are all assumed to be [+multiple].¹⁵⁰ Although special contexts such as poetry might allow various types of adjacent parallel constructions to utilize their distributive effects, the author's intuition is that the parallelism can occur with -ga (and adjuncts) but not with -o or -ni (see Footnote 141). Although this intuition is subtle, it can be taken as a piece of evidence for the preliminary analysis proposed above.

¹⁴⁹ With this assumption, the Case feature of T in languages which allow multiple subjects does not need to be deleted when checked, and is thus able to license more than one SPEC position. Assuming further that T overtly moves into AgrS via Head-to-Head movement, the nominative Case-features and the Φ -features of the subject can be checked off in the SPEC position of AgrS.

¹⁵⁰ As we have discussed in Section 6.2, there is a contrast of availability of the EPC between Japanese and Korean: Japanese allows the EPC only with the nominative Case, whereas Korean also allows it with the accusative and dative Case.

6.4 Summary of Chapter 6

This chapter summarized two of *-ga*'s syntactic and interpretive properties: *-ga* as the external possessor marker and *-ga* as the parallel subject marker. These two roles are utilized in an exploration of the ambiguity effect of *-ga*'s multiple functions on processing doubly center-embedded sentences with 3*ga* sequences, which is the subject of the next chapter. There are a total of four functions of *-ga* relevant to our interest there: the above two roles and the roles reviewed in Chapter 3, i.e., *-ga* as the single subject marker and *-ga* as the nominative object marker.

The report on Experiment 3 presented in Chapter 7 involves the characteristics of the EPC and the PSC discussed here both in the creation of materials and analyses of the response outcomes. In the materials construction, the contrast between the equality-of-status requirement for the PSC and the possession-relation requirement for the EPC was very important. To maximize the amount of information obtainable from sentence completion responses about how NP-*ga*'s are preferentially interpreted in processing, lexical content of NP-*ga* sequences in the test materials for Experiment 3 was designed to express either of the two kinds of relations. Details are spelled out in the next chapter.

For the analyses of sentence completion responses in Experiment 3, the syntactic properties of the EPC and the PSC have several important consequences, together with those of the SSC and the NOC. As reviewed in Section 1.2, it is standardly assumed that the parser is non-parameterized (e.g., Inoue & Fodor 1995), and that the parser prefers to hypothesize structure of input

as economically as possible: All else being equal, the parser prefers to postulate the minimal number of chains created by movement both in S-structure (De Vincenzi 1991, 1994) and in the non-thematic interpretive stage (Frazier 1999) because unnecessary chains are costly. The parser also prefers to expect “simple but compact structures” (Fodor 1995) and the minimal number of nodes (Frazier 1978; Frazier & Fodor 1978) because unnecessary nodes and the non-minimal tree-distance between any two adjacent words are costly.

The syntactic properties of the SSC, PSC, NOC, and EPC would be important for the parser to employ the above universal principles, and their interpretive properties are relevant in later stages of processing. Let us now see what the parser's preference is like in its structure-building when it encounters NP-*ga* sequences as linguistic input, given that these can be ambiguous between -*ga*'s multiple functions.

CHAPTER 7

STRUCTURAL PREFERENCES FOR NP-*ga*

7.1 Introduction

This chapter reports on an off-line sentence completion experiment which explored preferences among the multiple syntactic functions associated with the nominative case-marker *-ga*. Such preferences will bear on the way successive NP-*ga*'s are interpreted, and hence potentially on the explanations about processing in doubly center-embedded sentences in Japanese. The large-scale experiment generated a multitude of data, which here will be presented as five databases. These support the development of an argument about the parser's preferences in assigning structure to NP-*ga* sequences, as well as its preferences with respect to processing, more generally.¹⁵¹

While it is likely that the processing problem with English double center-embedding is due not to ambiguity, but rather to resource limitations, in the case of Japanese the possibility exists that the multiplicity of *-ga*'s potential syntactic roles might contribute to the processing difficulty that is observed. So, for example, in discussing the outcomes of Experiment 1 (see Chapter 4), we speculated that the 3*ga* cost might derive in part from the syntactic

¹⁵¹ The completion response data for which an analysis is reported in this chapter have been reported elsewhere under different analyses, to different ends. (See Uehara 1997b, 1997c, 1997d, 1997e, 1999b; Uehara & Bradley 1998, 2001.)

ambiguity of *-ga*. Opinion varies as to how an [NP-*ga* NP-*ga*] sequence is likely to be interpreted by the human sentence processing mechanism: On the one hand, each NP-*ga* might signal a new clause (e.g., Inoue 1991); on the other, the second of two consecutive NP-*ga*'s might be taken as a nominative object in the clause initiated by the first (e.g., Nagai 1995). Since *-ga* is syntactically ambiguous in this way, ambiguity would increase dramatically in a multiple *-ga* sequence, as one after another NP-*ga* phrase is encountered. Although earlier research has revealed a variety of interesting facts about Japanese sentence processing, the information available with respect to *-ga* sequences remains rather slim, and to the author's knowledge, there is no comprehensive database available which provides information about the parser's interpretative preferences for *-ga*.

Among *-ga*'s multiple syntactic functions are the four roles that we have already reviewed (see Chapters 3 and 6): NP-*ga* enters into the Single Subject Construction (SSC), the Nominative Object Construction (NOC), the External Possession Construction (EPC), and the Parallel Subject Construction (PSC). In illustration of this, consider the sentence-initial fragment in (7.1) which can be completed in the four different ways exemplified by (7.2a-d) below:¹⁵²

¹⁵² In these examples (as in all that follow in this chapter), the phrases originating in the fragment are printed in boldface, and added material is shown unbolded.

(7.1) Mearii-ga tomodati-ga ... **Fragment**
 Mary-Nom friend-Nom

(7.2) a. **Mearii-ga [tomodati-ga tazunetekuru]-to itta.** **SSC**
 Mary-Nom friend-Nom visit-that said

"Mary said that her friend will visit her."

b. **Mearii-ga tomodati-ga suki-da.** **NOC**
 Mary-Nom friend-Nom fond-is

"Mary likes her friend."

c. **Mearii-ga tomodati-ga totemo sinsetu-da.** **EPC**
 Mary-Nom friend-Nom very kind-is

"Mary's friend is very kind."

d. **Mearii-ga tomodati-ga sorezore kuruma-de yattekita.** **PSC**
 Mary-Nom friend-Nom each car-by came over

"Mary and her friend each came over by car."

If each of the *ga*-marked nouns in the fragments in (7.1) is the subject of its own clause, the resulting sentence has a single center-embedding, as shown in (7.2a). If the second of the two phrases, *tomodati-ga*, is interpreted as a nominative object rather than a subject, the sentence has a one-clause structure with a [+stative] predicate, shown in (7.2b). The sentence will also have a one-clause structure if the NP-*ga*'s stand in a possessor-possessum relationship, as in the EPC in (7.2c), or if they have "equivalent status", as in the PSC in (7.2d).

Now consider the case of a fragment that is a *3ga* sequence, as in (7.3) below. A sample of the many possible ways in which that fragment could be incorporated into a complete sentence is listed in (7.4a-e).

- (7.3) Mearii-ga tomodati-ga imooto-ga ... **Fragment**
 Mary-Nom friend-Nom younger sister-Nom
- (7.4) a. **Mearii-ga [tomodati-ga [imooto-ga naite-iru]-to itta. 3 SSCs**
 Mary-Nom friend-Nom younger sister-Nom crying-is-that
 siraseta]-to itta.
 informed-that said
 “Mary said that her friend told her that the younger sister was crying.”
- b. **Mearii-ga [tomodati-ga imooto-ga suki-da]-to itta. SSC+NOC**
 Mary-Nom friend-Nom younger sister-Nom fond-is-that said
 “Mary said that her friend likes the younger sister.”
- c. **Mearii-ga [tomodati-ga imooto-ga totemo SSC+EPC**
 Mary-Nom friend-Nom younger sister-Nom very
 sinsetu-da]-to itta.
 kind-is-that said
 “Mary said that her friend’s younger sister is very kind.”
- d. **Mearii-ga tomodati-ga imooto-ga hitoride 2 EPCs**
 Mary-Nom friend-Nom younger sister-Nom alone
 kuruma-de yatteki’ta.
 car-by came over
 “Mary’s friend’s younger sister came over by car by herself.”
- e. **Mearii-ga tomodati-ga imooto-ga sorezore 3 PSCs**
 Mary-Nom friend-Nom younger sister-Nom each
 kuruma-de yatteki’ta.
 car-by came over
 “Mary, her friend, and (someone’s) younger sister each came over by car.”

Interestingly, we see that the different structural interpretations of *-ga* result in a range of possible completions from the extremely difficult double self-embedding in (7.4a) through simplex structures in (7.4d) and (7.4e). Between these end-points lie multiple biclausal possibilities, as illustrated in (7.4b) and (7.4c).

A position that researchers have often taken with respect to incremental processing is that, all else being equal, the parser prefers to continue processing one clause when the input affords that possibility. The parser prefers to *minimally attach* new input (Frazier 1978, among others), and to hypothesize a *compact structure* (Fodor 1995). This is relevant to our investigation of the syntactic ambiguity of *-ga* because whether an additional NP-*ga* is taken to be the single subject of its clause or something else, e.g., an object (in an NOC), a possessor (in an EPC), or a parallel subject (in a PSC), means that the number of clauses to be built varies. If an extra clause is hypothesized, more nodes must be built, which is apparently non-minimal.

But to hypothesize fewer clauses for an [NP-*ga* NP-*ga* NP-*ga* ...] string, one or more of the nominatively marked phrases must be interpreted “non-transparently”, as a nominative object or an external possessor, or transparently (but rather exotically) as an additional *parallel* subject. That is, if each *-ga* in the string is taken to be playing what we take to be its prototypical role as the marker of a singleton subject, interpretive transparency conflicts with an otherwise well-motivated preference for fewer clauses. Thus, *-ga*’s multiple functions are structural competitors with each other in the parser’s hypothesis-building, in interesting and as yet unexplored ways. Analyses of

the databases emerging from Experiment 3 uncover important generalizations about the parser's preference in interpreting *-ga*. At the same time, the nature of these generalizations has consequences for general issues concerning the sensitivities of the human parsing mechanism.

The remainder of this chapter is organized as follows: Section 7.2 discusses the four NP-*ga*'s roles involved in Experiment 3 and their expected intersections with already postulated universal processing principles. Section 7.3 introduces the experimental paradigm employed in Experiment 3, namely, the sentence completion task. Section 7.4 presents the experiment and describes its method, as well as the strategies adopted for treating the data. This section also reports and discusses the results for each of the separate databases around which the experiment was organized. Finally, Section 7.5 summarizes the chapter.

7.2 NP-*ga*'s Roles and Universal Processing Principles

Let us recall some general principles that the parser is assumed to use across languages, which we summarized in (1.6) to (1.9) in Section 1.2. For convenience, these are repeated as (7.5) to (7.8) below.

(7.5) Minimal Attachment (MA):

Attach incoming material into the phrase marker being construed using the fewest nodes in consistent with the well-formedness rules of the language under analysis.

(Frazier 1978; Frazier & Fodor 1978)

(7.6) Minimal Chain Principle (MCP):

Avoid postulating unnecessary chain members at S-structure, but do not delay required chain members.

(De Vincenzi 1991: 13)

(7.7) Minimal Lowering (ML):¹⁵³

Lower only when necessary (e.g., interpret a DP in its surface position if possible.)

(Frazier 1999: 119)

(7.8) Primary over Non-Primary (PoNP):¹⁵⁴

If an element is ambiguous between an argument and an adjunct, interpret it as an argument.

(Frazier & Clifton 1996, see also Abney 1989; Gibson 1991; Pritchett 1988, 1992)

Since the current study assumes that the human language comprehension mechanism is non-parameterized, we expect to see these principles interact with structural characteristics of Japanese sentences.

¹⁵³ Frazier (1999) assumes that LF is the interface between syntax and non-thematic aspects of interpretation, and that the position of an overt copy of a lexical phrase determines its referential (non-thematic) interpretation.

¹⁵⁴ "Primary" and "non-primary" are Frazier & Clifton's (1996) terms, which refer to "argument" and "adjunct", respectively. See Section 1.2.

The principles listed above have been referred to as **Minimal Everything** (Inoue & Fodor 1995: 35). Minimal Everything also includes the following: (a) Right Association, i.e., the preference for low right attachment; (b) Late Closure, i.e., the preference to keep processing the most recently postulated phrase as far as possible; and (c) Local Attachment, i.e., the preference for a close relation between adjacent items in input. However, Inoue & Fodor (1995: 50-51) suggest that Right Association and Late Closure, strictly, do not apply in Japanese because every constituent ends with its head and phrases cannot generally be extended to the right, and that Local Attachment in effect overlaps with Minimal Attachment because non-local attachment in Japanese always disobeys Local Attachment and Minimal Attachment at the same time. For these reasons, we do not include the three.

In languages such as Japanese that are head- and complementizer-final with overt case-markers, the structural information provided through case-markers is important (see e.g., Inoue 1991; Miyamoto 2002; Uehara 1997b, c, d; Yang 1999). An overt case-marker is often the realization of more than one kind of abstract case. In the incremental parsing process, interpreting morphological case *transparently* may be an important strategy for the parser, in order to be as economical as possible. Thus, we should consider also a possible strategy briefly discussed in (1.10) in Section 1.2, repeated here as (7.9).

(7.9) Transparent Interpretation of Morphological Case:

Interpret morphological case transparently, i.e., as attesting its prototypical role.

Based on the properties of *-ga* as set out in Chapters 3 and 6, let us see what this strategy really means, relative to the already postulated principles in (7.5) to (7.7), in the particular instance of the different possible interpretations of *-ga*. A very rough summary along these lines is given in Table 7-1. In the table, the symbols “√ ” and “x” mean that the relevant principle is obeyed and violated, respectively, and the symbol “Δ” means that the outcome depends on the details of situation.

Table 7-1: -ga's Syntactic Roles and General Processing Principles

-ga	Analysis	TIMC	MA		MCP	ML	PoNP
			-ga	clause			
SSC	No movement	✓	✓	x	✓	✓	✓
PSC	Copy at LF or PF deletion	✓	✓	x	✓	Δ	✓
	Adjunction to Distributive QP	✓	x	✓	✓	x	✓
NOC	Overt movement	x	✓	✓	x	x	✓
	Covert movement	x	✓	✓	✓	x	✓
EPC	PR-raising (movement)	x	x	✓	x	x	x
	Base-generation or PR-raising (movement)	x	Δ	✓	Δ	x	x
	Adjunction (no movement)	x	x	✓	✓	x	x

Note 1: In the table, TIMC = Transparent Interpretation of Morphological Case; MA = Minimal Attachment; MCP = Minimal Chain Principle; ML = Minimal Lowering; PoNP = Primary over Non-Primary. Other abbreviations are explained in the text.

Note 2: In the case of MA, we consider implications for the NP-*ga* phrase itself (MA/-*ga*), separately from downstream implications for clause-building (MA/clause).

Transparent Interpretation of Morphological Case (TIMC) for an NP-*ga* includes SSC and PSC usages, but of these, certainly SSC is strictly the most prototypical. On the other hand, since an NP-*ga* in the NOC and the EPC does not have a subject role, such interpretations would violate TIMC. Given our earlier summaries of syntactic analyses of the four roles, TIMC can be

considered as a realization of economy principle, and it is particularly similar to the MCP, as shown in the table.

As noted in Chapters 3 and 6, syntactic analyses of *-ga* can vary, depending on the role and the analysis. In particular, the NOC is analyzed as involving either overt movement (e.g., Koizumi 1994, among others) or covert movement (e.g., Takahashi 1996, among others), and the EPC has been analyzed in three different ways: (a) overt PR-raising (e.g., Takahashi 1996; Tateishi 1991, among others); (b) base-generation for alienable relation and PR-raising for inalienable relation (e.g., Ura 1996, among others); and (c) adjunction (e.g., Saito 1982, 1985, among others).

The variety of formal analyses is reflected in our consideration for MA. While MA states its content only in terms of the number of phrasal nodes, we have to consider two points: (a) possible *local* effects of MA, on the NP-*ga* itself, and (b) possible *broader* effects, in terms of the number of clauses in the entire sentence as a consequence of different interpretations when there is more than one NP-*ga*. For example, to stay in one clause, the PSC would be helpful, but the adjunction of Distributive QP would result in an extra node. For this reason, Table 7-1 includes two columns under MA: one considers phrasal nodes arising from the interpretation of *-ga*, *per se*, and the other, the number of clauses resulting of more than one NP-*ga*.

Also, the NOC is assumed to involve either overt movement or covert movement, and analyses for the EPC vary in this respect. This divergence is reflected in table entries in the MCP column for the NOC and the EPC: If there is movement at S-Structure, the MCP is violated and processing cost is

predicted. Thus, there are two possibilities for the NOC, and three, for the EPC, as indicated in Table 7-1. Note that, for the EPC, the Δ 's in the MCP column refer to the following situation: A line of syntactic analysis relies on the notion of (in)alienability as a motivation for movement (e.g., Ura 1996), and the notion of (in)alienability is not clearly defined (for details see Section 6.2).

ML is assumed to apply within the reference module proposed by Frazier (1999, see (1.5) in Chapter 1.2 for detail). The reference module determines the non-thematic interpretation of DPs and their scope, and there the overt copy of an lexical item must be interpreted at LF. The SSC is the only interpretation that can be considered as straightforward in LF interpretation. In what we have called the N-PSC (where terms are non-adjacent), the PSC can be analyzed as an instance of ellipsis, and if copying occurs at LF, it must be interpreted there. Alternatively, if this form of the PSC is assumed to be a PF deletion phenomenon, the full structure should be the same in overt syntax and at LF. Predictions about obedience to or violations of ML therefore vary, as will the consequent predictions of associated processing cost. But in what we have called A-PSC (where terms are adjacent), the analysis discussed in Section 6.3.2 assumes Distributive QP, and this must be interpreted. In the case of the NOC, the stativity requirement for its verb would result in an exhaustive-listing interpretation of a *ga*-marked subject phrase (in addition to interpreting the nominative object as itself, as an object), but the NOC with topic subject would have no focused reading. The expected focus effect with [Subject-*ga* Object-*ga*] would be (doubly) costly because for the focus reading of the subject, not only the subject itself but also the nominative object may be

lowered (for details, see Frazier 1999, Chapters 3 & 7). Finally, EPCs have focus requirements, they would be subject to ML as well, regardless of whether which syntactic analysis of the above three is assumed.

Among the four roles of *-ga* of our current interest, the EPC interpretation would violate PoNP ("Primary over Non-Primary" in (7.8) above). That is, the PR (possessor) phrase is what is at issue here: In an EPC, N1's N2, N1 is not an argument. It is an adjunct. PoNP is also relevant to the sentence completion responses in Experiment 3, particularly to those whose fragment stimuli contained an NP-*ni* (Dat/Loc) or an NP-*wa* (Top): An NP-*ni* encountered in input can be either an argument (a datively marked indirect object or an experiencer subject) or a locative adjunct, and similarly an NP-*wa* can be a topic argument or a topic adjunct. In the case of an NP-*ni*, even though PoNP is obeyed, there is a choice whether or not to obey TIMC.

7.3 Sentence Completion Paradigm

The sentence completion paradigm employed in this investigation is an elicited production task, intended to provide information about the likely rankings the parser assigns to competing structural interpretations of ambiguous input. In the task, sentence fragments are presented in written form, and participants are asked to provide natural and well-formed completions, again in written form. There is no constraint on what can be added, other than that changes or insertions prior or internal to the material

given are disallowed, i.e., the fragments are to be taken as the beginnings of sentences.

In the analysis, the steps presumed to underlie performance in the task are in effect run backwards. That is, each completion response is examined to determine what structure had been imposed on the stimulus fragment. The assumption is that how an input stimulus has been processed constrains what can subsequently be added. In order to establish the parser's preferred ranking among competing structural options for a given input, many responses are collected for various fragment types, so that any systematicity in response patterns can be revealed.

Since Japanese is a head- and complementizer-final SOV language, it is not at all unusual that sentences should begin with a sequence of NPs, each overtly case-marked. The fragment stimuli in the investigations reported in this chapter were therefore designed to survey various combinations of case-marked NPs, with the number of NPs ranging from two to four. All but one of the stimulus fragments contained at least one NP-*ga* phrase.¹⁵⁵ Details of the actual stimulus fragments used in Experiment 3 are spelled out in Section 7.4.

In the construction of materials, caution was exercised in terms of the lexical content and the ordering of the NP-*ga* sequences. As discussed above, the SSC, NOC, EPC, and PSC are structural competitors when -*ga* is repeated. However, an EPC interpretation of an NP-*ga* string is possible only

¹⁵⁵ The exception was a fragment in which three NPs were all marked with -*wa* (Top).

when the possessor-possessum relation is lexically supported, and a PSC interpretation is possible only when NPs can be taken to have equal status. Outcomes in a small-scale pilot study¹⁵⁶ indicated that completion responses to fragment stimuli containing consecutive NP-*ga*'s were often insufficiently informative to allow the analysis to distinguish between EPC and PSC interpretations. The examples below illustrate the problem (see (7.10a)) and then illustrate a means by which that problem was subsequently minimized in the construction of materials in Experiment 3 (see (7.10b)):

- (7.10) a. **kaseihu-ga** **obaasan-ga** Takahashi-san-ni
housekeeper-Nom grandmother-Nom Takahashi-Mr./Ms.-Dat
ikiatta.
ran into
"The housekeeper's grandmother ran into Mr./Ms. Takahashi." **EPC**
"The housekeeper and the grandmother (*each*) ran into **PSC**
Mr./Ms. Takahashi."
- b. **kaseihu-ga** **sobo-ga** Takahashi-san-ni
housekeeper-Nom my grandmother-Nom Takahashi-Mr./Ms.-Dat
ikiatta.
ran into
"The housekeeper and my grandmother (*each*) ran into **PSC**
Mr./Ms. Takahashi."

¹⁵⁶ Ten native speakers of Japanese participated in this pilot study, and were asked to provide completions for each of 10 stimulus fragments. Of these 10 fragments, eight consisted of three or four overtly case-marked NPs, which included either a *2ga* or *3ga* string. NP content in these strings was compatible with a possessor-possessum relationship (for the EPC) and also with the equal status (for the PSC). The analysis found responses to be ambiguous between the EPC and PSC interpretations, 23% of the time.

In (7.10a), the *ga*-sequence *kaseihu-ga obaasan-ga* is interpretable either as “the housekeeper’s grandmother” (i.e., the EPC) or as “the housekeeper and the grandmother (*each*)” (i.e., the PSC). *Obaasan* can refer to anybody’s grandmother and there are no explicit cues included in the verb phrase to rule out either the EPC or the PSC.¹⁵⁷ In contrast, *kaseihu-ga sobo-ga* in (7.110b) is unambiguous, interpretable only as a PSC “the housekeeper and my grandmother (*each*)”, because *sobo* means “my grandmother (and nobody else’s)”. Here, since *sobo* inherently specifies its possessor, interpretation of *kaseihu* is restricted in a way that disallows the EPC (i.e., “the housekeeper’s my grandmother” is ill-formed).

The same logic applies to other instances where the second NP of an [NP-*ga* NP-*ga*] string represents an entity that cannot be possessed by an individual. Thus, “the housekeeper’s Mr. Suzuki”, “the housekeeper’s police”, and “the housekeeper’s Prime Minister” are pragmatically anomalous. Note also that the order of NPs in this kind of [NP-*ga* NP-*ga*] string is crucial: *Sobo-ga kaseihu-ga* (cf. *kaseihu-ga sobo-ga* in (7.10b)) is ambiguous between “my grandmother’s housekeeper” and “my grandmother and the housekeeper (*each*)”. The construction of materials in Experiment 3 therefore controlled both the lexical content and the order of NPs in the stimulus fragments.

In a sense there is a tradeoff between the EPC and the PSC in terms of lexical constraints. However, this tradeoff is not completely mutual, strictly

¹⁵⁷ Another reading of *obaasan*, referring to *any* elderly woman, has no impact on the availability of a PSC in (7.10a) but is not felicitous for an EPC. We set this detail aside.

speaking: The EPC is possible only when supported by lexical content suited to the possessor-possessum relationship. Absent that relationship, the EPC is ruled out (or at least strongly discouraged), and the SSC, NOC, and PSC are competitors in the parser's structure-building. On the other hand, a fragment supporting the possessor-possessum relationship can permit the EPC but not rule out the PSC, if the NPs can be interpreted as having equal status. For fragments of this type, the EPC as well as the SSC, NOC, and PSC, are competitors. For materials construction, then, stimulus fragments were basically of two types (specified in detail later): One type permitted the EPC, and the other clearly discouraged it.

7.4 Experiment 3: Structural Preferences for NP-ga Inputs

Method

Participants

Eighteen native speakers of Japanese (average age 32 years) participated in the experiment. They were either graduate students or faculty members of the School of Education, at Gunma University in Japan. They were told that the purpose of the experiment was to investigate how native speakers of Japanese understand Japanese sentences. It usually took no more than one hour to complete the task. Participants were paid 1,000 yen for their participation.

Materials

Test materials for Experiment 3 consisted of 34 sentence-initial fragments. These stimulus fragments fell into two subsets (which we refer to as the Core Stimulus Subset and the Supplementary Stimulus Subset), distinguished from each other in terms of the types of case-markers on NPs. The Core Stimulus Subset (N=24) was made up of fragments having NPs marked with *-ga* (Nom), *-ni* (Dat / Loc), and *-o* (Acc), while NPs in fragments of the Supplementary Stimulus Subset (N=10) were marked only with either *-ga* or *-wa* (Top). Care was taken to pseudorandomize fragments in the questionnaire's list order, so that subjects did not encounter adjacent fragments of a similar type.

Let us now consider the two materials subsets in detail. Table 7-2 below schematizes the fragment types that made up the Core Stimulus Subset. Fragments that included two non-adjacent NP-*ga* phrases or one NP-*ga* phrase appear in the middle column, and those that had two adjacent NP-*ga* phrases, in the right column.

Table 7-2: Fragment Types in Core Stimulus Subset (N=24), Experiment 3

Fragment Content	Case-Marker Order	
All distinguishable orders of {NP- <i>ga</i> , NP- <i>ga</i> , plus either NP- <i>ni</i> or NP- <i>o</i> }	(1) <i>-ga -ni -ga</i> (2) <i>-ga -o -ga</i>	(9) <i>-ga -ga -ni</i> (10) <i>-ga -ga -o</i> (11) <i>-ni -ga -ga</i> (12) <i>-o -ga -ga</i>
All distinguishable orders of {NP- <i>ga</i> , NP- <i>ga</i> , NP- <i>ni</i> , NP- <i>o</i> }	(3) <i>-ga -ni -ga -o</i> (4) <i>-ga -o -ga -ni</i> (5) <i>-ga -ni -o -ga</i> (6) <i>-ga -o -ni -ga</i> (7) <i>-ni -ga -o -ga</i> (8) <i>-o -ga -ni -ga</i>	(13) <i>-ga -ga -ni -o</i> (14) <i>-ga -ga -o -ni</i> (15) <i>-ni -ga -ga -o</i> (16) <i>-o -ga -ga -ni</i> (17) <i>-ni -o -ga -ga</i> (18) <i>-o -ni -ga -ga</i>
All possible orders of {NP- <i>ga</i> , NP- <i>ni</i> , NP- <i>o</i> }	(19) <i>-ga -ni -o</i> (20) <i>-ga -o -ni</i> (21) <i>-ni -ga -o</i> (22) <i>-o -ga -ni</i> (23) <i>-ni -o -ga</i> (24) <i>-o -ni -ga</i>	

Note 1: NP-*ga* = Nom, NP-*ni* = Dat / Loc, NP-*o* = Acc

Note 2: Fragment numbering in the table does not reflect presentation order in the questionnaire proper.

The 24 fragments in the Core Stimulus Subset included 12 fragments containing three NPs and 12 fragments containing four NPs. These appear in Table 7-2 with sectioning and numbering designed for ease of exposition in what follows. The core fragments fall into three types, assembled in the following way to maximize the reach of the survey in Experiment 3: (i) six fragments containing three NPs (here numbered 1–2, 9–12) exhaust the

distinguishable orderings of {NP-*ga*, NP-*ga*, plus either NP-*ni* or NP-*o*}; (ii) 12 fragments containing four NPs (here numbered 3–8, 13–18) exhaust the distinguishable orderings of {NP-*ga*, NP-*ga*, NP-*ni*, NP-*o*}; and (iii) the remaining six fragments containing three NPs (here numbered 19–24) exhaust the possible orderings of {NP-*ga*, NP-*ni*, NP-*o*}.¹⁵⁸ This last type contains no repetition of NP-*ga*.

Of the 24 schemes shown in the above table, 18 contained two NP-*ga*'s, and among these, 8 contained two NP-*ga*'s non-adjacently (Fragments 1–8), whereas the remaining 10 had two adjacent NP-*ga*'s (Fragments 9–18). Thus, while completion responses to Fragments 1–8 may involve Non-Adjacent PSCs (N-PSCs), those to Fragments 9–18 may involve Adjacent PSCs (A-PSCs).

In the construction of materials, in which only one stimulus fragment was created for each schema in Table 7-2, care was taken in the assignment of lexical content, particularly with respect to the two aspects discussed earlier: NP content and NP order. First, NPs in the stimulus fragments uniformly selected human referents, these falling into three functional categories: Role terms (e.g., “doctor”, “acquaintance”), kinship terms (e.g., “cousin”, “grandmother”), and proper names (e.g., “Yukio”, “Mr. Takahashi”). Lexical items were inserted into the schema, under a constraint disallowing items of

¹⁵⁸ Note that the particle *-o* (Acc) marks only direct objects, whereas the *-ni* marker has three functions relevant to this experiment: Prototypically, the *-ni* particle marks indirect objects; however, *-ni* (Dat) also marks experiencer subjects, and a homophonous postposition exists which is used locatively, e.g., “for”, “to”, or “among”. That is, a *ni*-marked phrase can be either an argument (indirect object, experiencer subject) or an adjunct (locative).

the same functional type to be adjacent.

Further, the lexical content in fragments with two NP-*ga*'s was designed to discourage EPC interpretations, i.e., NP content was not compatible with a possessor-possessum relationship between adjacent NPs.¹⁵⁹ For a full list of test stimulus fragments, see Appendix K-1 (Japanese original) and K-2 (English translation).

Let us now consider fragments in the Supplementary Stimulus Subset, schematized in Table 7-3 below. Fragments including adjacent NP-*ga* or adjacent NP-*wa* phrases appear in the right column. The 10 stimulus fragments in this subset had NPs all marked with either -*ga* or -*wa* (Top). Overtly case-marked objects such as NP-*o* or NP-*ni* were absent.¹⁶⁰

¹⁵⁹ With respect to content, this requires "housekeeper-*ga* my grandmother-*ga*", but not "housekeeper-*ga* grandmother-*ga*"; and with respect to order, "housekeeper-*ga* my grandmother-*ga*", but not "my grandmother-*ga* housekeeper-*ga*".

¹⁶⁰ Note, however, that since the -*wa* marker topicalizes various constituents, NP-*wa* can be interpreted as, e.g., topicalized object or locative phrase, in addition to its interpretation as topicalized subject. This is relevant to our discussion.

Table 7-3: Fragment Types in Supplementary Stimulus Subset (N=10), Experiment 3

Fragment Content	Case-Marker Order	
EPC-discouraging -ga/-wa fragments	(25) -wa -ga	(27) -ga -ga
	(26) -ga -wa -ga	(28) -ga -ga -ga
		(29) -wa -wa -ga
	(30) -wa -ga -wa	(31) -ga -wa -wa
EPC-encouraging -ga/-wa fragments		(32) -wa -wa -wa
		(33) C-ga H-ga I-ga
		(34) C-wa H-ga I-ga

Note 1: NP-ga = Nom, NP-wa = Top, C = collective, H = human, I = inanimate

Note 2: As before, fragment numbering in the table does not reflect presentation order in the questionnaire proper.

Of these, eight fragments (numbered 25–32) discouraged the EPC interpretation, using the same means employed for the Core Stimulus Subset, and the remaining two fragments (numbered 33–34) explicitly invited the EPC interpretation.

For Fragments 33 and 34, the EPC interpretation was encouraged by lexical content in adjacent NP slots supporting the possessor-possessum relationship. Given this content, each fragment could be interpreted as having one double EPC (NP1's NP2's NP3), or either of two single EPCs (i.e., NP1's NP2 or NP2's NP3). And, while the NP content of the EPC-discouraging Fragments 25–32 employed only human-referent terms, the third NP in Fragments 33–34 used lexical content with inanimate reference

(hence, the notation H (human) and I (inanimate) in Table 7-3).¹⁶¹ The EPC interpretation is here an available structural option along with the SSC and the NOC, while the PSC is ruled out by unequal status (human/ inanimate) of the referents of NP2 and NP3.¹⁶²

For a full list of test stimulus fragments for the Supplementary Stimulus Subset, see Appendices L-1 and L-2 for the Japanese original and its English translation, respectively.

Procedure

In Experiment 3, participants were asked to devise a natural and well-formed sentence completion for each stimulus fragment. The instructions emphasized that no changes or insertions were allowed, prior to or internal to the fragment. Participants were also instructed to respond promptly, not spending too much time per completion, but rather writing down what first came to mind. Practice examples and test materials were all

¹⁶¹ For exploration purposes, Fragments 33-34 were modeled after Kuno's (1973a) famous EPC example, given in (i):

(i) bunmeikoku-ga dansei-ga heikinjumyo-ga mijikai.
civilized country-Nom male-Nom average-lifespan-Nom short-is

"Civilized country's males' lifespan is short."

(Kuno 1973a: 34, gloss and translation added)

As noted earlier (Section 6.2), Kuno offered this sentence as an example of what he termed the "Multiple Subject Construction (MSC); the External Possessor Construction terminology is a recent innovation. The EPC corresponds to the "genitive-driven" type of Kuno's MSC.

¹⁶² In addition to this constraint, the *-wa* marking on NP1, affording a status not equal to *ga*-marked NP2, effectively rules out a PSC reading for Fragment 34.

presented in normal Japanese script, in a booklet. Each stimulus fragment was presented horizontally as shown in (7.11), and subjects wrote whatever they wanted to add in the provided space from left to right.¹⁶³

(7.11) 小学生が姉に杉田先生を_____

Data Treatment

The analyses in Experiment 3 focused on the structure imposed on the stimulus fragment in each completion response. The assessment of sentential structure considered the internal structure of each clause as well as to the placement of clause boundaries. What is chiefly at issue is which of the SSC, NOC, PSC, and EPC interpretations was given to each NP-*ga* phrase, and the data tables that follow summarize a count of response frequencies of these items. In these tables, the SSC category means that each of two (non)adjacent *-ga* phrases was interpreted as subject of its own clause; the PSC category means that the second of two (non)adjacent *-ga* phrases was used as a subject parallel to that created by the first *-ga* phrase (strictly, A-PSCs when those *-ga* phrases were adjacent, and N-PSCs when they were non-adjacent, but the tables simply use the PSC label); and the

¹⁶³ Subjects were told that even though two lines were allowed for each completion, the length of their responses did not matter. Some responses were very short, while others went so far as to add a second sentence to the completed original.

NOC category means that one *-ga* phrase was used as a nominative object.¹⁶⁴

When a completion response was ambiguous between the SSC, PSC, and NOC categories, it was separately tabulated as “ambiguous” (AMB).

When a response was either incomplete or incomprehensible, it was tabulated as “Error”. The example in (7.12) illustrates such a response:

- (7.12) * **Yukio-ga koohai-ni** [s: [s **otooto-ga buin-o**
 Yukio-Nom junior student-Dat younger brother-Nom club member-Acc
 nagutta]-to] k yoosi-kara hahaoya-ni denwa-ga atta.
 hit-that teacher-from mother-to phone call-Nom came
 “Yukio .. ? .. the junior student .. ? .. a phone call that the younger brother
 hit a club member came from the teacher to the mother.”

In (7.12), the last two NPs of the fragment, *otooto-ga buin-o*, are used as the subject and object of an embedded clause, respectively, as indicated. Clearly, this embedded clause was intended to mean “The younger brother hit a club member”. It appears to be embedded under another clause, “[s A phone call [s: that ...] came from the teacher to the mother.]”. This being so, the first two NPs given in the fragment have no clause to belong to. Thus, the problem with the participant’s response seems to be that he failed to complete the verb phrase required in the outermost clause, e.g., ...]-to *itta* (“told that ...”).

¹⁶⁴ Although it is logically possible to interpret either or even both of two NP-*ga*’s as NOC(s), no such cases emerged in Experiment 3. All of the NOC interpretations observed used the first and second of the two *ga*-phrases as subject and nominative object, respectively. The label “NOC” indicates responses of this kind.

Results and Discussion

In this section, analyses of the sentence completion task are presented and discussed. A total of 612 sentence completion responses (34 fragments x 18 subjects) is divided up into five databases, Databases A to E, as shown in Table 7-4, where the numbering of fragments corresponds to those in Tables 7-2 and 7-3. Of the five databases, only Database D has two sub-datasets. The fragments in Databases A to C are the Core Stimulus Subsets (see Table 7-2), and those in Databases D and E, the Supplementary Stimulus Subsets (see Table 7-3). In what follows, we will discuss these databases, in turn, in support of a developing argument.

Table 7-4: Five Databases of Experiment 3

Database	Fragments		# of Responses
A	F1–8	3 or 4 NPs with 2 non-adjacent NP- <i>ga</i> 's	144
B	F9–18	3 or 4 NPs with 2 adjacent NP- <i>ga</i> 's	180
C	F19–24	3 NPs with 1 NP- <i>ga</i>	108
D	F25–29	EPC-discouraging - <i>ga</i> final fragments with 2 or 3 NPs	90
	F30–32	EPC-discouraging - <i>wa</i> final fragments with 2 or 3 NPs	54
E	F33–34	EPC-encouraging 3 <i>ga</i> fragment EPC-encouraging 1 <i>wa</i> + 2 <i>ga</i> fragment	36

Database A: Interpretation of NP-ga, Evidence 1

A first cut of the sentence completion data considered responses to Fragments 1–8 of the Core Stimulus Subset, i.e., those fragments containing two non-adjacent NP-ga phrases. Among 144 responses (18 participants x 8 items), it was possible to establish a unique structural role imposed on NP-ga phrases in 95.8% of the sentence completions (i.e., 138 of 144).¹⁶⁵ Table 7-5 below presents a summary of structural interpretations of NP-ga in these fragments.

Table 7-5: Structural Interpretations of NP-ga in Fragments Containing Non-Adjacent -ga Phrases (N=8)

Fragment Scheme	SSC	NOC	PSC	AMB	Error
(1) -ga -ni -ga	18	–	–	–	–
(2) -ga -o -ga	16	–	1	1	–
(3) -ga -ni -ga -o	15	–	1	–	2
(4) -ga -o -ga -ni	17	–	1	–	–
(5) -ga -ni -o -ga	17	–	1	–	–
(6) -ga -o -ni -ga	17	1	–	–	–
(7) -ni -ga -o -ga	16	–	–	–	2
(8) -o -ga -ni -ga	15	1	1	–	1
	131	2	5	1	5

¹⁶⁵ One response (0.7%) was set aside because it was ambiguous between the SSC and NOC categories, and a further 3.5% (i.e., 5 of 144) were unanalyzable because responses were incomplete or incomprehensible.

As a first finding, what we see in the table is that 94.9% of the analyzable responses gave an SSC interpretation to each NP-*ga* in the string, i.e., each acted as the single subject of its (separate) clause.

A second finding is that among the very few exceptions to the SSC interpretation, the PSC was at least as likely as the NOC (5 in total for the PSC, 3.9% of the sample, versus 2 for the NOC plus 1 possible additional case exhibiting an SSC/NOC ambiguity). This is interesting, given the fact that at least one NP with object marking (*-ni* (Dat) or *-o* (Acc)) intervened between the *ga*-marked phrases in the fragments providing Database A: The PSC interpretation is in a very real sense not straightforward in these cases because the NP-*ga*'s in the fragments were non-adjacent. However, the PSCs produced here involved those intervening items, as part of parallel argument sets. As we see in the table's fragment schemes, only NP-*ga* phrases occur more than once in the material given by a fragment. Therefore, to show parallel readings of the *-ga* phrases, extra arguments (either overt or covert) that were themselves parallel to non-subject phrases already given had to be added. Consider, for example, the N-PSC completion response in (7.13), and the efforts made by the writer to make the intended parallelism clear:

- (7.13) {**oji-ga** **kachoo-ni** **Sato-san, -o**} {**roosinsi-ga**
 my uncle-Nom section chief-for Sato-Mr./Ms.-Acc elderly gentleman-Nom
 buchoo-ni-to *pro* , } *suisensita*.
 department chief-for-Emp recommended
 "My uncle recommended Mr./Ms. Sato, for the section chief, and the elderly
 gentleman recommended (*him_i*) for the department chief."

In this response, a parallelism between NP1-*ga* and NP4-*ga* was achieved by grouping the first three NPs of the stimulus fragment {*oji-ga kachoo-ni Sato-san-o*} into one "set" of arguments, and supplementing the fragment's second NP-*ga* with the addition of yet one more *ni*-marked phrase and a null object to create an equivalent second "set", {*roosinsi-ga buchoo-ni pro*}; the null object's antecedent is NP-*o* of the first set. These parallel sets are simultaneously associated with the ditransitive verb *suisensita* in an elegant (if complicated) simplex sentence. Thus, via its use of a double {subject – indirect object – direct object} construction, the structure counts here as an N-PSC. Intuition suggests that the writer included an extra indirect object and the emphatic particle *-to* to sharpen the intended interpretation of the two NP-*ga*'s as simultaneous subjects, i.e., to make the parallelism clear. Notice that (7.13) corresponds to (6.21b), repeated as (7.14b); it is an instance of the four structures discussed in Section 6.3.1, as examples of N-PSC responses.

- (7.14) a. {**NP₁-ga** **NP-ni** **NP-o**} {**NP₂-ga** NP-ni NP-o} V
 b. {**NP₁-ga** **NP-ni** **NP-o_i**} {**NP₂-ga** NP-ni *pro_i*} V
 c. {**NP₁-ga** **NP-ni_i** **NP-o**} {**NP₂-ga** *pro_i* NP-o} V
 d. {**NP₁-ga** **NP-ni_i** **NP-o_j**} {**NP₂-ga** *pro_i* *pro_j*} V

In some instances, however, the effort to show the parallel-subject interpretation of multiple *-ga* phrases resulted in N-PSCs that were less than entirely natural, as illustrated in the following response shown in (7.15).

- (7.15) {**otooto-ga** **Keiichi, -o**} {**yopparai-ga** Keiji, -o} [_{NP} [_S *pro* _{i,j} (Subj)]
 younger brother-Nom Keiichi-Acc drunk man-Nom Keiji-Acc
 oborete-ita]-no]-o tasuketa.
 drowning-were-situation-Acc saved
 “The younger brother saved Keiichi and a drunk man saved Keiji when they were drowning.”

In this response, an accusatively marked NP *Keiji-o* is added so that the resulting structure contains a double {subject – object} string; the two NP-*ga*'s in the string jointly control the *pro* subject of the embedded verb *oborete-ita*. The addition of a second object phrase succeeds in making the N-PSC complete, but the sentence is awkward, exactly because there are two objects, *Keiji-o* and the added *Keiichi-o*, and an embedded clause. In a sentence without such parallelism, a natural expression would have had the form “A-*ga* [B-*ga oboreteita*]-no-o *tasuketa*”, meaning “A rescued B, when he_i was drowning”. (The response would have been perfectly natural if it had simply “{A-*ga* B-o} {C-*ga* D-o} *tasuketa*”, with the embedded clause omitted.)

A third finding is that NP-*ga*'s are rarely interpreted as nominative objects even though NOCs are used quite commonly in daily conversation. While the N-PSC required the addition of arguments to create complete parallel sets, a different type of effort seems to have been required for the NOC interpretation. The two completion responses unambiguously employing the NOC suggest

what the requirement might have been like, for the fragments of Database A.

Consider first the NOC response shown in (7.16):

- (7.16) **hisho-o**, **Naito-san -ga** *t*_i [s' [s **kakarichoo-ni** **kodomo-ga**
 secretary-Acc Naito-Mr./Ms.-Nom section chief-Dat child-Nom
 ippai aru]-to] odorokaseta.
 many have-that surprised
 "Mr./Ms. Naito surprised the secretary (saying) that the section chief has many children."

Here, the second NP-*ga* (*kodomo-ga*) of the stimulus fragment was employed as a nominative object, licensed by the [+stative] verb *aru*. The immediately preceding NP-*ni* was interpreted, not as a prototypical indirect object, but as an experiencer subject, hence, dative-marked. The second instance of the NOC interpretation, shown in (7.17), also has a special interpretation for an NP-*ni*:

- (7.17) **senmu-ga** **Kanai-san, -o** [NP [s' [s *pro* , (Subj)
 managing director-Nom Kanai-Mr./Ms.-Acc
sinseki-ni **tokuisaki-ga** takusan tukur-eru-kamosirenai]
 relative-among good customers-Nom many make-able-might
 toiu] riyuu]-de sono posuto-ni tuketa.
 that reason-for that post-in put
 "The managing director appointed Mr./Ms. Kanai to that position for the reason that he may be able to make many good customers among his relatives."

In (7.17), the second -*ga* phrase of the fragment (*tokuisaki-ga*) appears as an NOC in the embedded clause, which contains a *pro* subject controlled by the

object of the matrix clause, *Kanai-san*. The nominative object interpretation of *tokuisaki-ga* is indicated by the use of potential *-eru* ("able") as part of the embedded verb *tukuru* ("make"), to form a complex [+stative] predicate. Here, the fragment's *ni*-marked NP (*sinseki-ni*) is interpreted not as an indirect object (i.e., NP-Dat) but rather as a locative phrase (i.e., NP-Loc) meaning "among (his) relatives". That is, an adjunct interpretation is favored over an argument interpretation, the PoNP being disobeyed.

It may be that general processing principles underlie the outcomes we have seen above. Table 7-6 is a simplified summary of this consideration.

Table 7-6: General Principles and NP-*ga* Interpretation, Database A

-ga	Analysis	TIMC	MA		MCP	ML	PoNP
			-ga	clause			
SSC	No movement	✓	✓	2 +	✓	✓	✓
PSC	Copy at LF or PF deletion	✓	✓	2 +	✓	Δ	✓
NOC	Overt movement	x	x	1 +	x	x	✓
	Covert movement	x	x	1 +	✓	x	✓

The SSC interpretation of each NP-*ga* is consistent with TIMC and at the same time with all the principles we are interested in, except for the number of

clauses. The smallest number of clauses of the resulting sentence associated with the SSC and the N-PSC is two: SSC interpretation must result in *at least* one matrix plus one subordinate clause, and the N-PSC, two conjoined clauses (one of which is invisible). The N-PSC interpretation differs from the SSC only with respect to the ML: The invisible clause must be interpreted. On the other hand, the NOC is not helpful except for the number of clauses of the resulting sentence. Here, the preference ranking emerging in the summary data in Table 7-5 naturally falls out.

Since the ranking itself does not explain the very large difference between the overwhelming SSC interpretation and the small amount of the N-PSC and the NOC interpretations, let us consider what this pattern might come from. The number of clauses in the resulting sentences might not be a problem: In no case would there be more than two identical syntactic positions, adjacently, nor would more than one embedded clause be necessary. The disadvantages of the NOC interpretation may be explained by the implied accumulation of violations: the MCP, MA (with respect to *-ga*), and ML. Moreover, the fragments of the fragments of Database A included NP-*o* and/or NP-*ni* phrases, blocking the NOC interpretation of NP-*ga* within the same clause: NP-*o* is already and unambiguously a direct object, and few [+stative] predicates take two internal arguments, i.e., NP-*ga* (object) and NP-*ni* (indirect object). This means, then, that the NOC interpretation actually requires a new clause, in which the NP-*ni* phrase clausemate must be interpreted non-transparently as an experiencer subject or as a postpositional phrase (i.e.,

“non-primary” rather than “primary”), as seen in (7.16) and (7.17), above.¹⁶⁶

The N-PSC is assumed to involve either copying at LF or PF deletion: If it involves copying at LF, this might be costly with respect to the ML; and if it involves PF deletion, recovering the structure from null PF form might be costly for the parser. In the case of sentences that do not have complete overt parallel sets involving one or more null argument, as in (7.15b-c), interpreting (and/or postulating) control relation(s) might also be subject to limitation on resource consumption.

Database B: Interpretation of NP-*ga*, Evidence 2

Database B consists of a total of 180 sentences, the completion responses from 18 participants for each of 10 fragments containing the two *adjacent* NP-*ga*'s in Fragments 9-18. For 94.4% of those responses, (i.e., 170 of 180), it was possible to assess the structural role imposed on the NP-*ga* phrases.¹⁶⁷

Table 7-7 presents a summary of the outcomes for Database B. The conventions of the table are identical to those of Table 7-5 earlier. Note, however, that since the fragments of interest here contained adjacent -*ga*

¹⁶⁶ In fact, the completion response in (7.16) is the only instance in Database A in which a fragment's NP-*ni* was interpreted as an experiencer subject. There were 6 instances in which NP-*ni* was interpreted as a postpositional phrase.

¹⁶⁷ 4.4% of responses (i.e., 8 of 180) were incomplete or incomprehensible, and a further 1.1% (i.e. 2 of 180) was ambiguous between the categories of analysis.

phrases, A-PSCs (rather than N-PSCs) are relevant now.

Table 7-7: Structural Interpretations of NP-*ga* in Fragments Containing Adjacent -*ga* Phrases (N=10)

Fragment Scheme	SSC	NOC	PSC	AMB	Error
(9) - <i>ga</i> - <i>ga</i> - <i>ni</i>	17	–	1	–	–
(10) - <i>ga</i> - <i>ga</i> - <i>o</i>	18	–	–	–	–
(11) - <i>ni</i> - <i>ga</i> - <i>ga</i>	16	–	–	2	–
(12) - <i>o</i> - <i>ga</i> - <i>ga</i>	14	–	3	–	1
(13) - <i>ga</i> - <i>ga</i> - <i>ni</i> - <i>o</i>	16	–	2	–	–
(14) - <i>ga</i> - <i>ga</i> - <i>o</i> - <i>ni</i>	18	–	–	–	–
(15) - <i>ni</i> - <i>ga</i> - <i>ga</i> - <i>o</i>	16	–	–	–	2
(16) - <i>o</i> - <i>ga</i> - <i>ga</i> - <i>ni</i>	13	–	3	–	2
(17) - <i>ni</i> - <i>o</i> - <i>ga</i> - <i>ga</i>	12	–	5	–	1
(18) - <i>o</i> - <i>ni</i> - <i>ga</i> - <i>ga</i>	14	–	2	–	2
	154	0	16	2	8

For the fragments generating Database B, 90.6% of analyzable responses (154 of 170) gave an single subject interpretation to each NP-*ga*, i.e., each was used as the sole subject of its own clause. Thus, just as in Database A, the overwhelming preference was for SSCs. All 16 exceptions to the SSC interpretation (9.4% of the analyzable sample, cf. 3.9% for fragments with *non-adjacent* -*ga* phrases, earlier) took the form of sentences with (adjacent) parallel subjects. This is exemplified by the response in (7.18).

- (7.18) **Tanaka-san-ni , tomodati-o , dooryoo-ga Keiko-ga**
 Tanaka-Mr./Ms.-Dat friend-Acc co-worker-Nom Keiko-Nom
- Yosiko-ga Takako-ga minna-ga *t, t,* atae-yooto-siteita.
 Yoshiko -Nom Takako-Nom everyone-Nom give-to-trying-was
 Takako-ga minna-ga *t, t,*
 Takako-Nom everyone-Nom
- "The co-workers, Keiko, Yosiko, Takako, and everyone (*each*) tried to find friends for Mr./Ms. Tanaka."

The completion response in (7.18) is particularly insistent in its PSC interpretation: It contains *five* PSCs in total, three extra *-ga* phrases (*Yoshiko-ga Takako-ga minna-ga*) having been added to the two NP-*ga*'s of the fragment.¹⁶⁸ Just as *minna-ga* in the response above emphasizes the PSC interpretation, there were other responses that added not only more NP-*ga*'s but also other terms reinforcing the multiplicity of subjects, e.g., *aituide* ("one after another"), *kozotte* ("unanimously, in a troop"). Certainly, the adjacent *-ga* phrases of the fragments now under consideration allow the PSC interpretation to apply straightforwardly (without the requirement to create parallel sets), and it is perhaps not surprising that the PSC occurs more than twice as often as in fragments with non-adjacent *-ga* phrases.

In contrast with the 9.4% occurrence rate for the A-PSC, an NOC interpretation was not applied unambiguously to any of the *-ga* phrases in this set of fragments. However, the two ambiguous responses of Database B have an NOC reading alternating with SSC. The sentence in (7.19) is one

¹⁶⁸ Alternatively, the parallel subjects could be interpreted as being in apposition (e.g., *dooryoo = Keiko; Yoshiko; Takako; minna*). The author's intuition, however, suggests a strong distributive effect associated with this sentence, so that *doryoo, Keiko, Toshiko, and Takako* are all different individuals.

such response, and its possible interpretations are given in (7.20).

(7.19) **Watanabe-san-ni haha-ga kenji-ga** doomo kiniir-anai yoosu-da-to itta.

(7.20) a. **Watanabe-san-ni, haha-ga t_i [s kenji-ga**
 Watanabe-Mr./Ms.-Dat my mother-Nom prosecutor-Nom
 doomo pro_{jk} (Obj) kiniir-anai yoosuda]-to itta.
 somehow like-not seem-that said
 "My mother _{i} told Mr. Watanabe that the prosecutor somehow seems not to like her _{i} /someone/something."

b. **Watanabe-san-ni, haha-ga t_i [s pro_{jk} (Subj)**
 Watanabe-Mr./Ms.-Da my mother-Nom
kenji-ga doomo kiniir-anai yoosuda]-to itta.
 prosecutor-Nom somehow like-not seem-that said
 "My mother told Mr./Ms. Watanabe that she/someone seems somehow not to like the prosecutor."

c. pro (Subj) **Watanabe-san-ni [s haha-ga kenji-ga**
 Watanabe-Mr./Ms.-Dat my mother-Nom prosecutor-Nom
 doomo kiniir-anai kiniir-anai yoosuda]-to itta.
 somehow like-not like-not seem-that said
 "I /someone told Mr./Ms. Watanabe that my mother seems somehow not to like the prosecutor."

As shown in (7.20a), an SSC reading of the fragment's two NP-*ga* phrases is possible; *haha-ga* and *kenji-ga* can be interpreted as subjects of the matrix and embedded clauses, respectively, and the embedded clause takes a *pro* object. But alternative NOC readings are also possible, since the embedded

clause uses a [+stative] verb, *kiniiru* (in its negative form).¹⁶⁹ Therefore, a second possibility is to interpret *haha-ga* as the matrix subject and *kenji-ga* as the nominative object of the embedded clause, which has a *pro* subject, as shown in (7.20b).¹⁷⁰ A third possibility is that the first and second *-ga* phrases can be the subject and the nominative object respectively in embedded clause, respectively, where the matrix clause itself takes a *pro* subject, as in (7.20c).

Even if the two ambiguous responses were counted as NOCs, the occurrence rate for this interpretation of NP-*ga* would maximally be 1.2% (i.e., 2 of 172), and the conclusion drawn from Database A is reinforced by Database B: The NOC interpretation is rare. The adjacency of *-ga* phrases has not invited more NOC interpretations; instead, it has triggered more PSC interpretations. The contrast between the virtually absent NOC, and the PSC with a 9.4% occurrence rate is interesting given that in normal usage the NOC is far more commonly observed than the literary/poetic A-PSC (see Section 6.3.2).

Let us discuss how the TIMC and the four universal principles may determine the interpretation of NP-*ga*'s in Database B, using the summary in Table 7-8.

¹⁶⁹ The simplex verb *kiniiru* ("to like") is itself a [+stative] verb, and its negative form *kiniir-anai* ("not to like") maintains its stativity.

¹⁷⁰ The remaining ambiguous response in Database B occurred for the same stimulus fragment as (7.19), and exhibits the same three-way ambiguity with a [+stative] embedded verb. The content is given in (i):

(i) **Watanabe-san-ni** **haha-ga** **kenji-ga** **sinyoo-deki-nai-to** **itta.**
Watanabe-Mr./Ms.-Dat my mother-Nom prosecutor-Nom trust-able-not-that said

Table 7-8: General Principles and NP-*ga* Interpretation, Database B

-ga	Analysis	TIMC	MA		MCP	ML	PoNP
			-ga	clause			
SSC	No movement	✓	✓	2 +	✓	✓	✓
PSC	Adjunction to Distributive QP	✓	x	1 +	✓	x	✓
NOC	Overt movement	x	✓	1 +	x	x	✓
	Covert movement	x	✓	1 +	✓	x	✓

The strong preference for the SSC preference and the dispreference for the NOC can be explained, as in Database A. That is, in the case of the SSC interpretation, the MCP, MA, and ML are clearly straightforward except that the number of clauses of the resulting structure would be two or more. In the case of the NOC, on the other hand, each of the MCP, MA, and ML would be disobeyed, and additional cost with extra clauses might be taxed because of the existence of an NP-*ni* and/or an NP-*o* in the vicinity, which would be subject to the PoNP. The A-PSC interpretation would be expected somewhere between the SSC and NOC, as shown in Table 7-8. The preference ranking implied by the data in Table 7-7, earlier, agrees with the above prediction.

In our prediction, the A-PSC interpretation differs from the SSC interpretation in three points: (a) Since the A-PSC is assumed to involve

adjunction of each parallel subject to Distributive QP,¹⁷¹ an extra node for this QP must be postulated, which is relevant to MA in its local sense; (b) the number of the resulting sentence would be kept minimal; and (c) since the distributive QP must be non-thematically interpreted, this may be subject to the ML. The difference of the number of resulting clauses between the N-PSC and the A-PSC might be a contributor to the increase of the PSC occurrences in Database B, relative to Database A: In the processing of an N-PSC sentence, (at least) one invisible conjunct must be computed. (And, depending on how parallel sets are set up, the parser might have to hypothesize control relations for the existence of *pro* in one such set.)

Also, adjoining more than two subject-*ga*'s to Distributive QP does not seem to count as "three actual structural roles that are adjacent on surface", which we found to be problematic for the parser, as we saw in (7.18). In any case, none of two identical syntactic positions, adjacently, and no more than one embedded clause would matter. Taking the findings displayed out in Tables 7-5 and 7-7 together, we might say that an NP-*ga* phrase is preferentially the subject of its own clause, despite the fact that devices *are* available through which the presumed processing cost of an additional clause could be avoided. The A-PSC is in its way an interesting tool to simultaneously satisfy preferences for interpreting the nominative case-marker transparently and for minimizing the number of clauses.

¹⁷¹ For details of this analysis, see Section 6.3.2. An alternative to this analysis is to assume the A-PSC is a sub-case of the N-PSC (see Section 6.3.1).

Besides the above discussion, the lack of NOCs so far (and particularly in the fragments with adjacent *-ga* phrases) might be the null subject that this would imply in the sentence-initial clause. That is, there might be a strong tendency (especially in the absence of discourse context) to interpret the first given NP-*ga*: as the first subject, hence the overt subject of the first clause, leaving the second NP-*ga* in a clause following. Moreover, separating *-ga* phrases from each other might have reduced the chances for NOC interpretations. Database C examines this possibility.

Database C: Interpretation of NP-*ga* in First Clause

Database C consists of 108 completion responses, which were collected from 18 participants for six 3NP fragments (Fragments 19–24) of the Core Stimulus Set. Of these responses, 100 were analyzable (i.e., 92.6%).¹⁷²

We are now interested in whether null subjects were routinely avoided in the sentence-initial clause of responses because this might be a factor indirectly leading to the low occurrence rate of the NOC interpretation in the materials in Databases A and B. In the examination of Database C, completion responses were therefore analyzed in terms that were entirely different from those of the analyses so far. The issue here is which is preferred, to include an overt subject in the first clause, or to postulate a null

¹⁷² There were 7 ambiguous responses (i.e., 6.5%), and 1 response was incomplete or incomprehensible (i.e., 1.0%).

subject so that no scrambling is necessary.

For an assessment of this issue that is independent of the question of NOC and PSC interpretations, Database C considers responses to Fragments 19–24 including only one NP-*ga*. The analysis determined whether the first *-ga* phrase of the fragment input was employed as a subject in the first clause,¹⁷³ or in the clause following it. Thus, the clause boundaries imposed on each fragment were located, and the placement of *-ga* phrases with respect to the boundaries was tabulated. As in earlier analyses, incomplete or incomprehensible responses were recorded as “Errors”, but responses recorded as “Ambiguous” were those in which the first NP-*ga* of the fragment could belong either to the first clause or to the clause following. This kind of ambiguity between analyses is illustrated in (7.21), and the parsings in (7.22) show its possible readings.

(7.21) **Ogawa-san-ni koochoo-ga raikyaku-o** okor-asete-shimatta koto-o
morashita.

(7.22) a. [_S *pro* (Subj) **Ogawa-san-ni** [_{NP} [_S **koochoo-ga raikyaku-o**
Ogawa-Mr./Ms.-Dat principal-Nom guest-Acc
okor-asete-shimatta] koto]-o morashita.]
angry-made-has fact-Acc leaked
“Someone revealed to Mr./Ms. Ogawa that the principal made the guest
angry.”

¹⁷³ Here the term “first clause” is used, rather than “highest/matrix clause”. Responses did not necessarily begin with a matrix clause. There were 28 analyzable responses with a sentence-initial subordinate clause among the completion responses of the entire Core Stimulus Set (of 432 responses in total = 18 participants x 24 fragments); of these, 18 arose with the fragments for Database C.

- b. [_S **Ogawa-san-ni**, **koochoo-ga** *t*, [_{NP} [_S *pro* (Subj) **raikyaku-o**
 Ogawa-Mr./Ms.-Dat principal-Nom guest-Acc
 okor-asete-shimatta] koto]-o morashita.]
 angry-made-has fact-Acc leaked

"The principal revealed to Mr./Ms. Ogawa that the principal/someone made the guest angry."

The readings in (7.22) typify the way in which this ambiguity arises: Verbs outnumber overt subjects so that a *pro* subject is required somewhere in the sentence, and both verbs are equally compatible with the available overt subject or with a required null subject.

The outcomes of Database C are summarized in Table 7-9. The first and second columns, respectively, indicate the frequency of responses with the first given NP-*ga* in the sentence-initial clause, and the frequency of responses with the first given NP-*ga* in the second clause.¹⁷⁴

¹⁷⁴ There were two additional 3NP fragments containing just one NP-*ga* in the Core Stimulus Set. In these fragments, the -*ga* phrase was in fragment-initial position. For canonically ordered Fragment 19 [-*ga* -*ni* -*o*] and for Fragment 20, counterpart with VP-internal scrambling [-*ga* -*o* -*ni*], the -*ga* phrase was employed as the subject of the first clause in 100% of responses. No responses were ambiguous or incomplete.

Table 7-9: Clause-Position of First NP-*ga* (in Fragments without Adjacent -*ga* Phrases), (N=6)

Fragment Scheme	[... <i>ga</i> ...	[<i>pro</i> ...[... <i>ga</i> ...	AMB	Error
(19) - <i>ga</i> - <i>ni</i> - <i>o</i>	18	–	–	–
(20) - <i>ga</i> - <i>o</i> - <i>ni</i>	18	–	–	–
(21) - <i>ni</i> - <i>ga</i> - <i>o</i>	12	–	6	–
(22) - <i>o</i> - <i>ga</i> - <i>ni</i>	18	–	–	–
(23) - <i>ni</i> - <i>o</i> - <i>ga</i>	16	1	–	1
(24) - <i>o</i> - <i>ni</i> - <i>ga</i>	15	2	1	–
	97	3	7	1

Of the analyzable responses, 97.0% (97 of 100) interpreted the first encountered NP-*ga* as the overt subject of the first clause. Only 3.0% (3 of 100) of responses began with a null subject. The dispreference for early null subjects is obviously very strong.

Among the six fragments, the -*ga* phrase was presented in the initial position in the canonically ordered Fragment 19 [-*ga* -*ni* -*o*] and in its counterpart Fragment 20 with VP-internal scrambling [-*ga* -*o* -*ni*]. For these fragments, perhaps not surprisingly, the -*ga* phrase was interpreted as the subject of the first clause in 100% of responses. In Fragments 21–24, the -*ga* phrase was presented in the non-initial position. Of 64 analyzable responses for these fragments, 95.3% (i.e., 61 responses) interpreted the NP-*ga* as the subject of the first clause.

With respect to the interpretation of the NP-*ga* presented in the fragment, the MCP would be obeyed, whether to postulate a null subject, avoiding

scrambling, or to include it as the subject of the first clause, because the NP-*ga* itself is not moved.¹⁷⁵ However, for NP-*ni* and/or NP-*o*, the MCP is obeyed only when null subject is postulated, because the null subject involves only a singleton chain, whereas the NP-*ni* and/or NP-*o* interpreted as being scrambled in front of the subject involve(s) a multi-member chain(s). With respect to the interpretation of the NP-*ga* in each fragment, the both cases follow MA, because NP-*ga* is interpreted transparently as the subject of its clause, without involving movement. The number of the clauses of the resulting sentence via a null subject would be at least two, greater than that via the NP-*ga* as the overt subject in first clause. Finally, with respect to interaction with the ML, the two preferences would have different issues: The null subject in first clause must be interpreted and this requires the parser to find the controller of that null subject. In the situation without discourse context, this may accrue some cost. The overt subject in first clause is itself would not matter to the ML, but the scrambled element(s), i.e., NP-*ni* and/or NP-*o* might be interpreted as focused.

Interestingly, null subjects (and null objects) occurred frequently in the non-initial clauses of the completion responses of Experiment 3 in general, where the antecedents of those null elements had already been established in an earlier clause. Thus, the response pattern of Database C might be due to the nature of the task performed without discourse context. Furthermore, in this off-line task, respondents saw the entire fragment to devise a sentence,

¹⁷⁵ For a brief summary of non-scramblability of subject-*ga*, see Section 3.2.1.

and hence the parsing process of the fragment in the task was not in a strict left-to-right manner.

Thus, at this point the strong preference for an overt subject in the first clause leaves open the possibility an indirect cause (yet to be clearly specified) for the lack of the NOC in Databases A and B.

Database D: Interpretation of NP-*ga*, Evidence 3

Database D consists of 144 completion responses in total (8 fragments x 18 participants). Eight of the 10 fragments of the Supplementary Stimulus Sets (see Table 7-3) are of relevance now: These are Fragments 25–32. All the fragments in the Supplementary Stimulus Set consist of NPs marked either with *-ga* or *-wa*, but with no other case-markers, and among these, Fragments 25–32 are the EPC-discouraging fragments.

Database D has two subcomponents: Database D-1 and Database D-2. Database D-1 consists of 90 responses to Fragments 25–29, each of which had a *ga*-marked NP as its final term, while Database D-2 consists of 54 responses to Fragments 30–32, where the final term was *wa*-marked. The fragments in Database D-1 directly address the NOC issue we are interested in. We now ask whether the *final term* of these fragments, specifically, is given a subject interpretation (hence, as the subject of its own clause) or whether it is interpreted as a *ga*-marked object of the clause initiated by the preceding NP. Database D-2 is a follow-up to clarify an important part of the

NOC response pattern of Database D-1. For this reason, Database D-2 is inserted in the middle of our discussion of D-1, to simplify the flow of the argument. Discussions of the patterns of PSC responses and SSC responses in Database D-1 follow the entire discussion of the NOC.

Database D-1

Within Database D-1, 86 of 90 completion responses (i.e., 95.6%) allowed us to examine the structural role imposed on the NP-*ga* phrases.¹⁷⁶

Table 7-10 below summarizes the result of the analysis of Database D-1. The table is organized as follows: The “SSC” category now means that the *fragment-final -ga* phrase was interpreted as the subject of its own clause, whereas the “NOC” category means that it was interpreted as a nominative object. The “PSC” category means that the fragment-final NP-*ga* was interpreted as a subject parallel to one or both of the preceding NP-*ga*’s (within the same clause). The PSCs involved here are only A-PSCs. Importantly, the A-PSC can apply only to Fragments 27 and 28, since the discourse inequality implied by *-wa/-ga* marking rules it out in Fragments 25, 26, and 29.¹⁷⁷ Note also that the EPC has been ruled out by noun content in all five

¹⁷⁶ A small proportion of the database (3.3%, i.e., 3 of 90) was incomplete or uninterpretable, and a further 1.1% (i.e., 1 of 90) was ambiguous between the SSC and the NOC interpretations. These responses were discarded.

¹⁷⁷ The PSC category here refers to the A-PSC because the NP-*ga*’s were adjacent to each other in Fragments 27 and 28. Although it was logically possible to exploit two of the three consecutive NP-*ga*’s in Fragment 28 as PSCs, there were no such responses. Also, the final NP-*ga* in Fragment 26 could logically be interpreted as a subject parallel to the fragment-initial NP-*ga* as an N-PSC, with the NP-*wa* in the middle being interpreted as a member of the first of the two parallel sets, for example. However, there were no responses of this type. For simplicity, therefore, the table

fragments.

Table 7-10: Structural Role of Fragment-Final NP-*ga* in Fragments without Overtly Marked Objects (N=5)

		SSC	NOC	PSC	AMB	Error
(25)	- <i>wa</i> - <i>ga</i>	9	9	N/A ^a	–	–
(26)	- <i>ga</i> - <i>wa</i> - <i>ga</i>	17	–	N/A ^a	–	1
(27)	- <i>ga</i> - <i>ga</i>	17	–	–	1	–
(28)	- <i>ga</i> - <i>ga</i> - <i>ga</i>	16	2	–	–	–
(29)	- <i>wa</i> - <i>wa</i> - <i>ga</i>	5	11	N/A ^a	–	2
		64	22	0	1	3

^a Not applicable

The findings in the response pattern of Database D pattern are as follows: Fragment-final NP-*ga* was interpreted as a subject in 64 of 86 analyzable responses, i.e., at a rate of 74.4%, and as a nominative object in the remainder (i.e., 25.6%). In the instance of a response classified as ambiguous, the ambiguity was between an SSC and an NOC interpretation. If this were taken as an NOC response, the occurrence rate for the NOC would be 26.4% (i.e., 23 of 87), at maximum. The A-PSC did not occur at all, even in the 2 of 5 fragments in which it was not ruled out by the -*wa*/-*ga* inequality. Thus, overall, the SSC is three times as likely as the NOC, despite the fact that an SSC interpretation of a fragment-final NP-*ga* required that an additional

indicates "N/A" under the PSC label for Fragment 26.

clause be built.

The above pattern is not so clear-cut that we can develop a *simple* account on the basis of constraints imposed on NP-*ga*'s interpretation by the general principles we have been considering, in the same way as we did for Databases A and B. Consider the summary in Table 7-11.

Table 7-11: General Principles and NP-*ga* Interpretation, Database D-1

-ga	Analysis	TIMC	MA		MCP	ML	PoNP
			-ga	clause			
SSC	No movement	✓	✓	2 +	✓	✓	✓
PSC	Adjunction to Distributive QP	✓	x	1 +	✓	x	✓
NOC	Overt movement	x	✓	1 +	x	Δ	✓
	Covert movement	x	✓	1 +	✓	Δ	✓

In particular, when we see the NOC interpretations in Database D, we notice that case-by-case these responses have a very strange distribution over the fragment stimuli: For 3 of 5 fragments, the NOC is rarely produced, while for the 2 remaining, it is remarkably common. In (7.23) below is a list of the fragments in Database D with their numbers on the left and the frequency with which they are interpreted as NOCs on the right. Noun content of the

fragments is translated into English for convenience:

(7.23)	F25	my older sister- <i>wa</i> Makoto- <i>ga</i>	NOC = 9
	F26	mother- <i>ga</i> chief doctor- <i>wa</i> Takashi- <i>ga</i>	NOC = 0
	F27	professor- <i>ga</i> Mr./Ms. Sato- <i>ga</i>	NOC = 0
	F28	father- <i>ga</i> Michio- <i>ga</i> famous writer- <i>ga</i>	NOC = 2
	F29	grandchild- <i>wa</i> Mr./Ms. Shimizu- <i>wa</i> young person- <i>ga</i>	NOC = 11

The distribution we see in (7.23) seems to suggest that when the NOC did occur, it was prompted by several factors, i.e., the principles in Table 7-12 plus other influences. We focus on three possibilities here: (a) The interpretation of NOC sentences as it pertains to the ML principle, now marked in the table (for the first time) with the symbol “ Δ ” (i.e., depending on the situation); (b) the *content* of the *ga*-marked noun and the term that precedes; and (c) the contrastive reading of embedded NP-*wa*’s (see Section 3.2.2; for details, see Kuno 1973a).

The ML principle seems to apply here because of an intricate connection between an exhaustive-listing reading of subject-*ga* and the stativity requirement for the NOC’s predicate (see Section 3.3; also, Kuno 1973a). That is, in order for a clause to have a nominative object, its predicate must have a [+stative] feature, and if it does, an exhaustive-listing reading is

triggered for the subject-*ga* of that clause.¹⁷⁸ This being so, the copy of the focused subject must be non-thematically interpreted, being lowered at LF, and in such a case, the nominative object might have also been lowered (see Chapters 3 and 7 in Frazier 1999). The focused NP-*ga* subject (which is an indirect result of the predicate's stativity) would therefore be costly, with respect to ML. But in the case of the [NP-*wa* NP-*ga*] string, the topicalized subject does not obtain a contrastive reading (even with a [+stative] predicate) that requires a particular context to pick out the entity represented by the noun marked with -*wa*. The contrast in the NOC's occurrence rates between the two simplest fragments, Fragment 27 [-*ga* -*ga*] on the one hand, and Fragment 25 [-*wa* -*ga*] on the other, might be a manifestation of this fact: While *no* unambiguous responses for the former interpreted the fragment-final NP-*ga* as an NOC, those for the latter were split evenly between the NOC and the SSC.

The contrast in the occurrence rates of the NOC between responses for Fragments 28 [-*ga* -*ga* -*ga*] and 29 [-*wa* -*wa* -*ga*] might be an extension of the pattern seen in the simpler fragments. According to Kuno (1973a), embedded NP-*ga*'s are neutralized, but the low frequency of the NOC for Fragment 28 (2 of 18, cf. 11 of 16 for Fragment 29) might indicate that there is still some certain awkwardness in establishing an NOC in an embedded [NP-*ga* NP-*ga*] sequence.

However, a problem with the above simple consideration of the ML principle, that no NOCs whatsoever were observed in completion responses to

¹⁷⁸ In Section 3.2.1, the exhaustive-listing interpretation of -*ga* is summarized as related to Individual-Level predicates. For details, see Sections 3.2.1 and 3.3.

Fragment 26 in which the second and third NPs were marked with *-wa* and *-ga*, respectively. Here, all analyzable responses used the SSC, cf. the common occurrences of the NOC for Fragments 25 and 29. There might be two other factors simultaneously involved in this response pattern, i.e., the lexical content of fragments “chief doctor-*wa* Takashi-*ga*”, and a contrastive reading for embedded NP-*wa*. Let us now consider these factors in turn.

With respect to fragment content, the lexical items in Fragment 25 (my older sister-*wa* Makoto-*ga*) and Fragment 29 (Mr./Ms. Shimizu-*wa* young-person-*ga*) represent type of combination very different from those of Fragment 26 (chief doctor-*wa* Takashi-*ga*), in the following sense: “Makoto” is a very common male first name, and it might have been easy to associate it with a female “older sister” in the kind of liking/disliking relationship which is very frequently expressed with the NOC. Likewise, since “Mr./Ms. Shimizu” is a common family name, a similar relationship with “young person” might have readily come to mind.¹⁷⁹ The response set out in (7.24) is representative.

¹⁷⁹ In fact, one NOC response for Fragment 29 used “envy”, but all other 19 responses total for the two fragments contained “like”, “love”, “dislike” or “hate” as the predicate for their NOC clauses. An informal survey asked 25 native speakers of Japanese (all were undergraduate students) for a completion of a “-*wa* -*wa* -*ga*” fragment which used Fragment 29’s scheme but substituted different lexical items “*kantoku-wa kameraman-wa tsuukoonin-ga* (movie director-Top cameraman-Top pedestrian-Nom)”. There were two incomprehensible responses and no ambiguous responses. Of the 23 analyzable responses, five were NOC responses in which second and third NPs were interpreted as the subject and a nominative object of an embedded clause, respectively. The outcomes for Fragment 29 and this fragment, taken together, suggest the effect of noun content.

- (7.24) [_S [_S **mago**, **-wa** [_S **Shimizu-san-wa** **wakamono-ga** kiraida]-to
 grandchild-Top Shimizu-Mr./Ms.-Top young person-Nom dislike-that
 sitt]-e [_S *pro*, (Subj) situboosita.]]
 learned-and discouraged
 “The grandchild learned that Mr./Ms. Shimizu dislikes young people, and was discouraged.”

In contrast, “chief doctor” and “Takashi” in Fragment 26 might easily have been associated with each other as participants in such an event that “the chief doctor diagnosed that Takashi ...”, as typified by the response in (7.25).

- (7.25) [_S **hahaoya -ga** [_S **shunin'ishi-wa** [_S **Takashi -ga** omoi byooki-da]-to
 mother-Nom chief doctor-Top Takashi-Nom serious ill-is-that
 sindansita]-to iimasita.]
 diagnosed-that said
 “The mother said that the chief doctor diagnosed that Takashi is seriously ill.”

In addition to an effect of lexical content, a contrastive-reading for embedding **-wa** might act to suppress NOCs in Fragment 26: Of the 17 SSC responses for this fragment, 14 interpreted each NP in the [NP-**ga** NP-**wa** NP-**ga**] string to be the subject of its own clause. Interestingly, in the remaining three responses, “chief doctor-**wa**” was interpreted as a topic complement of an embedded clause in which “Takashi-**ga**” was the subject, as schematized in (7.26).

(7.26) F26 mother-ga [chief doctor, -wa Takashi-ga e, ...] ...¹⁸⁰

The response in (7.27) below, making “chief doctor” a topic complement,¹⁸¹ clearly emphasizes the contrastive-reading of -wa with the additional clause “Masako will become a teacher”, which contrasts with the preceding “Takashi will become a chief doctor”.¹⁸² The contrastive-reading of the topic is strengthened by their positions preceding their subjects.

¹⁸⁰ Opinions vary as to how topic constituents are derived (or base-generated) in Japanese (see Section 3.2.2). The notation “e” used in this schematization does not necessarily mean that “chief doctor” has been base-generated in this position. Rather, that notation is used, neutrally, to mean either it is base-generated there and then moved to the surface position, or else it is base-generated in the surface position and associated with the position marked e by a syntactic chain, or LF movement, etc.

¹⁸¹ If “chief doctor” was not a topic, it would be marked by -ni (Dat) in the post-subject position in this case.

¹⁸² The other two responses are given in (i) below:

- (i) a. **hahaoya** -ga [shunin'ishi, -wa Takashi_k -ga e, eran]-de pro_k (Subj)
 mother-Nom chief doctor-Top Takashi-Nom choose-and
 chiryo-o ukeru-to chichioya-ni itta.
 treatment-Acc receive-that father-Dat told
 “The mother told the father that Takashi will choose the chief doctor and Takashi will receive treatments.”
- b. **hahaoya** -ga pro_i (Indirect Obj) [shunin'ishi, -wa Takashi_j -ga e,
 mother-Nom chief doctor-Top Takashi-Nom
 turete-kuru]-kara pro_j (Subj) moo sukosi gaman-sinasai-to itta.
 bring-come-because more little patience-do-that said
 “The mother told someone that he/she should be patient for a little while because Takashi will bring the chief doctor.”

In these responses, “chief doctor” was interpreted as a topicalized direct object controlling an empty category preceded by the embedded subject *Takashi-ga*. These responses imply a situation in which someone is sick and needs to choose/bring a chief doctor, and therefore the chief doctor is emphasized.

- (7.27) **hahaoya**, -ga [**shunin'ishi**, -wa **Takashi-ga** *e*, naru]-to
 mother-Nom chief doctor-Top Takashi-Nom become-that
i-i pro_{i,k} (Subj) [**kyoosi**_m -wa **Masako-ga** *e_m* naru]-to itta.
 said-and teacher-Top Masako-Nom become-that said
 "The mother said that Takashi will become a chief doctor, and she/someone
 said that Masako will become a teacher."

The above pattern (i.e., topic complement in an embedded clause) was observed nowhere else in completion responses to the other four fragments in Database D-1 that we have been discussing. However, the same pattern emerged for Fragments 30–32 ending with NP-*wa* in the Supplementary Stimulus Set. So, let us examine them as Database D-2.

Database D-2

Out of 54 responses collected for Fragments F30–F32 (18 respondents x 3 fragments), there were 49 analyzable responses (i.e., 90.7%), which provide information about what kind of structural roles were imposed on non-initial NPs in the *wa*-final fragments.¹⁸³

¹⁸³ There was one ambiguous response between analysis categories (i.e., 1.9%) and four responses either incomplete or incomprehensible (i.e., 7.4%). These were all excluded. The sentence in (i) is the AMB response. This was ambiguous between "[x [Sbj Obj]" and "[x [Obj Sbj]", as (iia-b) show, respectively. The predicate *husawasiku-nai* can be associated with *hanayome* and *Iwata-san* in either way.

(i) **chuugakusei-wa hanayome-wa Iwata-san-wa** husawasi-ku-nai-to kangaeru-hazuda.

(ii) a. **chuugakusei-wa** [hanayome-wa **Iwata-san-wa** husawasiku-nai]-to
 junior high school student-Top bride-Top Iwata-Mr./Ms.-Top suitable-not-that
 kangaeru-hazuda.
 consider-must
 "The junior high school student must consider that the bride is not suitable for Mr./Ms.
 Iwata."

A summary of response outcomes is presented in Table 7-12 on the next page.¹⁸⁴ Since we are now interested in the structural roles imposed on the fragments' non-initial NPs, the first NP is simply represented by the symbol "x" in the labels. Thus, the leftmost label "[x [Sbj] [Sbj]" means that the second and third NPs were interpreted as subjects (topics) of their own clauses. The middle label "[x [Subj] Obj]" means that the second and third NPs were interpreted as subject (topic) and object of the same clause. In contrast, the rightmost label "[x [Obj] Sbj e]" means that the second and third NPs were interpreted as topic object and its subject, respectively, which is the pattern seen in the three responses for Fragment 26 illustrated earlier in (7.26).

b. chuugakusei-wa	[hanayome-wa	lwata-san-wa	e,
junior high school student-Top	bride-Top	lwata-Mr./Ms.-Top	
husawasiku-nai]-to	kangaeru-hazuda.		
suitable-not-that	consider-must		
"The junior high school student must consider that Mr./Ms. lwata is not suitable for the bride."			

¹⁸⁴ There were no PSC interpretations observed for the three fragments, and the table does not explicitly indicate them. Note that the PSC was not applicable to Fragment 30 because of the inequality of *-ga/-wa* marking, while for Fragments 31 and 32, topicalized PSCs were logically possible because there was more than one NP-*wa* in a row, but there were no such instances observed.

Table 7-12: Structural Role of Non-Initial NPs in *wa*-Final Fragments without Overtly Marked Objects (N=3)

	[x [Sbj] [Sbj]	[x [Sbj] Obj]	[x [Obj] _i Sbj e _i]	AMB	Error
(30) <i>-wa -ga -wa</i>	14	2	–	–	2
(31) <i>-ga -wa -wa</i>	12	2	4	–	–
(32) <i>-wa -wa -wa</i>	11	1	3	1	2
	37	5	7	1	4

Out of the analyzable responses, 75.5% (i.e., 37 of 49) interpreted each of the non-initial NPs as a subject (or topic). There were seven responses (i.e., 14.3%) exhibiting the [topic object_i – subject – e_i] pattern; these were responses to Fragments 31 and 32. In all three fragments, while the *-ga* phrases were always interpreted as single subjects of their own clauses regardless of their positions, the treatment afforded *-wa* phrases varied: Fragment-initial NP-*wa*'s were always interpreted as topicalized subjects of matrix clauses; on the other hand, when an NP-*wa* was not fragment-initial, it was not infrequently interpreted as a topic object of an embedded clause, preceding its subject. This may strengthen the proposal above that the response pattern we saw in Database D-1 (Table 7-10) is in part a manifestation of the contrastive-reading of embedded NP-*wa*.^{185,186}

¹⁸⁵ The fragments' lexical content seems to be in play in the response pattern in Table 7-12, together with the contrastive-reading of *-wa*. Since Experiment 3 employed just one set of lexical items per fragment scheme, it is unclear how the two factors interplay. English translations for the lexical content of Fragments 31 and 32 are given in (i) below.

PSC and SSC interpretations in Database D-1

Let us now discuss the patterns of PSC and the SSC responses in Database D-1. As shown in Table 7-10 earlier, in an environment lacking overtly case-marked objects, NOC interpretations did emerge for fragment-final NP-*ga* (some 25% of the time), but A-PSC interpretations did not — even though they could have been available (in Fragments 27 and 28). This pattern contrasts with the many instances of the PSC seen in Tables 7-5 and 7-7. In order to minimize the numbers of clauses and simultaneously to interpret the nominative marker transparently, the A-PSC should have been helpful. Possibility, the NP referents (Fragment 27: “professor” and “Mr./Ms. Sato”; Fragment 28: “father”, “Michio”, and “famous writer”) were not easily interpreted as having equivalent status, compared to, for example, “co-worker” and “Keiko” in Fragment 27 (see the response example in (7.19), earlier).

A final and important point revealed in Table 7-10 is what we see in the response pattern of Fragment 28 (a 3*ga* string), and it is a point relating to SSC responses. While two of the 18 completion responses to this fragment

(i) F31 my aunt-*ga* store owner-*wa* college student-*wa*

F32 junior high school student-*wa* bride-*wa* Mr. Imai-*wa*

¹⁸⁶ Another possibility for the NOC response pattern that has not been explored here is whether beginning a sentence with NP-*wa* or NP-*ga* might have affected the interpretation of the fragment-final NP-*ga* in the 3NP fragments. The response pattern in Table 7-10 indicates that NOC interpretations did occur when a fragment began with a *wa*-marked NP, and never occurred when it began with a *ga*-marked NP. However, there have been neither syntactic restrictions nor processing preferences discussed so far in the literature (to the author's knowledge) as to whether or not the -*ga*/-*wa* beginning of the matrix clause affects the occurrence of the NOC in an embedded clause or a clause following it. Clearly, further research is called for on this issue.

imposed just two clauses, the remaining 16 all postulated three clauses. The three-clause responses were the result of interpreting each of the three NP-*ga*'s in the fragment as a single subject of its own clause. Surprisingly, these responses all involved double center-embedding construction with a 3*ga* sequence. A close examination of clause types imposed in these responses, however, reveals an interesting fact: Although there was the possibility of a double *self*-embedding with a 3*ga* sequence, which has been proved to be extremely problematic in Experiments 1 and 2, no completion responses involved that construction straightforwardly. That is, constructions such as [_S NP-*ga* [_S [_S NP-*ga* [_S [_S NP-*ga* VP] that] VP] that] VP] or [_S NP-*ga* [_{NP} [_S NP-*ga* [_{NP} [_S NP-*ga* VP] NP] VP] NP] VP] were entirely avoided. In order to do this, the three clauses were created differently from each other through the use of three typical strategies described below.

A first strategy was observed in four responses, interpreting either the second or third NP-*ga* as the subject of an adverbial clause, as exemplified by the response in (7.28).¹⁸⁷

¹⁸⁷ Of the four responses, three interpreted the second -*ga* phrase as the subject of a because-clause, whereas one took the third -*ga* phrase as the subject of a because-clause.

- (7.28) [s **titioya-ga** , [NP [s **Michio-ga** , [s **yuumeisakka** , -ga kinjo-ni
 father-Nom Michio-Nom neighborhood-in neighborhood-in
 sunde-iru]-node *pro* , (Subj) iutuka *pro* , (Obj) turete-kuru-to
 living-is-because sometime bring-come-that
 itta]-no]-o tanosimi-ni-site-iru.]
 said-fact-Acc forward-to-looking-is

"The father is looking forward to the fact that Michio said that he will bring a famous writer sometime because the writer lives in his neighborhood."

A second strategy was to use a nominalized clause and a sentential complement together, as the response in (7.29) did.

- (7.29) [s **titioya-ga** , [NP [s **Michio-ga** , [s **yuumeisakka-ga** jibun , -no
 father-Nom Michio-Nom famous writer-Nom self-Gen
 yuujin dearu]-to itteiru]-no]-o omoidasita.]
 friend is-that saying-fact-Acc remembered

"The father remembered the fact that Michio said that the famous writer is his friend."

Here, the middle and innermost clauses are distinguished from each other because the former is a sentential direct object of the matrix clause [NP [S' [S ...]]-no]-o ("[NP the fact-Acc [S' that [S ...]]]"), while the latter is the middle clause's sentential complement marked with the complementizer *-to* ("that"). Nine of the 12 responses interpreted the last two NP-ga's as the subjects of a nominal clause and a sentential complement, in one or the other order.¹⁸⁸ In eight of the nine responses, the nominal clause was interpreted as an

¹⁸⁸ While some responses nominalized the middle clause by *-no* ("the fact") to make it a direct object, others used *koto* ("the fact") or *uwasa* ("rumor") to nominalize either the middle or the innermost clause.

accusatively-marked sentential direct object, just as the response in (7.29) does; the clause was marked with an interrogative complementizer *-ka* in the remaining response.

A last strategy was a combination of a relative clause plus a sentential complement, and the fragment-final NP-*ga* is interpreted as the subject of that relative clause. The response in (7.30) contains a relative clause inside a sentential complement.

- (7.30) [_S **titioya-ga** , [_S **Michio-ga** , [_{NP} [_S **yuumeisakka-ga** *t* , *sunda-kotogaaru*]
 father-Nom Michio-Nom famous writer-Nom lived-has
manshon ,]-ni kondo hikkosu]-to tuma-kara kiita.]
 apartment-to this time move-that wife-from heard
 "The father heard from his wife that Michio will move this time into an
 apartment in which a famous writer has lived."

There were two further responses containing a relative clause, whose subject was the fragment-final NP-*ga*. While the head noun modified by the relative clause in (7.30) is a locative phrase, those in the two other responses were the direct object of the middle clause.

What the above three strategies basically seem to do is to incorporate one embedded clauses into another so that the entire sentence is composed of clauses that are maximally distinct. In other words, it might be an attempt to complete assigning structure to the innermost clause, so that at least that part can be sent to the next interpretive stage as soon as possible, as structural output that is interpretable in that stage.

This might in turn suggest that the difficulty with more than two surface-adjacent syntactically identical positions can occur with the structural type itself as well.^{189,190} A relevant statement is offered by Fodor (1995), who describes the parser's preference in assembling phrase structure, as follows:

With regard to phrasal structure, what the human processor likes best is simple but compact structures, which have no more tree branches than are necessary, and the minimal tree distance (walking up one branch and down another) between any pair of adjacent words.

(Fodor 1995: 221)

Certainly, one possibility here is that since the off-line task employed in Experiment 3 allowed respondents to see the entire fragment for completion, there might be some reflection of the nature of this task in the kind of response produced. However, the choice among interpreting the three NP-*ga*'s transparently, obeying the MCP, and the avoidance of having the same clause

¹⁸⁹ As a piece of evidence for incremental integration in Japanese as opposed to head-driven integration, Nakatani & Gibson (2003) demonstrate that reading times increase as the subjects of double center-embedding are encountered one after another, but that load decreases as their corresponding verbs are encountered, one after another. Since their test materials were adverbial clauses in a doubly center-embedded construction, the outermost verb was always affixed by a subordinating conjunction, e.g., *-node* ("because"). However, a decrease in reading times was observed in the first and second verb regions. This is not consistent with what we speculate here. Nakatani & Gibson's test materials were not exactly parallel to what we are discussing (not only in the third verb but also the selection of subject NPs), but one possibility is the nature of the off-line sentence completion task employed in Experiment 3, which does not work in a strictly incremental fashion. Further systematic research is certainly called for.

¹⁹⁰ To what extent the latter affects the processability of doubly center-embedded sentences is a very important issue, and further research is required.

type might be an interesting conflict for the parser might experience, without other helpful routes to accomplish a full structure-hypothesis. The EPC was, after all, discouraged in the fragments discussed to this point. Therefore, we finally turn to an examination of completion responses to fragments that encouraged EPC interpretations, in Database E.

Database E: Interpretation of NP-*ga*, Evidence 4

Database E consists of a total of 36 responses, i.e., 18 completion responses to two fragments that positively encouraged EPC interpretations: Fragment 33 took the form [NP-*ga* NP-*ga* NP-*ga*], and Fragment 34, the form [NP-*wa* NP-*ga* NP-*ga*]. Unlike the EPC-discouraging fragments for Databases A to D, the lexical content in Fragments 33–34 was designed to exhibit possessor-possessum relationships so that the EPC interpretation was optionally available. The opportunity for the EPC interpretation occurred between any two adjacent NPs of the three NPs in each fragment. This in turn means that the EPC interpretation was logically possible in three ways, using each fragment either *fully* or *partially*, as schematized in (7.31):

- (7.31) a. **NP₁'s NP₂'s NP₃**
 b. **NP₁'s NP₂ ...**
 c. **... NP₂'s NP₃**

As shown in (7.31a), if the three NPs were included in a single clause via the EPC, they would be interpreted as “NP1’s NP2’s NP3”. If only the first two NPs entered into an EPC, they would be interpreted as “NP1’s NP2”, as in (7.31b), whereas if the last two NPs were taken as an EPC, they would be interpreted as “NP2’s NP3”, as in (7.31c). In this way, (7.31b) and (7.31c) can each be considered as exhibiting a single EPC, whereas (7.31a) can be called a double EPC (or two simultaneous single EPCs).

The optionality of the EPC interpretation means that the SSC and the NOC interpretations are also available as competitors in the parser’s structure-building. The PSC interpretation was also possible, but only if the NP referents of the fragment were interpreted as having equal status despite the possible possessor-possessum relationship between them.

In Database E, the completion responses were analyzed in the following way: When the three NPs in a fragment were all interpreted as separate subjects of their own clauses, it was recorded as “SSC”. When the three NPs were interpreted in a single clause as an EPC, it was recorded as “Double EPC”, to mean that the EPC had been employed twice. As we will see soon, there were, in fact, responses in which two of the three NPs were taken as a single EPC, and the remaining NP was given an SSC interpretation. This type of response was recorded as “SSC *plus* EPC”. Responses in which a *-ga* phrase was interpreted as a nominative object were recorded as “NOC”. Also, “PSC” was the category for responses in which more than one *-ga* phrase was interpreted as subject of the same clause. Finally, incomplete or incomprehensible responses were recorded as “Errors”, and responses which

were ambiguous with respect to the above analysis categories were recorded as “ambiguous” (AMB).

Of the 36 responses collected, 97.2% (i.e., 35 responses) were analyzable. There were no incomplete or incomprehensible responses, and 1 response was ambiguous between analysis categories.¹⁹¹

Table 7-13 below is a summary of the outcomes of the completion responses in Database E, focusing on how the NPs presented in the fragments were structurally interpreted. The labels in the table reflect the analysis categories described above except for “PSC” category (because no responses at all actually showed the PSC interpretation).

¹⁹¹ The ambiguous response is given in (i). It is interpretable in *at least* two ways, either “SSC” or “SSC *plus* EPC”, as in (iia-b), respectively.

(i) **Sonii-ga shain-ga taido-ga** warui-to itte-ita-to itte-ita.

(ii) a. [_S **Sonii-ga** [_S **shain-ga** [_S **taido-ga** warui]-to
Sony-Nom company worker-Nom attitude-Nom b ad-that
itte-ita]-to itte-ita.]
saying-was-that saying-was.

“Sony said that the company workers said that their/someone’s attitudes are bad.”

b. [_S *pro* (Subj)] [_S **Sonii-ga** [_S **shain-ga** **taido-ga** warui]-to
Sony-Nom company worker-Nom attitude-Nom bad-that
itte-ita]-to itte-ita.]
saying-was-that saying-was.

“Someone said that Sony said that their company workers’ attitudes are bad.”

Since the response contains three predicates, which is the same number as that of the fragment’s NP-*ga*’s, they can be interpreted as an SSC response, as in (iia). However, the last two added verbs used the same lexical item and there was no explicit signal specifying which NPs were associated with those verbs. Thus, there is the possibility of a null subject in the matrix clause, as shown in (iib), which can be analyzed as “SSC *plus* EPC”. And although it seems intuitively unlikely, yet two further possibilities remain: *Sonii-ga* and a null subject are in the matrix and middle clauses, respectively, with a single EPC *shain-ga taido-ga* in the innermost clause; or one null subject each for those clauses with a double EPC in the innermost clause.

Table 7-13: Structural Interpretations of NPs in EPC-Encouraging Fragments (N=2)

		SSC	SSC EPC ^a	Double EPC	NOC	AMB	Error
(33)	H-ga H-ga l-ga	–	16	1	–	1	–
(34)	H-wa H-ga l-ga	1	13	1	3	–	–
		1	29	2	3	1	0

^a Responses containing one SSC and one Single EPC

What we see in the table is that 82.9% of analyzable responses (i.e., 29 of 35) interpreted the fragment's three NPs as one SSC *plus* one EPC.

The above response pattern contrasts with that in Database D for Fragment 28, which consists of a 3ga string but offered no opportunities for the EPC: there, absent the possibility of the EPC, each of the three -ga phrases was interpreted transparently as the single subject of its own clause even though the resulting structure contained three clauses.

Recall that in responses of this type in Database D, the notorious double self-embedding was avoided by structuring the clauses differently from each other. In contrast, when opportunities for EPC interpretations were offered in the fragments of Database E, only 1 response interpreted each of the three NPs as the subject of its own clause. This response to Fragment 34 is shown in (7.32).

- (7.32) [s[s **Jainantsu**, -wa [NP [s **tooshu**, -ga [s **wanryoku-ga** tuka-nai]-to
 Giants-Top pitcher-Nom arm power-Nom develop-not-that
 itt-eiru]-no]-o kii]-te [s *pro*, (Subj) *pro*, (Obj) tokkunsita.]]
 saying-is-fact-Acc heard-and trained hard
 "The Giants heard that their pitchers are saying the fact that their arms are
 not becoming stronger, and (the organization) is training them hard."

This structure is a double center-embedding with a matrix topic subject.

Although the NP-*wa* of the fragment means that there is no possibility of a double self-embedding with a 3ga string, the three clauses were shaped differently from each other: The matrix clause takes a nominalized object, and that middle takes an innermost sentential complement, directly. This is the same strategy as was commented on, for Database D.

In Database E, among the responses that avoided three SSCs were three NOC responses to Fragment 34, which are typified by (7.33).

- (7.33) [s **Jainantsu**, -wa [NP [s **tooshu-ga** **wanryoku-ga** hituyooda]-to
 Giants-Top pitcher-Nom armpower-Nom need-that
 iukoto]-o tuneni shuchoosite-iru.]
 fact-Acc always emphasizing-are
 "The Giants always emphasize that pitchers need strong arms."

In the three NOC responses, the number of clauses required in the resulting sentence was two, one fewer than the sentence in (7.32): The third NP was interpreted as a nominative object in order to make the sentence a real single embedding. The opportunity for an EPC was ignored.

Interestingly, even though Fragments 33 and 34 each offered the opportunity for a double EPC interpretation, this was rarely taken up. The responses in (7.34) and (7.35) are the only instances that fully exploited the available possessor-possessum relationships, to interpret the three NPs as a double EPC.

- (7.34) [_S [_{NP} [_S **Sonii-ga** **shain-ga** **taido-ga**
 Sony-Nom company worker-Nom a ttitude-Nom
 nattei-nai]-no]-o, Toosiba-wa *t*, kenasite-ita.]
 good-not-fact-Acc Toshiba-Top criticizing-is
 "Toshiba was criticizing the fact that Sony's company worker's attitudes are
 not good."

- (7.35) [_S **Jainantu-wa tooshu-ga** **wanyoku-ga** hekikinsite takai.]
 Giants-Top pitcher-Nom arm power-Nom on average high
 "The Giants' pitchers' arms are strong on average."¹⁹²

In the majority of responses, three SSCs were avoided by partially exploiting the opportunity for the double EPC, as exemplified by the response in (7.36) below.

¹⁹² For the purpose of our discussion of the double EPC here, this English translation does not reflect the function of the topic *-wa*, such as "As for the Giants, their pitcher's arms are strong on average."

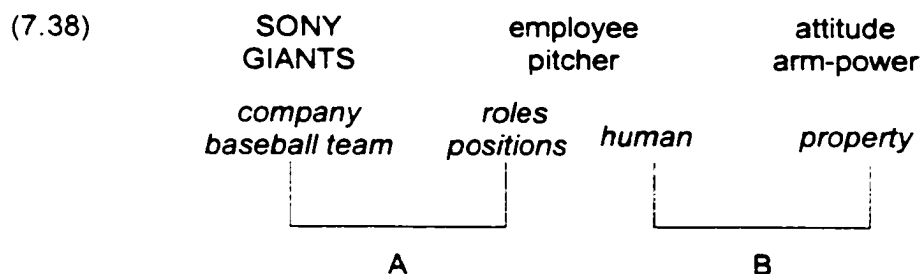
- (7.36) [_S [_S **Sonii**, -ga [_S **shain-ga** **taido-ga** warui]-to itt]-e
 Sony-Nom company worker-Nom attitude-Nom bad-that said-and
 [_S *pro*, (Subj) *pro*, (Obj) hanbun-kurai kubinisita.]]
 half-about fired

“Sony said that their company worker’s attitudes are not good, and fired about half of them.”

Let us now examine whether there is any preference in how the EPC was used in the “SSC *plus* EPC” responses, i.e., at which sites the single EPC interpretation was made, either between the first two NPs or the last two NPs. An examination of clause-boundary sites imposed inside the fragments revealed that the boundary was invariably between the first and second NPs, and never between the second and third NPs, as schematized in (7.37).

- (7.37) a. **NP₁’s NP₂ [NP₃ 0%**
 b. **NP₁ [NP₂’s NP₃ 100%**

There are two possibilities to explain this asymmetric response pattern: First, recall that (in)alienability plays an important role in establishing EPCs in various languages (Section 6.2, also see Payne & Barshi 1999; Vergnaud & Zubizarreta 1992). The (in)alienability between the various NPs might have been responsible for the preference for grouping NP2 and NP3. Let us consider the relationships between the fragments NPs, which are illustrated in (7.38) below.



Since NP2 and NP3 in each fragment represented a human and its property, respectively, the relationship between them (i.e., B in (7.38) above) was inalienable. Although employees or pitchers are necessary roles or positions for a company or a baseball team represented by NP1, people that fill those roles or positions can change. That is, the relationship between NP1 and NP2 (A in (7.38) above) could have been construed as alienable. Therefore, it might have been the (in)alienability that triggered the response pattern we see in Database E.¹⁹³ However, it seems equally possible that the NP1-NP2 relationship was interpreted as inalienable, as well, because a company or a baseball team must necessarily have employees or pitchers, which are in a whole-part relationship with each other. Note that there is nothing in the content of the fragments to individuate NP2's referents.

¹⁹³ Recall Ura's (1996) analysis of alienable and inalienable EPCs reviewed in Section 6.2. He proposed base-generation for the former, and movement for the latter. If Japanese is sensitive to (in)alienability in the establishment and interpretation of the EPC and inalienable NPs support it more easily than alienable ones do, Ura's analysis makes a prediction opposite to what the *a priori* processing principle for Minimal Chain (de Vincenzi 1991, 1994) predicts. That is, the condition more supportive of the EPC would be more costly than the unsupportive condition: PR-Raising assumed for the inalienable relation involves a two-member chain, whereas base-generation assumes for alienable relation involves a singleton chain. Therefore, the inalienable relation supposedly more supportive of the EPC would be more costly for the parser.

Thus, if it was not a matter of sensitivity to issues of (in)alienability that guided the parser's hypothesis-building, what could it be that triggered the grouping asymmetry? One possibility is that it is a general preference for grouping the last two NPs together over the first two in segmenting a 3NP string. We can investigate this possibility by re-examining part of the completion responses to the EPC-discouraging fragments in the Supplementary Stimulus Set,¹⁹⁴ focusing particularly on those that imposed only one clause boundary, fragment-internally.

There were five fragments whose responses are helpful for this purpose. There were 3NP fragments that contained an NP-*wa*. As remarked earlier, the -*wa* marker topicalizes (or thematizes) not only NP-*ga* subjects but also non-subject NPs, such as NP-*o*, and NP-*ni* (e.g., Kuno 1973a, among others). This means that NP-*wa* is ambiguous, and we have actually seen -*wa* phrases being interpreted as non-subjects in Database D. Hence, the neutrality of -*wa* phrases allows us to examine general preferences for segmenting a 3NP string, without the strong bias afforded by explicitly case-marked non-subject phrases such as NP-*o* and NP-*ni*.

Of 90 responses (18 participants x 5 fragments) collected, seven were either incomplete or incomprehensible responses. Of the remaining 83 responses, 59 imposed two clause boundaries internal to the given 3NP string, and these responses are therefore set aside. The remaining 24 responses imposed only one clause boundary internal to the string, and there are the

¹⁹⁴ Note that this re-examination is not part of Database E.

relevant cases for our present purposes. Table 7-14 below presents a summary of where that single boundary was imposed. In the table, the symbol "x" and a bracket represent NPs and boundary sites.

Table 7-14: Sites of Single Fragment-Internal Clause Boundary Imposed in -ga /-wa 3NP EPC-Discouraging Fragments (N=5)

		x [x x	x x [x	AMB
(26)	-ga -wa -ga	–	–	–
(29)	-wa -wa -ga	11	–	–
(30)	-wa -ga -wa	2	–	–
(31)	-ga -wa -wa	6	–	–
(32)	-wa -wa -wa	5	–	–
		24	0	0

As we see in the table, responses that imposed a single boundary in 3NP fragments *all* placed it between the first two NPs. Not a single response placed it between the last two NPs. That is, when only one boundary was imposed, it invariably grouped NP2 and NP3 together, as schematized in (7.39).

- (7.39) a. NP₁ NP₂ [NP₃ 0%
- b. NP₁ [NP₂ NP₃ 100%

Certainly, the above examination provides only indirect information and the number of instances is very small, and it will be necessary to seek more definitive evidence about the role of (in)alienability. The above examination seems, however, to suggest the possibility that the pattern of grouping three NPs we have seen may (also) reflect a general preference in the parser's structure-building.

Given that the parsing process is incremental in Japanese just as in other languages (e.g., Inoue & Fodor 1995), the response pattern of Database E might reflect constraints stemming from the universal principles we have been considering on interpretations for each NP-*ga*. For example, when NP1-*ga* and NP2-*ga* are encountered one at a time, they might be each interpreted transparently as the subject of their own clauses, in accordance with the MA and other principles. When a further NP-*ga* is encountered (at NP3), bearing a possible possession relationship to NP2-*ga*, the parser might reanalyze NP2-*ga* as an external possessor in order to avoid a third clause. Thus, even though interpreting each NP-*ga* transparently is generally favored, imposing a third clause in the case like Fragment 33 might result in a doubly *self*-embedding with a 3*ga* sequence, as (7.40) below illustrates.

(7.40) SSC		[NP₁-ga	[NP₂-ga	[NP₃-ga
TIMC		✓	✓	✓
MA	-ga	✓	✓	✓
	clause	1	2	3 (#)
MCP		✓	✓	✓
ML		✓	✓	✓
PoNP		✓	✓	✓

Thus, to avoid hypothesizing that three NP-ga's are in identical structural positions (with the implication of double embedding), the parser might reanalyze NP2-ga as an external possessor, as illustrated in (7.41).

(7.41) SSC + EPC		[NP₁-ga	[NP₂-ga	NP₃-ga
TIMC		✓	✓	x
MA	-ga	✓	x	✓
	clause	1	2	2
MCP		✓	Δ	✓
ML		✓	x	Δ
PoNP		✓	x	✓

Since the overwhelming majority of responses in Database E exhibit this choice, it must be assumed the more economical alternative for the parser, compared with other possibilities.

A question arises as to why the parser did not also reanalyze the first NP-ga as an external possessor to take the fullest advantage of the opportunities offered. One possible explanation is that this kind of twofold reanalysis might be costly. Alternatively (or jointly), double EPC might itself

be costly. So let us consider what the double EPC interpretation would look like. Consider (7.42).

(7.42) Double EPC		[NP ₁ -ga	NP ₂ -ga	NP ₃ -ga
TIMC		x	x	✓
MA	-ga	Δ	Δ	✓
	clause	1	1	1
ML		x	x	x
MCP		Δ	Δ	✓
PoNP		x	x	✓

Recall that there are at least three possible syntactic analyses of the derivation of the EPC: (a) PR-raising; (b) base-generation for alienable relation and PR-raising for inalienable relation; and (c) adjunction. This means that the Δ's would be all ✓'s at the best and x's in the worst case. Either way, the motivation for the EPC is focus, as we saw in Section 6.2. Imposing a double EPC means that there should be multiple foci associated with this structure,¹⁹⁵ which would be disobeying ML twice. Even though this alternative produces a one-clause hypothesis, it was clearly dispreferred. Violation of ML twice might then be the reason (or part of the reason) why the EPC opportunity was not exploited in full, and if any further syntactic burden adds to this, costs

¹⁹⁵ For a brief discussion of multiple foci and the EPC, see Section 6.2. Also, as noted earlier, responses elicited in this experiment might have provided us with information not only about the syntactic parsing stage but also about the post-syntactic stages due to the nature of the off-line sentence completion task. If so, the lack of inter-sentential pragmatic ground might have discouraged EPC interpretations, working against multiple foci.

would of course be worse (one or two chains associated with PR-raising or one or two extra nodes as the result of adjunction, for example, in alternative analyses). Moreover, a double EPC interpretation would also violate PoNP twice because NP1 and NP2 are preferred to be adjuncts rather than arguments.

Another alternative to the SSC interpretation is the NOC interpretation (strictly the SSC plus NOC interpretation¹⁹⁶), as schematized in (7.43).

(7.43) SSC + NOC		[NP₁-ga	[NP₂-ga	NP₃-ga
TIMC		✓	✓	x
MA	-ga	✓	✓	x
	clause	1	2	2
MCP		✓	Δ	x
ML		✓	x	x
PoNP		✓	✓	Δ

This alternative would result in a two-clause (single-embedding) structure.

NP3-ga would violate the MCP and MA via overt or covert movement, and a response of this type may also involve a two member control chain between an experiencer subject and the PRO associated with it inside the VP (e.g., Takahashi 1996, see Section 3.3). Also, as we discussed in the Database D Section, focus effects would be involved as the interaction between the NOC predicate and the subject of the same clause, which is relevant to the ML.

¹⁹⁶ There are various possible structures considered involving the NOC interpretation, but this is the only type observed in the responses.

Thus, structures imposed at NP2-*ga* and NP3-*ga* would not be minimal in the parser's structure-hypothesis, compared to SSC plus EPC. As discussed above, the SSC plus EPC interpretation seems to be the optimal choice for the parser to take.

7.5 Summary of Chapter 7

This chapter reported an off-line sentence-completion experiment that explored the effect of ambiguity arising from the multiple syntactic functions associated with the -*ga* marker. Using a range of stimulus fragments of varying type, a large pool of completion responses was elicited, which were reported in five separate but inter-related databases. Analyses of these databases provide several pieces of important information about the parser's preferences in processing NP-*ga* sequences, in particular, about the parser's preferences in general.

First, NP-*ga* seems most likely to be interpreted as the single subject of its own clause, suggesting that an NP-*ga* encountered in input is not really ambiguous for the parser. When two -*ga* phrases not supporting a possession relation were encountered at the beginning of a sentence, they were interpreted as single subjects of separate clauses in over 90% of analyzable responses, regardless of whether they were adjacent to each other. When a sentence-beginning consisted only of adjacent -*ga* phrases (again, without any possession relation), those phrases were again interpreted as

single subjects approximately in 90% of the time. The strong preference for the single subject interpretation of NP-*ga* suggests that the difficulty with double self-embedding appears not due to an ambiguity associated with the multiple syntactic function of *-ga*.¹⁹⁷ The findings of Experiments 1 and 2, taken together, suggest that a configuration involving three identical structural positions adjacent in the surface string is a crucial contribution to the center-embedding problem in Japanese; this suggestion is also extendable to several phenomena in other languages, such as English. The finding of Experiment 3 may indicate that structural positions, identical and adjacently positioned, are difficult for reasons other than the syntactic ambiguity of *-ga*'s multiple functions. This in turn means that the processing problem with double self-embedding in Japanese is due not to syntactic ambiguity, but rather to the resource load associated with syntactic similarity, just as in English.

Second, the findings of Experiment 3 also show that the parser apparently employs principles falling under "Minimal Everything" in processing Japanese, just as in other languages. These principles are always in play in interpreting each NP-*ga*. The strong preference for the single-subject interpretation of *-ga* together with the fact that the majority of exceptions to that interpretation were parallel-subject interpretations, further suggests the importance of interpreting morphological case transparently. A strategy such as Transparent Interpretation of Morphological Case may be particularly

¹⁹⁷ In Experiments 1 and 2, there were no possession relationships between NPs.

important for languages such as Japanese that are head- and complementizer-final, where one case-marker (or particle) is often the morphological realization of more than one abstract case.

Experiment 3 has shown that this strategy is a very likely realization of the Minimal Chain Principle (De Vincenzi 1991, 1994), and that it functions in conjunction with other universal principles, such as the Minimal Attachment (Frazier 1978; Frazier & Fodor 1978), Minimal Lowering (Frazier 1999), and Primary-over-Non-Primary (e.g., Frazier & Clifton 1996, among others).

Since Experiment 3 is a large-scale exploratory study, each fragment was tested with just one set of lexical items. Thus, the findings emerging here are important and interesting, but necessarily limited. Several issues for future research will be discussed in Chapter 8, together with issues arising from Experiments 1 and 2 reported earlier.

CHAPTER 8

CONCLUSIONS

The research undertaken in this dissertation, involving three independent yet interrelated experiments, aimed to investigate the mechanism(s) underlying the problem that the human sentence processor so often suffers with doubly center-embedded sentences. In pursuit of this goal, the investigation looked at processing costs for sentences of Japanese, a language having structural properties very different from those of English, the language previously used in much of the relevant research. Given the standard assumption that fundamental aspects of language processing are universal, the move to a different language sets up opportunities for new and important insights, since universal principles interact with the varying grammatical properties of particular languages in illuminating ways. The research therefore exploits the fact that Japanese marks abstract case overtly (cf. rare instances, only, of such case-marking in English), and uses as the medium for exploration the effect of three consecutive NPs marked with the nominative particle *-ga*. The hypothesis is that close study of the processing characteristics of *3ga* sequences would be revealing for the more general problem of double embedding, in the sense that *3ga* may represent a “worst-case” scenario, one in which maximally similar constituents are positioned with maximal adjacency.

Among a variety of double center-embedding structures that are possible in Japanese, those involving double self-embeddings of sentential complements were chosen for the experiments, since these allow the possibility of a surface sequence (schematically, N1 N2 N3 V3 V2 V1) which is the closest equivalent possible to that seen in the prototypical English examples.

In what follows, the logic and outcomes of the research reported in the dissertation are first summarized. Then, several issues emerging in the course of the experiments are taken up, as a means to suggest avenues for (and speculations about) useful future research.

8.1 Summary of Experimental Findings

The experiments reported in the current study fall into two groups with respect to their goals: The aim of Experiments 1 and 2 was to examine the contribution of *3ga* sequences to the difficulty of processing center-embedded sentences of Japanese, while that of Experiment 3 was to explore the parser's preferences among multiple possible structural interpretations of NP-*ga*, to see how these might align with already proposed universal principles.

Experiment 1 was a preliminary study employing off-line rating methods, and provided evidence in two different tasks in support of the following intuition: Japanese speakers generally find doubly center-embedded structures difficult to process, but not all doubly center-embedded sentences are equally difficult. Rather, difficulty is at its peak when such sentences contain three nominatively

case-marked subjects consecutively. In particular, Experiment 1 showed that processing is judged easier when an NP-*ga* sequence is *reduced* so that surface NP-*ga* NP-*ga* NP-*ga* becomes, e.g., NP-*wa* NP-*ga* NP-*ga*, via topicalization of the matrix subject. The same is true when the NP-*ga* string is *interrupted* by the inclusion of an independent constituent (an adverbial phrase, AdvP) within the sequence, so that surface NP-*ga* NP-*ga* NP-*ga* becomes, e.g., NP-*ga* NP-*ga* AdvP NP-*ga*.

However, Experiment 1's outcome left open the question of whether the 3*ga* cost, the existence of which had now been firmly established, relates specifically to the underlying problem of double-embedding, or whether instead it represents no more than a quite separate burden added to an already complex processing situation. This alternative interpretation arises as a real possibility from a single test case included in the stimulus list for one of the two judgment tasks, assessing an instance in which the 3*ga* sequence occurs in a single- rather than double-embedding. In this instance, an embedded clause used a nominatively marked object, and the judgment data suggested that the same 3*ga* cost was evident.

Experiment 2 therefore followed up with a powerful design devised explicitly to assess the generality of the 3*ga* cost, and employed a self-paced reading technique so as to tap syntactic processing more sensitively. Two separate materials designs, one for each of double- and single-embeddings, were built into the stimulus list. These factorial designs were constructed differently for different levels of embedding, to maintain felicity in the

experimental sentences, but had parallel logic: The design for double embedding factorially combined a manipulation of adverb placement (to interrupt or not interrupt the NP string) with variation in the particle taken (*-ga* versus *-wa*) by the first of the three NPs; and the design for single embedding combined a manipulation of the kind of object taken in the embedded clause (nominative versus accusative) with the same variation of NP1's particle. In either instance, a *3ga* cost is identified if there is special difficulty in reading sentences with an unbroken or full sequence of three NP-*ga* phrases, but no such special difficulty in the corresponding sentences where that sequence can never occur because NP1 is marked with *-wa*.

The reading time data of Experiment 2 revealed just that pattern of interaction for the double center-embedding design, but not for the single center-embedding design; in the latter case, the interaction was null. Thus these more definitive data, less susceptible than off-line judgments to post-syntactic influences, e.g., conventions about "good writing style", support a firm claim that the *3ga* cost is specific to double-embedding. Conclusions drawn about *3ga* therefore bear on the problem of double-embedding, more generally.

A second kind of data was collected in Experiment 2, allowing an estimate of the extent to which double- and single-embeddings are actually understood by Japanese speakers. These data are provided by the error rates for YES/NO comprehension questions following experimental sentences. They reveal, first, that *3ga*'s impact on processing (as reflected in reading time data) does not lead

to a detectable impairment in comprehension; that is, while error rates are greater for double- than for single-embeddings, these do not vary across the structural manipulations of the double-embedding design. Moreover, errors are much fewer than predicted by chance; that is, while double center-embeddings are indeed more difficult to process than single embeddings, processing is apparently more often successful than not. These data bear on a suggestion currently live in the field, that Japanese is more tolerant of embedding than is, say, English. (One version of this suggestion proposes that an extra level of embedding is required in Japanese, before a level of difficulty is reached that corresponds to the difficulty that English speakers experience with double embeddings.) Assessment of this kind of cross-linguistic claim is extraordinarily difficult, and for the moment it remains unevaluated. The speculation would be, however, that a fair-handed comparison should factor in the additional dependencies involved when filler-gap relations must also be computed, since English uses relative clauses to build its dangerous double-embeddings.

For Japanese, then, structure-building is maximally difficult in two-level center-embeddings when the sentence includes a *3ga* sequence. This suggests that difficulty with identical structural assignments for surface-adjacent constituents is fundamental to the problem with double center-embedding. We therefore view the more general problem as being one involving a resource-limited processing mechanism that is subject to interference when *structurally similar* assignments must be projected, repeatedly, for each of a series of *positionally similar* constituents. The *3ga* sequence is then exactly the

worst-case scenario: Structural similarity is maximal when configurations are *identical* (i.e., three subjects, cf. a topic plus two subjects) and positional similarity is maximal when those constituents are *adjacent* (i.e., consecutive on the surface, cf. separated by an independent, intervening adverbial phrase).

If the language processing mechanism is universal, this “worst-case” configuration should apply across languages. And indeed, the typically problematic English double center-embedding (with its object-extracted relative clauses) arguably has just these characteristics. Whether relative pronouns (or complementizers) are overt or covert, the English construction has three subjects effectively adjacent in surface form.

The findings of the current study are limited, necessarily, because the investigation focused on the adjacent repetition of subjects in Japanese. However, cross-linguistic comparisons support a speculation that the problem is not particular to subject position. For example, substantial processing difficulty arises for English sentences where three clausal modifiers are encountered consecutively.

The findings of Experiments 1 and 2 are inconsistent with predictions made by any existing theory that does not refer both to identity in structural assignment and to positional similarity. That is, the findings of Experiment 1 and 2 are not explained in terms of more than two incomplete sentences, more than two incomplete case-assignment relations, incomplete thematic relations with a pre-set maximal limit, and measurements of the locality of discourse dependencies. Nor do accounts that attribute the problem to surface-form

similarity (say, among three stacked NPs) explain the findings of the current study.

Lewis's (1998) Similarity-Based Interference Theory incorporates structural and positional similarity factors. However, in this theory's current formulation, structural similarity is to be evaluated in terms of *potential* rather than *actual* positions. This immediately predicts, incorrectly, that any 3ga sentence in Japanese will be problematic, whether the sequence arises in double- or single-embedding, and this is a serious inconsistency. That is, processing problems presumably arise not because *potentially similar* structural roles are a drain on resources, but more specifically because similar constituents must repetitively enter (in the double-embedding construction) into dependencies reflecting *identical* structural roles.

Experiment 3 is prompted by the observation that while there is agreement that the center-embedding problem in English is not caused by temporary ambiguity, no information has been available about whether this is also true for Japanese. In particular, no information has been available about how the parser prefers to interpret NP-ga. Thus, Experiment 3 used a sentence completion task to explore the possibility that ambiguity arising from -ga's multiple possible syntactic roles is a factor entering into the 3ga cost, and perhaps the problem of double-embedding more generally. Here, analyses of the structures imposed on sentence fragments by participants (as indicated by the structures evident in their completion responses) show that an NP-ga phrase encountered in input is interpreted with high probability as the single subject of its own clause. This in

turn suggests that it is unlikely that processing difficulties are due to local ambiguity.

Interestingly, completion responses occasionally involved double center-embedding constructions with *3ga*, but double *self*-embeddings (of the type employed as the test materials of Experiment 1 and 2), were not observed. Although the task employed in Experiment 3 was off-line and may not have been performed strictly incrementally, this pattern may suggest that identity and adjacency are relevant to processing difficulty not only for structural assignees (subject phrases), but also for assigners (their corresponding predicates).

Many sub-patterns emerging in the analyses of the completion data of Experiment 3 were found to be explicable in terms of the intersection between NP-*ga*'s potential syntactic roles and universal parsing principles, as summarized in, e.g., the Minimal Everything proposal of Inoue & Fodor (1995). The parser's use of those economy-driven principles is evidently very systematic. For example, the impact of a processing principle specifying a preference for argument interpretation over adjunct interpretation, was observed in response patterns with respect to NP-*ni* and NP-*wa*, which can be role-ambiguous in incremental processing. Findings of this kind are consistent with the view that the parser is not parameterized (Inoue & Fodor 1995, among others).

Finally, response patterns for the sentence-completions of Experiment 3 also indicated the usefulness of a processing generalization as follows:

(8.1) Transparent Interpretation of Morphological Case:

Interpret morphological case transparently, i.e., as attesting its prototypical role.

Whether the statement set out in (8.1) is merely a descriptive generalization, or instead should be viewed as an explanatory principle independent of those currently proposed (e.g., the Minimal Chain Principle, De Vincenzi 1991) depends crucially on as-yet-unresolved issues in the syntax of Japanese. But its motivation in the current context is very clear: In pursuit of economy, a resource-limited parsing mechanism committed to incremental processing might rely heavily on overt case-markers in languages such as Japanese (SOV, and head- and complementizer-final). But since the same morphological case often realizes more than one abstract case, a given case-marker can be multiply ambiguous. In incremental processing, choices among competing structural hypotheses are to be made at the earliest possible point, and Transparent Interpretation of Morphological Case picks out the hypothesis that is most frequently attested.

8.2 Issues for Future Research

Although this study has provided important information about both the center-embedding problem and other aspects of the parsing mechanism, much further research is needed. Among myriad possibilities, we focus in what

follows on a select few, grouping these under three broadly defined issues.

First, it is undoubtedly important to determine, more precisely, what for the parser falls under the notion of “identical structural assignments that are positionally surface-adjacent”. In the current study, repetition effects were investigated only in terms of NP-*ga*, and although the findings have been key in explaining several phenomena, the usefulness of further research has already been motivated in our earlier discussion. So, for example, we have seen that there may be a difference relevant to this issue in the contrast between alternative configurations of clausal modifiers, in English, where single center-embedding is not problematic but two-level is said to be unprocessable, though the contrasting sentences have the same broad meaning (Gibson 1998). It seems equally relevant that embeddings of exactly the same clause type were avoided in sentence completions for 3*ga* fragments in Experiment 3 of the current study. Is this properly taken as an issue of the avoidance of double self-embedding? Or is it, instead, an indication that identity and adjacency factors are independently in play for *clause* types (and/or *predicate* types)? Since Experiments 1 and 2 held clause type constant, by design, their findings can provide no information on this point.

But even within the materials design of Experiment 2, the way is now set for investigations at a finer grain, in which the fact of greater or lesser processing difficulty for different sentence types (now established at the level of whole sentences) would be localized to regions within those sentences. Further development of a processing theory sensitive to the importance of identity and

adjacency might be prompted by determining *at what point* similarity-based effects are first registered, and where such effects peak. Eye-movement tasks seem to be the most appropriate means by which such within-sentence processing load assessments should be obtained, region-by-region, since reading is still self-paced in stimulus presentations that lack the restrictions of *bunsetsu-by-bunsetsu* presentation.

Finally, studies of similarity effects for case-markers other than the nominative might be useful in extending the reach and precision of the current claim. Certainly the prototypical role of NP-*ga* as the subject marker is related to the highest specifier position, which seems to play a prominent role in processing (Frazier 1999). We note, though, that in Japanese it may not be possible to test other syntactic roles because repetition of NPs with markers such as NP-*o* (Acc) or NP-*ni* (Dat), for example, would involve empty categories and/or scrambling (and thus a possibly intractable global ambiguity).

A second broad issue arises, as noted in Section 8.1, in cross-linguistic evaluations of the processing difficulty engendered by double-embedding. Could it possibly be the case that double-embeddings are better tolerated in one language than another? The current study's otherwise well-motivated use of sentential complements, cf. object-extracted relative clause in the prototypical English example, is a confound in that comparison, compromising any direct evaluation. Yet if any aspect of the human sentence processor is non-parameterized, its allocated resources should certainly have a universal setting. A study in Japanese using doubly and singly center-embedded

materials involving filler-gap dependencies would be valuable here. Indeed, such cases can be constructed in various ways in Japanese, allowing experimental materials to be prepared for a systematic design. For example, the schematization of a double-embedding in (8.2) includes three subject-verb dependencies and two filler-gap dependencies, just as the usual English case does, and the example sentence in (8.3) illustrates how this schematization might be given lexical content.

(8.2) [NP1-ga [NP2-ga [NP3-ga t_i V3] NP, t_j V2] NP, V1]

(8.3) # [_S shoonen-ga [_S gakusei-ga [_S sensei-ga t_i hoomonsita] hito , -o
 boy-Nom student-Nom teacher-Nom visited person-Acc
 t_j , shookaisita] yuujin , -ni denwasita.]
 introduced friend-Dat called
 "The boy called the friend who the student introduced to the person who the teacher visited."

Note that an adverbial phrase can be inserted so as to interrupt (or not interrupt) the 3ga sequence of (8.3), just as in the design of Experiment 2. For example, *totemo kisakuni* (very casually) can be placed VP-externally in IP2 between NP2 (*gakusei-ga*) and NP3 (*sensei-ga*); and a different adjective, e.g., *teikitikeni* (regularly) can be placed VP-externally in IP3 after NP3. And the 3ga sequence reduces to 2ga when NP1 is topicalized with *-wa* (as in Experiment 2), or when and *-ga* on NP3 is replaced by *-no* (Gen).

Conversely, a study in English might be attempted which manipulates at least the adjacency factor of the Japanese experiments. To give some sense of

the adverb manipulations involved, the sentences in (8.4) vary the usual English example in a way that is roughly equivalent to the current study.

- (8.4) a. The rat (that) the cat that *reportedly* the dog chased bit died.
 b. The rat (that) the cat (that) the dog *reportedly* chased bit died.

As a third prompt for further research, the exploratory nature of the investigation of NP-*ga* interpretations in Experiment 3 must be acknowledged. That study sought broad coverage via the wide range of fragment types it surveyed in the sentence completion task. Its attendant weakness lay in the fact that only one exemplar (hence, one lexical-content set) was presented for each of its many fragment types. Thus, for the fragment types now revealed to be most central to the argument, further studies could include various classes of lexical items in systematically varying combinations. In this way, evidence about the effect of noun content on the likelihood of different interpretations of NP-*ga* can be obtained; and hence on the issue of lexical bias in what we have taken to be parser's preferred rankings. This is relevant for all the fragments tested, but has particular importance for the nominative object construction (NOC), frequently occurring in daily conversation in Japanese, but produced in the sentence completion task in Experiment 3 for a surprising small range of case-marker configurations. The NOC, as we have seen, offers an important test-case for the proposal that the parser prefers to interpret morphological case transparently.

Transparent Interpretation of Morphological Case is proposed in this dissertation, both because of its intuitive naturalness for languages like Japanese, and because it offered effective coverage for many response patterns emerging in Experiment 3. Its status remains open. Is it merely a descriptive generalization reflecting the surface outcome of universal principles for which a case has already been built on other grounds, in other languages? Or is an independent parsing principle, requiring a separate statement? To clarify this issue, further systematic research is required. On the one hand, that research might pursue issues in the syntax of nominative objects and external possessors, in Japanese; on the other, it might take the form of psycholinguistic research in other languages that have overt case markers instantiating more than one abstract case.

Appendix A-1: Phonological Repetition Effects and 3ga Cost, An Experimental Report

This experiment investigates the effect of repeating a phonologically identical nominative marker on processing doubly center-embedded sentences.^{198,199} In this experiment, an off-line absolute processability rating task was performed in Korean. Korean not only has structural characteristics similar to Japanese, but also has a pair of phonologically conditioned nominative markers, *-i* and *-ka*,²⁰⁰ whereas phonological variants of the nominative case-marker *-ga* are not available in Japanese. Employing this pair of nominative markers as a manipulation tool, the phonological repetition effect was tested with materials created in a 2x2 design, which factorially combined Phonological Substitution (phonological repetition versus reduced repetition) with Complexity Factors (double embedding versus single embedding). Assuming that the human parsing mechanism functions in a universal manner, it was hoped that the outcome of this experiment would provide us with information about the parser's sensitivity to phonological identity in double center-embedding.

Method

Participants

Forty native speakers of Korean participated in the study. Their average age was 27 years, and their average stay in the U.S. was 0;9 years. All participants had obtained a B.A. degree from a college in Korea, and had lived there until they completed their undergraduate studies. They were attending a beginners or an intermediate English summer course at Queens College in New York City. Participants were told that the purpose of the experiment was to research how native speakers of Korean understand Korean sentences, and were paid \$7.00 each for their

¹⁹⁸ This experiment has been reported elsewhere. (See Uehara & Bradley 1996, 2002.)

¹⁹⁹ The author acknowledges the assistances of Soon Ae Chun and John Whitman for the materials construction and of Herb Seliger for the recruitment of participants at Queens College.

²⁰⁰ Korean has another nominative case-marker, *-kkeyse*, which is used as the honorific subject marker, but which is not a phonological variant of *-i* and *-ka*.

participation in the experiment.

Materials

Materials construction began with the creation of structural skeletons for doubly center-embedded sentences containing three consecutive NPs all marked with the phonologically identical nominative case-markers. In the nominative marking in Korean, *-i* marks consonant-final lexical items while *-ka* marks vowel-final lexical items. Two skeletons were created, differing from each other only in that *-i* and *-ka* were used to mark all three subject NPs. As schematized in (1a) and (1b), skeleton *-i* was used in one, while *-ka* was used in the other.

- (1) a. [s **-i** [s **-i** [s **-i** -lul V] V] V] 3 *i*
 b. [s **-ka** [s **-ka** [s **-ka** -ul V] V] V] 3*ka*

The innermost clauses of the 3*i* and the 3*ka* structures in (1) both contained an object. In Korean, the accusative marking is also phonologically conditioned: Vowel-ending lexical items are marked with *-lul*, whereas consonant-ending lexical items are marked with *-ul*. The 3*i* structure for this experiment specified vowel-final subject NPs and a consonant-final object NP, while the 3*ka* structure specified consonant-final subject NPs and a vowel-final NP. These phonological restrictions were crucial when lexical content was chosen for the NP positions in the structural skeletons.

In the second stage of materials construction, the *-i* and *-ka* marking the innermost subjects of the basic skeletons in (1a-b), respectively, were filled with their phonological alternatives, creating a total of two skeletons. This is shown in (2), where boldface indicates the locations to which the substitution manipulation was applied.

- (2) a. *-i* / **-ka** 3 *i* [s -i [s -i [s **-i** -lul V] V] V]
 substitution 2 *i* [s -i [s -i [s **-ka** -lul V] V] V]
 b. **-ka** / *-i* 3*ka* [s **-ka** [s **-ka** [s **-ka** -ul V] V] V]
 substitution 2*ka* [s **-ka** [s **-ka** [s **-i** -ul V] V] V]

The above design was then expanded to include a complexity factor, two versus one level of center-embedding. Singly center-embedded structural skeletons were created by omitting the middle clauses of the basic doubly center-embedded

skeletons listed in (3). In this way, the final design reflected the combination of Phonological Substitution and Complexity.

(3)	a.	<i>-i /-ka</i> substitution	3 <i>i</i>	[s -i	[s -i	[s - i	-lul	V]	V]	V]
			2 <i>i</i>	[s -i	[s -i	[s - ka	-lul	V]	V]	V]
			2 <i>i</i>	[s -i		[s - i	-lul	V]		V]
			1 <i>i</i>	[s -i		[s - ka	-lul	V]		V]
	b.	<i>-ka/-i</i> substitution	3 <i>ka</i>	[s - ka	[s -ka	[s - ka	-ul	V]	V]	V]
			2 <i>ka</i>	[s -ka	[s -ka	[s - i	-ul	V]	V]	V]
			2 <i>ka</i>	[s -ka		[s - ka	-ul	V]		V]
			1 <i>ka</i>	[s -ka		[s - i	-ul	V]		V]

In the final stage of materials construction, four different sets of lexical items were filled into the structural quadruples, to produce a total of eight sets of test sentence quadruples. As already described, the lexical items in the NP positions of the skeletons reflected the phonological restrictions needed to meet the use of the *-i /-ka* variants. Thus, within each quadruple, the lexical item inserted into the innermost subject NP position differed from its alternative, whereas the verbs were identical. Phonological substitution was therefore believed to alter the overall plausibility of sentential meanings as little as possible.

The process of selecting lexical items for NP slots also took the following into account: While nouns representing human referents were used in all NP slots, adjacent NPs were always of different types because repetitive use of NPs of the same kind in subject positions may increase the processing difficulty of a center-embedded sentence (see Bever 1970; Hudson 1996, among others). For example, if NP1 selected a kinship term, NP2 and NP3 were a role term and a proper noun, respectively. Proper nouns never occurred consecutively (contra Lee & Nakayama 2003). The avoidance of repetition of the same noun type in adjacent NP slots was insured not only in the doubly center-embedded sentences, but also with singly center-embedded sentences.

The result was eight sets of quadruples (32 test sentences). The two sets of quadruples in (4) and (5) are examples of *-i /-ka* and *-ka/-i* test quadruples, respectively, used in this experiment. In the examples, DCE and SCE stand for double and single center-embedding, respectively, and the site where phonological substitutions were applied are emphasized in bold face (For a full list of the critical materials, see the end of Appendix A-1).

- (4) DCE 3i [Myeng Hwan-i [tongsayng-i [pesuchancang-i
Myeng Hwan-Nom younger brother-Nom bus conductor-Nom
nwuna-lul ttemilessta]-ko pulphyenghayssta]-ko hayssta.]
elder sister-Acc pushed-that complained-that said
- DCE 2i [Myeng Hwan-i [tongsayng-i [kacengbu-ka
Myeng Hwan-Nom younger brother-Nom housewife-Nom
nwuna-lul ttemilessta]-ko pulphyenghayssta]-ko hayssta.]
elder sister-Acc pushed-that complained-that said
- "Myeng Hwan said that his younger brother complained that a **bus conductor/housewife** pushed his older sister."
- SCE 2i [Myeng Hwan-i [pesuchancang-i nwuna-lul ttemilessta]-ko
Myeng Hwan-Nom bus conductor-Nom elder sister-Acc pushed-that
hayssta.]
said
- SCE 1i [Myeng Hwan-i [kacengbu-ka nwuna-lul ttemilessta]-ko
Myeng Hwan-Nom housewife-Nom elder sister-Acc pushed-that
hayssta.]
said
- "Myeng Hwan said that a **bus conductor/housewife** pushed his older sister."
- (5) DCE 3ka [Emeni-ka [kyohoy moksa-ka [Yanghuy-ka yakhonca-lul
mother-Nom church pastor-Nom Yanghuy-Nom fiancé-Acc
cal kollassta]-ko chingchanha-si-essta]-ko calangha-si-essta.]
well chose-that praised(Hon)-that was proud(Hon)
- DCE 2ka [Emeni-ka [kyohoy moksa-ka [Swuhyeng-i yakhonca-lul
mother-Nom church pastor-Nom Swuhyengi-Nom fiancé-Acc
cal kollassta]-ko chingchanha-si-essta]-ko calangha-si-essta.]
well chose-that praised(Hon)-that was proud(Hon)
- "Mother was proud that the pastor had expressed admiration (for the fact) that **Yanghuy/Swuhyeng** had chosen her fiancé well."
- SCE 2ka [Emeni-ka [Yanghuy-ka yakhonca-lul cal kollassta]-ko
mother-Nom Yanghuy-Nom fiancé-Acc well chose-that
calangha-si-essta.]
was proud(Hon)
- SCE 1ka [Emeni-ka [Swuhyeng-i yakhonca-lul cal kollassta]-ko
mother-Nom Swuhyengi-Nom fiancé-Acc well chose-that
calangha-si-essta.]
was proud(Hon)
- "Mother was proud that **Yanghuy/Swuhyeng** had chosen her fiancé well."

The 32 test sentences were distributed to form four counterbalanced versions, and each version was supplemented by 40 filler sentences that were identical across all the versions.

Procedure

Participants were presented with a paper-and-pencil questionnaire booklet which consisted of two sections: Section 1 sought basic demographic information, and Section 2 presented the test sentences singly and asked for absolute processability judgments on a 6-point scale. The six points on the scale were represented by the symbols commonly used in the Korean culture:

- ◎ understand completely
- easy to understand
- ? understand fairly well
- X? a little hard to understand
- X don't understand
- XX don't understand at all

It was expected that participants would be able to signal the difference between understandable and non-understandable sentences with the middle values, ○? and X?. Before the task, participants were given three sentences for practice in responding with the rating symbols. The three practice sentences contained no material relevant to the critical sentences. They were created to be interpreted as very easy to understand, understandable but not completely, and impossible to understand.

Participants were asked to proceed through the questionnaire at their own pace. They were also asked to try to understand the meaning of sentences at a natural speed without back-tracking. It usually took no more than 20 minutes to complete the questionnaire.

Data Treatment

For the purpose of analysis, the rating scale was assumed to be treated by participants at least quasi-interval. Therefore, responses were directly converted into

numerical values (© = 1, XX = 6). Their distribution was analyzed parametrically.

Results

Mean processability ratings for Experiment 3's absolute processability judgments are presented in Table A-1. In the table, the ratings are shown at two levels of complexity: For DSC 3*i* /3*ka* and SCE 2*i* /2*ka* sentences, to which the phonological substitutions had not applied yet; and for their post-substitution alternatives, DSC 2*i* /2*ka* and SCE 1*i* /1*ka* sentences, which contained fewer instances of phonological repetition. The data presented in the table collapses NP-*i* and NP-*ka* because the analysis showed neither an effect of marker type, $F(1, 36)=1.22$, $p>.25$, nor an interaction of marker with other factors, $p>.25$ for all terms.

Table A-1 Mean Rated Processability as a Function of Phonological Substitution and Complexity

	Phonological Substitution	
	DCE 3 <i>i</i> / 3 <i>ka</i> SCE 2 <i>i</i> / 2 <i>ka</i>	DCE 2 <i>i</i> / 2 <i>ka</i> SCE 1 <i>i</i> / 1 <i>ka</i>
Complexity		
Double Embedding	3.28	3.30
Single Embedding	2.04	1.79

Overall, processability ratings for the pre-phonological-substitution applications DSC 3*i* /3*ka* and SCE 2*i* /2*ka* sentences (mean rating 2.66 on the 6-point scale) did not differ from their pre-phonological-substitution application counterparts (mean rating 2.54), $F(1, 36)=2.07$, $p>.10$ for phonological substitution effect, and there was no interaction found between Substitution and Complexity, $F(1, 36)=2.31$, $p>.10$. Mean ratings processability for pre- and post- phonological-substitution applications are summarized in Table A-2.

Table A-2 Mean Rated Processability for Repetition Sentences and Their Variants as a Function of Phonological Substitution

Substitution	Mean Rating
Pre-Substitution	2.66
Post-Substitution	2.07

The failure to detect any effect from a phonologically conditioned variation cannot be, however, due to insensitivity in the way participants used the rating scale. This is confirmed by the main effect for Complexity, summarized in Table A-3 below: That is, the more complex doubly center-embedded sentences were much less favored in processability ratings (mean rating 3.29) than the simpler singly center-embedded sentences (mean rating 1.91), $F(1, 36)=97.71$, $p<.001$. Thus, a one-level difference in embedding has clearly reflected in processability judgments, corresponding to a decrease of 1.38 rating scale units from single to double embedding.

Table A-3 Mean Rated Processability for Doubly and Singly Center-Embedded Sentences as a Function of Complexity

Complexity	Mean Rating	F¹
Double Embedding	3.29	97.71***
Single Embedding	1.91	

¹ Degrees of freedom (1,30) for all comparisons

* $p < .05$ ** $p < .01$ *** $p < .0001$

Discussion

The primary finding of Experiment 3 is that the processing cost associated with a sequence of three consecutive NPs repetitively marked with the phonologically identical nominative marker does not differ from that associated with its alternative in which the phonological repetition is split up. More concretely, [NP-*i* NP-*i* NP-*i*] and [NP-*ka* NP-*ka* NP-*ka*] are not more costly than their phonological variants [NP-*i* NP-*i* NP-*ka*] and [NP-*ka* NP-*ka* NP-*i*], respectively.

Given the assumption that the human parsing mechanism manifests some aspects of its limitation universally across languages, it may be possible to translate this finding as follows: The fact that no phonological repetition effect was detectable in Korean indicates that the effect is unlikely to be a cause of the processing cost associated with 3ga sequences in Japanese. Even if it is, it appears to be a very minor factor. That is, the processing cost associated with 3ga sequences does not seem to manifest itself because of the phonological identity of the repeated nominative case-marker.

Existing work that empirically examines the phonological repetition effect on processing center-embedded sentences is minimal. Recall our brief review in Chapter 2 of the observation that Rosenbaum and Kim (1976) made with respect to the comprehension of Korean doubly center-embedded sentences such as (6).

- (6) a. [ku ay-tul-i [wuli hyeng-i [sensayng-i olh]-ko-lul
that child-PI-Nom we brother-Nom teacher-Nom right-that-Acc
palako-keysita]-nun-kes-ul alkoissta.]
wish(Hon)-AdNom that-Acc knows

"The children know that my brother wishes that the teacher is right."

(Rosenbaum & Kim 1976: 54; brackets' positions modified)

- b. [ku ay-tul-i [wuli apenim-kkeyse [nal ssi-ka kay]-ko-lul
that child-PI-Nom we father-Nom(Hon) weather-Nom clear-that-Acc
palako-keysita]-nun-kes-ul alkoissta.]
wish(Hon)-AdNom that-Acc knows

"The children know that our father wishes that the weather clears up."

(Rosenbaum & Kim 1976: 47; brackets' positions modified)

Rosenbaum & Kim attributed the processing difficulty of (6a) to a lack of various "structure aiding cues" which together support comprehension of the structurally

identical (6b). As we summarized earlier, the processing aiding cues observed by Rosenbaum & Kim can be classified into two types: One type supports discriminability among NPs; the other type supports relations between constituents. That is, the variation among the nominative case-markers, *-i*, *-kkeyse*, and *-ka*, is the first type, while the relationships signaled with honorific agreement and lexical/conceptual content is the second type. While Rosenbaum & Kim's study focused on those cues acting together, this experiment isolated just the phonological factor to examine whether impaired phonological discriminability underlies the cost of NP-*ga* repetition. What we see here is that phonological discriminability *alone* does not seem to improve the comprehension difficulty to the same degree as that observed by Rosenbaum & Kim.

Summary

To investigate the repetition effect of identical nominative case-markers on processing doubly center-embedded sentences, an experiment was performed in Korean. Korean is syntactically similar to Japanese and has a pair of phonologically conditioned nominative markers. The outcome of absolute processability ratings failed to show any difference between sentences containing three subject NPs, all marked with the phonologically identical nominative marker, and their alternatives with one less phonological repetition. If we assume that the human parsing mechanism reveals its limitations in the same manner across languages, then the outcome of Experiment 3 appears to suggest that the phonological similarity of the 3*ga* sequences is not a major factor contributing to the 3*ga* cost. If there is any effect of phonological repetition caused by the identical nominative marker, it is undetectably small when compared to syntactic repetition effects.

Appendix

-i/-ka substitution

- (1) Sachon-i Kyengchal-i Kiyeong-i wuncensa-lul ttayliessta-ko cwucanghanta-ko
 cousin-Nom police-Nom Kiyeong-Nom driver-Acc hit-that insisted-that
 cenhay cwuessta.
 report gave

Sachon-i Kyengchal-i Yengswu-ka wuncensa-lul ttayliessta-ko cwucanghanta-ko
 cousin-Nom police-Nom Yengswu-Nom driver-Acc hit-that insisted-that
 cenhay cwuessta.
 report gave

"My cousin told (me) that the police insisted that Kiyeong/Yengswu hit the driver."

Sachon-i Kiyeong-i wuncensa-lul ttayliessta-ko cenhay cwuessta.
 cousin-Nom Kiyeong-Nom driver-Acc hit-that report gave

Sachon-i Yengswu-ka wuncensa-lul ttayliessta-ko cenhay cwuessta.
 cousin-Nom Yengswu-Nom driver-Acc hit-that report gave

"My cousin told (me) that Kiyeong/Yengswu hit the driver."

- (2) Myeng Hwan-i tongsayng-i pesuchancang-i nwuna-lul
 Myeng Hwan-Nom younger brother-Nom bus conductor-Nom elder sister-Acc
 ttemilessta-ko pulphyenghayssta-ko hayssta.
 pushed-that complained-that said

Myeng Hwan-i tongsayng-i kacengbu-ka nwuna-lul
 Myeng Hwan-Nom younger brother-Nom housewife-Nom elder sister-Acc
 ttemilessta-ko pulphyenghayssta-ko hayssta.
 pushed-that complained-that said

"Myeng Hwan said that his younger brother complained that a bus conductor/housewife pushed his older sister."

Myeng Hwan-i pesuchancang-i nwuna-lul ttemilessta-ko hayssta.
 Myeng Hwan-Nom bus conductor-Nom elder sister-Acc pushed-that said

Myeng Hwan-i kacengbu-ka nwuna-lul ttemilessta-ko hayssta.
 Myeng Hwan-Nom housewife-Nom elder sister-Acc pushed-that said

"Myeng Hwan said that a bus conductor/housewife pushed his older sister."

- (3) han cunghaksayng-i apenim-i Hyey Yeng-i halmeni-lul
 junior highschool student-Nom father-Nom Hyey Yeng-Nom grandmother-Acc
 cal posalphye tulyessta-ko kkippeha-si-essta-ko allye cwuessta.
 well care gave-that was happy(Hon) inform gave

han cunghaksayng-i apenim-i Mili-ka halmeni-lul
 junior highschool student-Nom father-Nom Mili-Nom grandmother-Acc
 cal posalphye tulyessta-ko kkippeha-si-essta-ko allye cwuessta.
 well care gave-that was happy(Hon) inform gave

"A junior high school student informed (me) that his father was happy that Hyey Yeng/Mili took good care of her grandmother."

han cunghaksayng-i Hyey Yeng-i halmeni-lul
 junior highschool student-Nom Hyey Yeng-Nom grandmother-Acc
 cal posalphye tulyessta-ko allye cwuessta.
 well care gave-that inform gave

han cunghaksayng-i Mili-ka halmeni-lul
 junior highschool student-Nom Mili-Nom grandmother-Acc
 cal posalphye tulyessta-ko allye cwuessta.
 well care gave-that inform gave

"A junior high school student informed (me) that Hyey Yeng/Mili took good care of her grandmother."

- (4) Namtongsayng-i Kichel-i ku yesensayng-i Sanghuy-lul
 Younger brother-Nom Kichel -Nom that woman teacher-Nom Sanghuy -Acc
 talmassta-ko mitko issta-ko malhay cwuessta.
 resembled-that believing was-that say gave
 Namtongsayng-i Kichel-i yeca chinkwu-ka Sanghuy-lul
 Younger brother-Nom Kichel -Nom woman friend-Nom Sanghuy -Acc
 talmassta-ko mitko issta-ko malhay cwuessta.
 resembled-that believing was-that say gave

"My younger brother said (to me) that Kichel believed that that woman teacher/his girlfriend resembled Sanghuy."

Namtongsayng-i ku yesensayng-i Sanghuy-lul talmassta-ko
 Younger brother-Nom that woman teacher-Nom Sanghuy -Acc resembled-that
 malhay cwuessta.
 say gave

Namtongsayng-i yeca chinkwu-ka Sanghuy-lul talmassta-ko
 Younger brother-Nom woman friend-Nom Sanghuy -Acc resembled-that
 malhay cwuessta.
 say gave

"My younger brother said (to me) that that woman teacher/his girlfriend resembled Sanghuy."

-ka/-i substitution

- (1) Yenghuy-ka cito kyoswu-ka enni-ka yuhaksyng-ul
 Yenghuy -Nom advisor-Nom older sister-Nom foreign student-Acc
 mannayahanta-ko seltukhako issta-ko kangcohayssta.
 meet-must-that insisting was-that emphasized

Yenghuy-ka cito kyoswu-ka tongsayng-i yuhaksyng-ul
 Yenghuy -Nom advisor-Nom younger brother-Nom foreign student-Acc
 mannayahanta-ko seltukhako issta-ko kangcohayssta.
 meet-must-that insisting was-that emphasized

"Yenghuy emphasized that her advisor was insisting that her older sister/younger brother should meet the foreign student."

Yenghuy-ka enni-ka yuhaksyng-ul mannayahanta-ko
 Yenghuy -Nom older sister-Nom foreign student-Acc meet-must-that
 kangcohayssta.
 emphasized

Yenghuy-ka tongsayng-i yuhaksyng-ul mannayahanta-ko
 Yenghuy -Nom younger brother-Nom foreign student-Acc meet-must-that
 kangcohaysssta.
 emphasized

"Yenghuy emphasized that her older sister/younger brother should meet the foreign student."

- (2) Yuchiwen kyosa-ka Mira-ka oppa-ka Selak-ul kassta-ko
 Kindergarden teacher-Nom Mira-Nom older brother-Nom Mt.Sōrak-Acc went-that
 kekceghako issta-ko malssumhay cwu-si-essta.
 worrying was-that said gave(Hon)

Yuchiwen kyosa-ka Mira-ka samchon-i Selak-ul kassta-ko
 Kindergarden teacher-Nom Mira-Nom uncle-Nom Mt.Sōrak-Acc went-that
 kekceghako issta-ko malssumhay cwu-si-essta.
 worrying was-that said gave(Hon)

"The kindergarden teacher said (to me) that Mira was worrying that her older brother/uncle had gone to Mt. Sōrak."

Yuchiwen kyosa-ka oppa-ka Selak-ul kassta-ko
 Kindergarden teacher-Nom older brother-Nom Mt.Sōrak-Acc went-that
 malssumhay cwu-si-essta.
 said gave(Hon)

Yuchiwen kyosa-ka samchon-i Selak-ul kassta-ko
 Kindergarden teacher-Nom uncle-Nom Mt.Sōrak-Acc went-that
 malssumhay cwu-si-essta.
 said gave(Hon)

"The kindergarden teacher said (to me) that her older brother/uncle had gone to Mt. Sōrak."

- (3) Emeni-ka kyohoy moksa-ka Yanghuy-ka yakhonca-lul cal kollassta-ko
 mother-Nom church pastor-Nom Yanghuy -Nom fiancé-Acc well chose-that
 chingchanha-si-essta-ko calangha-si-essta.
 praised(Hon)-that was proud(Hon)

Emeni-ka kyohoy moksa-ka Swuhyeng-i yakhonca-lul cal kollassta-ko
 mother-Nom church pastor-Nom Swuhyeng-Nom fiancé-Acc well chose-that
 chingchanha-si-essta-ko calangha-si-essta.
 praised(Hon)-that was proud(Hon)

"Mother was proud that the pastor had expressed admiration (for the fact) that Yanghuy/Swuhyeng had chosen her fiancé well."

Emeni-ka Yanghuy-ka yakhonca-lul cal kollassta-ko calangha-si-essta.
 mother-Nom Yanghuy -Nom fiancé-Acc well chose-that was proud(Hon)

Emeni-ka Swuhyeng-i yakhonca-lul cal kollassta-ko calangha-si-essta.
 mother-Nom Swuhyeng-Nom fiancé-Acc well chose-that was proud(Hon)

"Mother was proud that Yanghuy/Swuhyeng had chosen her fiancé well."

- (4) Minsu-ka apeci-ka minpangwiaccessi-ka ttal-ul colonghayssta-ko
 Minsu-Nom father-Nom national guardsman-Nom daughter-Acc inveigled-that
 noyeweha-si-ko- issta-ko kwittumhay cwuessta.
 resenting was(Hon)-that hint gave

Minsu-ka apeci-ka ku hoysa sacangi-nim-i ttal-ul colonghayssta-ko
 Minsu-Nom father-Nom that company president-Nom daughter-Acc inveigled-that
 noyeweha-si-ko- issta-ko kwittumhay cwuessta.
 resenting was(Hon)-that hint gave

"Minsu gave a hint that the father resented that the national guardsman/that company president had inveigled (his) daughter."

Minsu-ka minpangwiaccessi-ka ttal-ul colonghayssta-ko
 Minsu-Nom national guardsman-Nom daughter-Acc inveigled-that
 kwittumhay cwuessta.
 hint gave

Minsu-ka ku hoysa sacangi-nim-i ttal-ul colonghayssta-ko
 Minsu-Nom that company president-Nom daughter-Acc inveigled-that
 kwittumhay cwuessta.
 hint gave

"Minsu gave a hint that the national guardsman/that company president had inveigled (his) daughter."

Appendix B-1: Basic Demographic Questionnaire

参 考 資 料

これから答えて頂く項目は、全てあなたのプライバシーを尊重し、極秘事項として扱われます。全ての項目は参加者全体で統計的に分析され、調査の参考資料として扱われるものであり、あなたの知性等を測るものではありません。

参加者番号： 年齢：満 才 性別： 男・女 右利き・左利き

- 職業（教師・学生の方は大学・学部・専門分野名をお書き下さい。）：

- あなたが今まで生活した場所は？（日本国外の場合はそれぞれの右の余白に国名と都市名をお書き下さい。）

出生地：		都・道・府・県		市
小学校：		都・道・府・県		市
中学校：		都・道・府・県		市
高 校：		都・道・府・県		市
大 学：		都・道・府・県		市
その他：		都・道・府・県		市
その他：		都・道・府・県		市
現在の住まい：		都・道・府・県		市

- あなたが育った言語環境は

- () 家庭でも外でも日本語
- () 家庭では 語、外では日本語（何歳ごろですか？ ）
- () 家庭では日本語、外では 語（何歳ごろですか？ ）
- () 家庭でも外でも 語（何歳ごろですか？ ）
- () その他

- あなたは現在の日常生活で、日本語以外の言語を使いますか。 はい いいえ

「はい」と答えた方に：何語を使いますか。

どのくらい使いますか。

なぜですか。

- 外国で生活した経験がありましたら、下に記入して下さい。書ききれない場合は同じ要領で裏面もお使い下さい。

(1) 19 年 月から 19 年 月 まで 年間 国名 都市名

目的 単身・家族同伴 使用言語

日本語はどの程度使いましたか。

(2) 19 年 月から 19 年 月 まで 年間 国名 都市名

目的 単身・家族同伴 使用言語

日本語はどの程度使いましたか。

Appendix B-2: Basic Demographic Questionnaire, English Translation

GENERAL BACKGROUND INFORMATION

All personal information you provide here will be maintained confidentially. The information you provide here will be used together with information from other subjects as part of a reference for the research. This is not a test to measure your intelligence or your language ability.

Subject Code No : Age : Sex : male / female Left-handed / Right-handed

- Occupation (If you are a teacher or a student, please write your school, department, and your specialty/ major) :

- Places where you have lived ? (If outside Japan, please write country and city in the right margin of the relevant line.)

Place of Birth :		Prefecture		City
Elementary School :		Prefecture		City
Junior High School :		Prefecture		City
High School :		Prefecture		City
College :		Prefecture		City
Other :		Prefecture		City
Other :		Prefecture		City
Current Residence :		Prefecture		City

- Linguistic Environment in which you grew up

- () Japanese both at home and outside home.
- () at home, Japanese outside home. (How old?)
- () Japanese at home, outside home. (How old?)
- () both at home and outside home. (How old?)
- () Other

- Do you use any language(s) other than Japanese in your current daily life? YES NO

If YES, what language(s)?

How much do you use it/them?

Why/for what?

- If you have lived outside Japan, please fill out the following. If you cannot fit all your experiences, please use the back of this sheet.

(1) 19 year month to 19 year month for years Country City

Aim Alone · With Family Language Used

How much Japanese did you use?

(2) 19 year month to 19 year month for years Country City

Aim Alone · With Family Language Used

How much Japanese did you use?

Appendix C-1: Off-Line Absolute Processability Rating Task, Test Sentences, Experiment 1A

(Sentence numbers do not correspond to those in Chapter 4.)

- (1) 恵一が弟が両親が出かけたとき帰って来たのに戸惑った。
恵一が弟が両親の出かけたとき帰って来たのに戸惑った。
- (2) 祖母が孝が姉が歌い出したとき泣き出したのに気付いた。
祖母が孝が姉の歌い出したとき泣き出したのに気付いた。
- (3) 佐藤さんが高橋さんがその人が山根さんを告訴したと思ったと言った。
佐藤さんは高橋さんがその人が山根さんを告訴したと思ったと言った。
- (4) 田中さんが鈴木さんが課長が山田さんを推薦すると言ったと思った。
田中さんは鈴木さんが課長が山田さんを推薦すると言ったと思った。
- (5) 母親が美智子が友達が遊んでいたとき勉強していたのに感動した。
母親は美智子が友達が遊んでいたとき勉強していたのに感動した。
- (6) 関谷さんが吉田さんが同僚が集まったとき病気だったのに同情した。
関谷さんは吉田さんが同僚が集まったとき病気だったのに同情した。
- (7) 清が父がみどりが妹が出かけたと言ったと説得できなかった。
清は父がみどりが妹が出かけたと言ったと説得できなかった。
- (8) 母が兄がその人が林さんが亡くなったと言ったと説得できなかった。
母は兄がその人が林さんが亡くなったと言ったと説得できなかった。
- (9) 啓子が正が先生が健二を期待だと今朝言ったと思っている。
啓子が正が今朝先生が健二を期待だと言ったと思っている。
- (10) 叔父が洋子が敬二がその生徒を好きだと夕べ言ったと思った。
叔父が洋子が夕べ敬二がその生徒を好きだと言ったと思った。

Appendix C-2: Off-Line Absolute Processability Rating Task, Test Sentences, Experiment 1A, English Translation

(Sentence numbers do not correspond to those in Chapter 4.)

-ga/-wa Substitution # 1

- (1) Satoo-san-ga Takahashi-san-ga sono hito-ga Yamane-san-o
 Satoo-Mr./Ms.-Nom Takahashi-Mr./Ms.-Nom that person-Nom Tamane-Mr./Ms.-Acc
 kokusosita-to o motta-to itta.
 sued-that thought-that said

Satoo-san-wa Takahashi-san-ga sono hito-ga Yamane-san-o
 Satoo-Mr./Ms.-Nom Takahashi-Mr./Ms.-Nom that person-Nom Tamane-Mr./Ms.-Acc
 kokusosita-to o motta-to itta.
 sued-that thought-that said

"Mr./Ms. Sato said that Mr./Ms. Takahashi thought that that person sued Mr./Ms. Yamane."

- (2) Tanaka-san-ga Suzuki-san-ga kachoo-ga Yamada-san-o
 Tanaka-Mr./Ms.-Nom Suzuki-Mr./Ms.-Nom section chief-Nom Yamada-Mr./Ms.-Acc
 suisensuru-to itta-to omotta.
 recommend-that said thought

Tanaka-san-wa Suzuki-san-ga kachoo-ga Yamada-san-o
 Tanaka-Mr./Ms.-Top Suzuki-Mr./Ms.-Nom section chief-Nom Yamada-Mr./Ms.-Acc
 suisensuru-to itta-to omotta.
 recommend-that said thought

"Mr./Ms. Tanaka thought that Mr./Ms. Suzuki said that the section chief would recommend Mr./Ms. Yamada."

-ga/-wa Substitution # 2

- (3) hahaoya-ga Michiko-ga tomodati-ga asondeita toki benkyoositeita-no-ni
 mother-Nom Michio-Nom friends-Nom playing-were time studying was-fact-by
 kandoosita.
 impressed

hahaoya-ga Michiko-ga tomodati-ga asondeita toki benkyoositeita-no-ni
 mother-Nom Michio-Nom friends-Nom playing-were time studying was-fact-by
 kandoosita.
 impressed

"Mother was impressed by the fact that Michiko was studying when her friends were playing."

- (4) Sekiya-san-ga Yoshida-san-ga dooryoo-ga atumatta toki
 Sekiya-Mr./Ms.-Nom Yoshida-Mr./Ms.-Nom co-workers-Nom got-together time
 byooki-datta-no-ni doojoosita.
 sick-was-fact-with sympathized

Sekiya-san-wa Yoshida-san-ga dooryoo-ga atumatta toki
 Sekiya-Mr./Ms.-Top Yoshida-Mr./Ms.-Nom co-workers-Nom got-together time
 byooki-datta-no-ni doojoosita.
 sick-was-fact-with sympathized

"Mr./Ms. Sekiya sympathized with Mr./Ms. Yoshida for the fact that he was sick when their co-workers got together."

-ga/-wa Substitution # 3

- (5) Kiyoshi-ga titi-ga Midori-ga imooto-ga dekaketa-to
 Kiyoshi-Nom my father-Nom Midori-Nom younger sister-Nom went out-that
 itta-to settoku dekinakatta.
 said-that persuade could not

Kiyoshi-wa titi-ga Midori-ga imooto-ga dekaketa-to
 Kiyoshi-Top my father-Nom Midori-Nom younger sister-Nom went out-that
 itta-to settoku dekinakatta.
 said-that persuade could not

"Kiyoshi could not persuade my father that Midori said that the younger sister went out."

- (6) a. haha-ga ani-ga sono hito-ga Hayashi-san-ga
 my mother-Nom my older brother-Nom that person-Nom Hayashi-Mr./Ms.-Nom
 nakunatta-to itta-to settoku dekinakatta.
 passed away-that said-that persuade could not
- b. haha-wa ani-ga sono hito-ga Hayashi-san-ga
 my mother-Top my older brother-Nom that person-Nom Hayashi-Mr./Ms.-Nom
 nakunatta-to itta-to settoku dekinakatta.
 passed away-that said-that persuade could not

"My mother could not persuade my older brother that that person said that Mr./Ms. Hayashi passed away."

-ga/-no Substitution

- (7) Keiichi-ga ototoo-ga ryoosin-ga dekaketa toki kaettekita-no-ni
 Keiichi-Nom older brother-Nom parents-Nom went-out time came-home
 tomadotta.
 embarrassed

Keiichi-ga ototoo-ga ryoosin-no dekaketa toki kaettekita-no-ni
 Keiichi-Nom older brother-Nom parents-Gen went-out time came-home
 tomadotta.
 embarrassed

"Keiichi was embarrassed at the fact that his brother came home when their parents went out."

- (8) sobo-ga Takashi-ga ane-ga utaidasita toki
 my grandmother-Nom Takashi-Nom my older sister-Nom singing-started time
 nakidasita-no-ni kizuita.
 crying started-fact-Dat noticed

sobo-ga Takashi-ga ane-no utaidasita toki
 my grandmother-Nom Takashi-Nom my older sister-Gen singing-started time
 nakidasita-no-ni kizuita.
 crying started-fact-Dat noticed

"My grandmother noticed the fact that Takashi started crying when my sister started singing."

Adverb Placement

- (9) Keiko-ga Tadashi-ga sensei-ga Kenji-o kiraida-to kesa itta-to
 Keiko-Nom Tadashi-Nom teacher-Nom Kenji-Acc hate-that this morning said-that
 omotteiru.
 think

Keiko-ga Tadashi-ga kesa sensei-ga Kenji-o kiraida-to itta-to
 Keiko-Nom Tadashi-Nom this morning teacher-Nom Kenji-Acc hate-that said-that
 omotteiru.
 think

"Keiko thinks that Tadashi said this morning that the teacher hates Kenji."

- (10) oji-ga Yoko-ga Keiji-ga sono seito-o sukida-to yuube itta-to
 my uncle-Nom Yoko-Nom Keiji-Nom that student-Acc like-that last night said-that
 omotta.
 thought

oji-ga Yoko-ga yuube Keiji-ga sono seito-o sukida-to itta-to
 my uncle-Nom Yoko-Nom last night Keiji-Nom that student-Acc like-that said-that
 omotta.
 thought

"My uncle thought that Yoko said last night that Keiji likes that student."

Appendix D-1: Off-Line Absolute Processability Rating Task, Anchor Sentences, Experiment 1A

(Sentence labels correspond to those in Chapter 4.)

- AS-1 美智子が妹が肇を好きだと思っている。
 AS-2 母が川田さんに叔母が兄に典子さんを紹介したと話した。
 AS-3 一郎が友達を明がその生徒が病気だと言ったと説得した。
 AS-4 弟が由美を勝が喜美子が先生を好きだと言ったと言い含めた。

Appendix D-2: Off-Line Absolute Processability Rating Task, Anchor Sentences, Experiment 1A, English Translation

(Sentence labels correspond to those in Chapter 4.)

- AS-1 Michiko-ga imooto-ga Hajime-o sukida-to omotteiru.
 Michiko-Nom younger sister-Nom Hajime-Acc like-that think
 "Michiko thinks that her younger sister likes Hajime."
- AS-2 haha-ga Kawada-san-ni oba-ga ani-ni Noriko-san-o
 my mother-Nom Kawada-Mr./Ms.-Dat my aunt-Nom my older brother-Dat Noriko-Ms.Acc
 shookaishita-to hanasita.
 introduced-that told
 "My mother told Mr./Ms. Kawada that my aunt introduced Noriko to my older brother."
- AS-3 Ichiroo-ga tomodati-o Akira-ga sono seito-ga byooki-da-to itta-to settokusita.
 Ichiro-Nom friend-Acc Akira-Nom that student-Nom sick-is-that said-that persuaded
 "Ichiro persuaded his friend that Akira said that that student is sick."
- AS-4 ootoo-ga Yumi-o Masaru-ga Kimiko-ga sensei-o sukida-to
 younger brother-Nom Yumi-Acc Masaru-Nom Kimiko-Nom teacher-Acc like-that
 itta-to iihukumeta.
 said-that convinced
 "The older brother convinced Yumi that Masaru said that Kimiko likes the teacher."

Appendix E-1: Off-Line Relative Processability Rating Task, Test Sentences, Experiment 1B

- (1) 小川さんが部長が井上さんが来客を案内すると言ったと思った。
小川さんは部長が井上さんが来客を案内すると言ったと思った。
- (2) 先生が次郎が美紀が話しているとき眠っているのに気付いた。
先生は次郎が美紀が話しているとき眠っているのに気付いた。
- (3) 京子が友達が真弓が弟が結婚したと言ったと説得できなかった。
京子は友達が真弓が弟が結婚したと言ったと説得できなかった。
- (4) 母が兄が父が帰ったとき出かけたのに驚いた。
母が兄が父の帰ったとき出かけたのに驚いた。
- (5) 義男が妹が弘が由紀が好きだと昨日言ったと思った。
義男が妹が昨日弘が由紀が好きだと言ったと思った。
- (6) 母親が美幸が俊が好きだと思っている。
母親が美幸が俊が好きだと思っている。
- (7) 幸男が両親が先生が弟が落第したと言ったと説得できなかった。
幸男が両親を先生が弟が落第したと言ったと説得できなかった。

Appendix E-2: Off-Line Relative Processability Rating Task, Test Sentences, Experiment 1B, English Translation

-ga/-wa Substitution # 1

- (1) Ogawa-san-ga buchoo-ga Inoue-san-ga raikyaku-o
Ogawa-Mr./Ms.-Nom department manager-Nom Inoue-Mr./Ms.-Nom guest-Acc
annaisuru-to itta-to omotta.
show around-that said-that thought

Ogawa-san-wa buchoo-ga Inoue-san-ga raikyaku-o
Ogawa-Mr./Ms.-Top department manager-Nom Inoue-Mr./Ms.-Nom guest-Acc
annaisuru-to itta-to omotta.
show around-that said-that thought

"Mr./Ms. Ogawa thought that the department manager said that Mr./Ms. Inoue would show the guest around."

-ga/-wa Substitution # 2

- (2) sensei-ga Jiroo-ga Miki-ga hanasiteiru toki nemutteiru-no-ni kizuita.
teacher-Nom Jiro-Nom Miki-Nom speaking-is time sleeping is-fact-Dat noticed

sensei-ga Jiroo-ga Miki-ga hanasiteiru toki nemutteiru-no-ni kizuita.
teacher-Nom Jiro-Nom Miki-Nom speaking-is time sleeping is-fact-Dat noticed

"The teacher noticed the fact that Jiro was sleeping when Miki was speaking."

-ga/-wa Substitution # 3

- (3) Kyooko-ga tomodati-ga Mayumi-ga ototoo-ga kekkonsita-to
Kyoko-Nom friend-Nom Mayumi-Nom younger brother-Nom got married-that
itta-to settoku dekinakatta.
said-that persuade could not

Kyooko-wa tomodati-ga Mayumi-ga ototoo-ga kekkonsita-to
Kyoko-Top friend-Nom Mayumi-Nom younger brother-Nom got married-that
itta-to settoku dekinakatta.
said-that persuade could not

"Kyoko could not persuade her friend that Mayumi said that her brother got married."

-ga/-no Substitution

- (4) haha-ga ani-ga titi-ga kaetta toki
 my mother-Nom my older brother-Nom my father-Nom came-home time
 dekaketa-no-ni odoraita.
 went out-fact-at surprised

haha-ga ani-ga titi-no kaetta toki
 my mother-Nom my older brother-Nom my father-Gen came-home time
 dekaketa-no-ni odoraita.
 went out-fact-at surprised

"My mother was surprised at the fact that my older brother went out when my father came home."

Adverb Placement

- (5) Yoshio-ga imooto-ga Hiroshi-ga Yuki-o sukida-to kinoo
 Yoshio-Nom younger sister-Nom Hiroshi-Nom Yuki-Acc like-that yesterday
 itta-to omotta.
 said-that thought

Yoshio-ga imooto-ga kinoo Hiroshi-ga Yuki-o sukida-to
 Yoshio-Nom younger sister-Nom yesterday Hiroshi-Nom Yuki-Acc like-that
 itta-to omotta.
 said-that thought

"Yoshio thought that his younger sister said yesterday that Hiroshi likes Yuki."

-ga/-o Substitution # 1

- (6) hahaoya-ga Miyuki-ga Shun-ga sukida-to omotteiru.
 mother-Nom Miyuki-Nom Shun-Nom like-that think

hahaoya-ga Miyuki-ga Shun-o sukida-to omotteiru.
 mother-Nom Miyuki-Nom Shun-Acc like-that think

"The mother thinks that Miyuki likes Shun."

-ga/-o Substitution # 2

- (7) Yukio-ga ryoosin-ga sensei-ga ototoo-ga rakudaisita-to
 Yukio-Nom parents-Nom teacher-Nom younger brother-Nom failed in exam-that
 itta-to settoku dekinakatta.
 said-that persuade could not

Yukio-ga ryoosin-o sensei-ga ototoo-ga rakudaisita-to
 Yukio-Nom parents-Acc teacher-Nom younger brother-Nom failed in exam-that
 itta-to settoku dekinakatta.
 said-that persuade could not

"Yukio could not persuade his parents that the teacher said that his younger brother failed in the exam."

Appendix F-1: Self-Paced Whole-Sentence Reading Task, Double Embedding Test Sentences, Experiment 2

- (1) 社員達が林課長が東北支社が社長命令で幹部を解雇するらしいと発表したのを聞いていた。
社員達が林課長が社内放送で東北支社が幹部を解雇するらしいと発表したのを聞いていた。
社員達は林課長が東北支社が社長命令で幹部を解雇するらしいと発表したのを聞いていた。
社員達は林課長が社内放送で東北支社が幹部を解雇するらしいと発表したのを聞いていた。

課長は社員に話をしましたか。 (はい)
- (2) 仁志君が井上教授が不真面目な学生がすっかり居眠りをしていると言ったのに冷やりとしました。
仁志君が井上教授がぼそっと不真面目な学生が居眠りをしていると言ったのに冷やりとしました。
仁志君は井上教授が不真面目な学生がすっかり居眠りをしていると言ったのに冷やりとしました。
仁志君は井上教授がぼそっと不真面目な学生が居眠りをしていると言ったのに冷やりとしました。

教授は学生が寝ていたのを知っていますか。 (はい)
- (3) マネージャーが監督が両球団が合意で投手をトレードすると記者会見したのを承知している。
マネージャーが監督が一人で両球団が投手をトレードすると記者会見したのを承知している。
マネージャーは監督が両球団が合意で投手をトレードすると記者会見したのを承知している。
マネージャーは監督が一人で両球団が投手をトレードすると記者会見したのを承知している。

監督は報道陣に何か発表しましたか。 (はい)
- (4) 友人が太郎が亡き祖母がたんねんに庭木を手入れしていたと話していたと言いました。
友人が太郎がしみじみと亡き祖母が庭木を手入れしていたと話していたと言いました。
友人は太郎が亡き祖母がたんねんに庭木を手入れしていたと話していたと言いました。
友人は太郎がしみじみと亡き祖母が庭木を手入れしていたと話していたと言いました。

太郎は木の手入れをしましたか。 (いいえ)
- (5) 看護婦が神岡さんが担当医師がゆっくり注射の準備をするのを待っているのに同情した。
看護婦が神岡さんがはだかで担当医師が注射の準備をするのを待っているのに同情した。
看護婦は神岡さんが担当医師がゆっくり注射の準備をするのを待っているのに同情した。
看護婦は神岡さんがはだかで担当医師が注射の準備をするのを待っているのに同情した。

看護婦さんは注射の用意をしましたか。 (いいえ)

- (6) 父親が子供達がサンタクロースがこっそり贈り物を持って来たと言いに来ると確信している。
 父親が子供達が無邪気にサンタクロースが贈り物を持って来たと言いに来ると確信している。
 父親は子供達がサンタクロースがこっそり贈り物を持って来たと言いに来ると確信している。
 父親は子供達が無邪気にサンタクロースが贈り物を持って来たと言いに来ると確信している。

子供達はもうお父さんのところに行きましたか。

(いいえ)

- (7) 会計係りが学部長が文部省が議会で予算削減を決定したらしいとぼやいていたと言いました。
 会計係りが学部長が廊下で文部省が予算削減を決定したらしいとぼやいていたと言いました。
 会計係りは学部長が文部省が議会で予算削減を決定したらしいとぼやいていたと言いました。
 会計係りは学部長が廊下で文部省が予算削減を決定したらしいとぼやいていたと言いました。

学部長は会計担当者と話をしましたか。

(はい)

- (8) 担任教師が生徒達が浩二がしぶしぶ奉仕活動をやっていたと報告しに来るのを聞いていました。
 担任教師が生徒達がそれぞれ浩二が奉仕活動をやっていたと報告しに来るのを聞いていました。
 担任教師は生徒達が浩二がしぶしぶ奉仕活動をやっていたと報告しに来るのを聞いていました。
 担任教師は生徒達がそれぞれ浩二が奉仕活動をやっていたと報告しに来るのを聞いていました。

浩二は先生に話をしに行きましたか。

(いいえ)

- (9) 検察官が地域住民が青木が先月の祭りで近所をふらついていたと証言するだろうと予測している。
 検察官が地域住民が明日の裁判で青木が近所をふらついていたと証言するだろうと予測している。
 検察官は地域住民が青木が先月の祭りで近所をふらついていたと証言するだろうと予測している。
 検察官は地域住民が明日の裁判で青木が近所をふらついていたと証言するだろうと予測している。

検察官はもう人々から話を聞きましたか。

(いいえ)

- (10) 郵便配達員が県知事が通行人が通りから手を振っているのに応えているのを見ていた。
郵便配達員が県知事が車中から通行人が手を振っているのに応えているのを見ていた。
郵便配達員は県知事が通行人が通りから手を振っているのに応えているのを見ていた。
郵便配達員は県知事が車中から通行人が手を振っているのに応えているのを見ていた。

郵便局員は知事に手を振っていましたか。

(いいえ)

- (11) 社長秘書が菊江がおそば屋さんが会議室に出前を届けると話していたのを思い出しました。
社長秘書が菊江が休憩所でおそば屋さんが出前を届けると話していたのを思い出しました。
社長秘書は菊江がおそば屋さんが会議室に出前を届けると話していたのを思い出しました。
社長秘書は菊江が休憩所でおそば屋さんが出前を届けると話していたのを思い出しました。

菊江は秘書と話をしましたか。

(はい)

- (12) 祐子が優しい部長が田中さんが大きな態度で業務をさぼっていると怒鳴ったのに驚きました。
祐子が優しい部長が激しい口調で田中さんが業務をさぼっていると怒鳴ったのに驚きました。
祐子は優しい部長が田中さんが大きな態度で業務をさぼっていると怒鳴ったのに驚きました。
祐子は優しい部長が激しい口調で田中さんが業務をさぼっていると怒鳴ったのに驚きました。
祐子は優しい部長が激しい口調で田中さんが業務をさぼっていると怒鳴ったのに驚きました。

田中さんは不真面目ですか。

(はい)

- (13) 妹たちが典男が宏明君がかえりにケーキを買ってくると言ったことにはしゃいでいました。
妹たちが典男がでかけに宏明君がケーキを買ってくると言ったことにはしゃいでいました。
妹たちは典男が宏明君がかえりにケーキを買ってくると言ったことにはしゃいでいました。
妹たちは典男がでかけに宏明君がケーキを買ってくると言ったことにはしゃいでいました。

典男君はケーキを買いに行きますか。

(いいえ)

- (14) 乗客が運転手が少年たちがスノーボードでレースをしているのを見たと思った。
乗客が運転手がバックミラーで少年たちがレースをしているのを見たと思った。
乗客は運転手が少年たちがスノーボードでレースをしているのを見たと思った。
乗客は運転手がバックミラーで少年たちがレースをしているのを見たと思った。

男の子達は競争をしていましたか。

(はい)

- (15) 編集長が伊藤君が有名作家が締切まえに原稿を送ってきたと報告してきたのにほっとした。
編集長が伊藤君が出社直後に有名作家が原稿を送ってきたと報告してきたのにほっとした。
編集長は伊藤君が有名作家が締切まえに原稿を送ってきたと報告してきたのにほっとした。
編集長は伊藤君が出社直後に有名作家が原稿を送ってきたと報告してきたのにほっとした。

伊藤君は原稿を送りましたか。

(いいえ)

- (16) 今井さんが工場長が第1倉庫が特急貨物で注文品を出荷したそうだと連絡してきたと言いました。
 今井さんが工場長が携帯電話で第1倉庫が注文品を出荷したそうだと連絡してきたと言いました。
 今井さんは工場長が第1倉庫が特急貨物で注文品を出荷したそうだと連絡してきたと言いました。
 今井さんは工場長が携帯電話で第1倉庫が注文品を出荷したそうだと連絡してきたと言いました。

工場長は倉庫からの情報を知っていますか。

(はい)

- (17) 佐藤さんが受付係が金田さんがマイクロバスで社員を迎えに来ていると連絡してきたと言っています。
 佐藤さんが受付係がインターホンで金田さんが社員を迎えに来ていると連絡してきたと言っています。
 佐藤さんは受付係が金田さんがマイクロバスで社員を迎えに来ていると連絡してきたと言っています。
 佐藤さんは受付係がインターホンで金田さんが社員を迎えに来ていると連絡してきたと言っています。

佐藤さんは社員を迎えに来ましたか。

(いいえ)

- (18) 顧問教師が上級生達が一郎が黙々と練習を頑張っていると誉めているのを聞いていました。
 顧問教師が上級生達が口々に一郎が練習を頑張っていると誉めているのを聞いていました。
 顧問教師は上級生達が一郎が黙々と練習を頑張っていると誉めているのを聞いていました。
 顧問教師は上級生達が口々に一郎が練習を頑張っていると誉めているのを聞いていました。

先輩は一郎君のことを良く思っていますか。

(はい)

- (19) 係長が職員が中村さんがめずらしく事務処理を間違えたことを非難しているのをたしなめた。
 係長が職員がいつまでも中村さんが事務処理を間違えたことを非難しているのをたしなめた。
 係長は職員が中村さんがめずらしく事務処理を間違えたことを非難しているのをたしなめた。
 係長は職員がいつまでも中村さんが事務処理を間違えたことを非難しているのをたしなめた。

係長は誤って事務処理をしましたか。

(いいえ)

- (20) ルームメイトが喜美子が管理人が昨日から手紙を預かってっていると教えてあげたのを忘れてしまった。
 ルームメイトが喜美子が今しがた管理人が手紙を預かってしていると教えてあげたのを忘れてしまった。
 ルームメイトは喜美子が管理人が昨日から手紙を預かってしていると教えてあげたのを忘れてしまった。
 ルームメイトは喜美子が今しがた管理人が手紙を預かってしていると教えてあげたのを忘れてしまった。

管理人はルームメイトと話をしましたか。

(いいえ)

- (21) 真弓たちが店員が人気歌手がたびたび新しいNHK ドラマに出ていると教えてくれたと言いました。
 真弓たちが店員がわざわざ人気歌手が新しいNHK ドラマに出ていると教えてくれたと言いました。
 真弓たちは店員が人気歌手がたびたび新しいNHK ドラマに出ていると教えてくれたと言いました。
 真弓たちは店員がわざわざ人気歌手が新しいNHK ドラマに出ていると教えてくれたと言いました。

店員はドラマのことを知っていましたか。

(はい)

- (22) 販売課長が事務員が得意先が口座に入金してきたとメモしておいたのを読み上げました。
 販売課長が事務員が帳簿に得意先が入金してきたとメモしておいたのを読み上げました。
 販売課長は事務員が得意先が口座に入金してきたとメモしておいたのを読み上げました。
 販売課長は事務員が帳簿に得意先が入金してきたとメモしておいたのを読み上げました。

お金が振り込まれたことは課長に伝わりましたか。

(はい)

- (23) 研究員達が所長が村山博士が三鷹で新しい実験を開始したと説明したのに聞き入っていません。
 研究員達が所長が訓示で村山博士が新しい実験を開始したと説明したのに聞き入っていません。
 研究員達は所長が村山博士が三鷹で新しい実験を開始したと説明したのに聞き入っていません。
 研究員達は所長が訓示で村山博士が新しい実験を開始したと説明したのに聞き入っていません。

博士は何か新しいことを始めましたか。

(はい)

- (24) 取調官が参考人が坂本がむかし老人をいたわっていたと主張するかもしれないと考えている。
 取調官が参考人があした坂本が老人をいたわっていたと主張するかもしれないと考えている。
 取調官は参考人が坂本がむかし老人をいたわっていたと主張するかもしれないと考えている。
 取調官は参考人があした坂本が老人をいたわっていたと主張するかもしれないと考えている。

取調官はもう参考人の話を聞きましたか。

(いいえ)

Appendix F-2: Self-Paced Whole-Sentence Reading Task, Double Embedding Test Sentences, Experiment 2, English Translation

- (1) shaintati-ga Hayasi-kacho-ga Toohoku sisha-ga shachoomereide-de
employees-Nom Sec.chief Hayashi-Nom Tohoku Branch-Nom president order-by
kanbu-o kaikosuru-rasii-to happyoosita-no-o kiite-ita.
executives-Acc fire-seem-that announced fact-Acc listening-was
"The employees were listening to the fact that Section Chief Hayashi announced the fact
that the Tohoku Branch seems to fire the executives following the president's order."
- shaintati-ga Hayasi-kacho-ga shanaihoosoo-de Toohoku sisha-ga
employees-Nom Sec.chief Hayashi-Nom announcement-by Tohoku Branch-Nom
kanbu-o kaikosuru-rasii-to happyoosita-no-o kiite-ita.
executives-Acc fire-seem-that announced fact-Acc listening-was
"The employees were listening to the fact that Section Chief Hayashi announced the fact
over the company intercom that the main office in Tokyo seems to fire the executives."
- shaintati-wa Hayasi-kacho-ga Toohoku sisha-ga shachoomereide-de
employees-Top Sec.chief Hayashi-Nom Tohoku Branch-Nom president order-by
kanbu-o kaikosuru-rasii-to happyoosita-no-o kiite-ita.
executives-Acc fire-seem-that announced fact-Acc listening-was
"As for the employees, they were listening to the fact that Section Chief Hayashi
announced the fact that the Tohoku Branch seems to fire the executives following the
president's order."
- shaintati-wa Hayasi-kacho-ga shanaihoosoo-de Toohoku sisha-ga
employees-Top Sec.chief Hayashi-Nom announcement-by Tohoku Branch-Nom
kanbu-o kaikosuru-rasii-to happyoosita-no-o kiite-ita.
executives-Acc fire-seem-that announced fact-Acc listening-was
"As for the employees, they were listening to the fact that Section Chief Hayashi
announced the fact over the company intercom that the main office in Tokyo seems to fire
the executives."
- Did the section chief talk to the employees? (YES)
- (2) Hitosi-kun-ga Inoue kyooju-ga humajimena gakusei-ga sukkari inemuri-o
Hitoshi-Mr.-Nom Prof.Inoue-Nom idle student-Nom completely nap-Acc
site-iru-to itta-no-ni hiyari-to-simasita.
doing-is-that said fact-at felt a chill
"Hitoshi felt a chill at the fact that Prof. Inoue said that an idle student is soundly taking a
nap (in class)."
- Hitosi-kun-ga Inoue kyooju-ga bosotto humajimena gakusei-ga inemuri-o
Hitoshi-Mr.-Nom Prof.Inoue-Nom monotonically idle student-Nom nap-Acc
site-iru-to itta-no-ni hiyari-to-simasita.
doing-is-that said fact-at felt a chill
"Hitoshi felt a chill at the fact that Prof. Inoue said monotonically that an idle student is
taking a nap (in class)."

Hitosi-kun-wa Inoue kyooju-ga humajimena gakusei-ga sukkari inemuri-o
 Hitoshi-Mr.-Top Prof.Inoue-Nom idle student-Nom completely nap-Acc
 site-iru-to itta-no-ni hiyari-to-simasita.
 doing-is-that said fact-at felt a chill

"As for Hitoshi, he felt a chill at the fact that Prof. Inoue said that an idle student is soundly taking a nap (in class)."

Hitosi-kun-wa Inoue kyooju-ga bosotto humajimena gakusei-ga inemuri-o
 Hitoshi-Mr.-Top Prof.Inoue-Nom monotonically idle student-Nom nap-Acc
 site-iru-to itta-no-ni hiyari-to-simasita.
 doing-is-that said fact-at felt a chill

"As for Hitoshi, he felt a chill at the fact that Prof. Inoue said monotonically that an idle student is taking a nap (in class)."

Did the professor know that a student was sleeping?

(YES)

- (3) maneejaa-ga kantoku-ga ryookyuudan-ga gooi-de tooshu-o
 Manager-Nom coach-Nom both baseball teams-Nom accordance-in pitcher-Acc
 toreedo-suru-to kishakaiken-sita-no shoochisite-iru.
 trade-that told the press-fact-Acc acknowledging-is
 "The manager acknowledges the fact that the coach met and told the press that both baseball teams will trade pitchers in accordance."

maneejaa-ga kantoku-ga hitoride ryookyuudan-ga tooshu-o
 Manager-Nom coach-Nom alone both baseball teams-Nom pitcher-Acc
 toreedo-suru-to kishakaiken-sita-no shoochisite-iru.
 trade-that told the press-fact-Acc acknowledging-is
 "The manager acknowledges the fact that the coach met and told the press by himself that both baseball teams will trade pitchers."

maneejaa-wa kantoku-ga ryookyuudan-ga gooi-de tooshu-o
 Manager-Top coach-Nom both baseball teams-Nom accordance-in pitcher-Acc
 toreedo-suru-to kishakaiken-sita-no shoochisite-iru.
 trade-that told the press-fact-Acc acknowledging-is
 "As for the manager, he acknowledges the fact that the coach met and told the press that both baseball teams will trade pitchers in accordance."

maneejaa-wa kantoku-ga hitoride ryookyuudan-ga tooshu-o
 Manager-Top coach-Nom alone both baseball teams-Nom pitcher-Acc
 toreedo-suru-to kishakaiken-sita-no shoochisite-iru.
 trade-that told the press-fact-Acc acknowledging-is
 "As for the manager, he acknowledges the fact that the coach met and told the press by himself that both baseball teams will trade pitchers."

Did the coach announce anything to journalists?

(YES)

- (4) yuujin-ga Taroo-ga naki sobo-ga tannenni niwaki-o
 friend-Nom Taro-Nom my dead grandma-Nom very well garden trees-Acc
 teiresite-ita-to hanasite-ita-to iimasita.
 taking care of-was-that saying-was-that said
 "The friend said that Taro said that my dead grandmother used to take very good care of garden trees."

yuujin-ga Taroo-ga simijimito naki sobo-ga niwaki-o
 friend-Nom Taro-Nom melancholically my dead grandma-Nom garden trees-Acc
 teiresite-ita-to hanasite-ita-to iimasita.
 taking care of-was-that saying-was-that said
 "The friend said that Taro melancholically said that my dead grandmother used to take very good care of garden trees."

yuujin-wa Taroo-ga naki sobo-ga tannenni niwaki-o
 friend-Top Taro-Nom my dead grandma-Nom very well garden trees-Acc
 teiresite-ita-to hanasite-ita-to iimasita.
 taking care of-was-that saying-was-that said
 "As for the friend, he said that Taro said that my dead grandmother used to take very good care of garden trees."

yuujin-wa Taroo-ga simijimito naki sobo-ga niwaki-o
 friend-Top Taro-Nom melancholically my dead grandma-Nom garden trees-Acc
 teiresite-ita-to hanasite-ita-to iimasita.
 taking care of-was-that saying-was-that said
 "The friend said that Taro melancholically said that my dead grandmother used to take very good care of garden trees."

Did Taro take care of the trees?

(NO)

- (5) kangohu-ga Kamioka-san-ga tantooishi-ga yukkuri
 nurse-Nom Kamioka-Mr./Ms.-Nom doctor in charge-Nom slowly
 chuusha-no junbi-o suru-no-o mate-iru-no-ni doojoosita.
 shot-for preparation-Acc do-fact-Acc waiting is-fact-for sympathetic-was
 "The nurse was sympathetic about the fact that Mr./Ms. Kamioka was waiting for his doctor to slowly prepare an injection."

kangohu-ga Kamioka-san-ga hadakade tantooishi-ga
 nurse-Nom Kamioka-Mr./Ms.-Nom naked doctor in charge-Nom
 chuusha-no junbi-o suru-no-o mate-iru-no-ni doojoosita.
 shot-for preparation-Acc do-fact-Acc waiting is-fact-for sympathetic-was
 "The nurse was sympathetic about the fact that Mr./Ms. Kamioka was waiting naked for his doctor to prepare an injection."

kangohu-wa Kamioka-san-ga tantooishi-ga yukkuri
 nurse-Top Kamioka-Mr./Ms.-Nom doctor in charge-Nom slowly
 chuusha-no junbi-o suru-no-o mate-iru-no-ni doojoosita.
 shot-for preparation-Acc do-fact-Acc waiting is-fact-for sympathetic-was
 "As for the nurse, she was sympathetic about the fact that Mr./Ms. Kamioka was waiting for his doctor to slowly prepare an injection."

kangohu-wa Kamioka-san-ga hadakade tantooishi-ga
 nurse-Top Kamioka-Mr./Ms.-Nom naked doctor in charge-Nom
 chuusha-no junbi-o suru-no-o mate-iru-no-ni doojoosita.
 shot-for preparation-Acc do-fact-Acc waiting is-fact-for sympathetic-was
 "As for the nurse, she was sympathetic about the fact that Mr./Ms. Kamioka was waiting naked for his doctor to prepare an injection."

Did the nurse get the injection ready?

(NO)

- (6) titioya-ga kodomotati-ga santakuroosu-ga kossori okurimono-o mottekita-to
 father-Nom children-Nom Santa Claus-Nom sneakingly gift-Acc brought-that
 ii-ni-kuru-to kakusinsite-iru.
 come to say-that believing-is
 "The father believes that the children will come and tell him that Santa Claus sneakingly brought them presents."

titioya-ga kodomotati-ga mujakini santakuroosu-ga okurimono-o mottekita-to
 father-Nom children-Nom innocently Santa Claus-Nom gift-Acc brought-that
 ii-ni-kuru-to kakusinsite-iru.
 come to say-that believing-is
 "The father believes that the children will come and tell him that Santa Claus sneakingly brought them presents."

titioya-wa kodomotati-ga santakuroosu-ga kossori okurimono-o mottekita-to
 father-Top children-Nom Santa Claus-Nom sneakingly gift-Acc brought-that
 ii-ni-kuru-to kakusinsite-iru.
 come to say-that believing-is
 "As for the father, he believes that the children will come and tell him that Santa Claus sneakingly brought them presents."

titioya-wa kodomotati-ga mujakini santakuroosu-ga okurimono-o mottekita-to
 father-Top children-Nom innocently Santa Claus-Nom gift-Acc brought-that
 ii-ni-kuru-to kakusinsite-iru.
 come to say-that believing-is
 "As for the father, he believes that the children will innocently come and tell him that Santa Claus brought them presents."

Did the children already go to their daddy?

(NO)

- (7) kaikeigakari-ga gakubuchoo-ga monbushoo-ga gikai-de
 accountant-Nom dean-Nom Ministry of Education-Nom congress-at
 yosanskugen-o ketteisita-rasii-to boyaita-ita iimasita.
 budget decrease-Acc decided-seem-that complaining-was said
 "The people in the accountant's office said that the dean was complaining (about the fact) that the Ministry of Education seems to have decided on a budget cut at the congress."

kaikeigakari-ga gakubuchoo-ga rooka-de monbushoo-ga
 accountant-Nom dean-Nom corridor-in Ministry of Education-Nom
 yosanskugen-o ketteisita-rasii-to boyaita-ita iimasita.
 budget decrease-Acc decided-seem-that complaining-was said
 "The people in the accountant's office said that the dean was complaining in the corridor (about the fact) that the Ministry of Education seems to have decided on a budget cut."

kaikeigakari-wa gakubuchoo-ga monbushoo-ga gikai-de
 accountant-Top dean-Nom Ministry of Education-Nom congress-at
 yosanskugen-o ketteisita-rasii-to boyaita-ita iimasita.
 budget decrease-Acc decided-seem-that complaining-was said
 "As for the people in the accountant's office, they said that the dean was complaining (about the fact) that the Ministry of Education seems to have decided on a budget cut at the congress."

kaikeigakari-wa gakubuchoo-ga rooka-de monbushoo-ga
 accountant-Top dean-Nom corridor-in Ministry of Education-Nom
 yosanskugen-o ketteisita-rasii-to boyaita-ita iimasita.
 budget decrease-Acc decided-seem-that complaining-was said

"As for the people in the accountant's office, they said that the dean was complaining (about the fact) that the Ministry of Education seems to have decided on a budget cut."

Did the dean talk to the people in charge of accounting?

(YES)

- (8) tanninkyoosi-ga seitotati-ga Koji-ga sibisibu hoosikatudoo-o
 homeroom teacher-Nom students-Nom Koji-Nom unwillingly volunteer activity-Acc
 yatte-ita-to hookokusi-ni-kuru-no-o kiite-imasita.
 doing was-that report-to-come-fact-Acc listening-were
 "The homeroom teacher was listening to his students reporting to him the fact that Koji was unwillingly doing volunteer activities."

tanninkyoosi-ga seitotati-ga sorezore Koji-ga hoosikatudoo-o
 homeroom teacher-Nom students-Nom individuallyt Koji-Nom volunteer activity-Acc
 yatte-ita-to hookokusi-ni-kuru-no-o kiite-imasita.
 doing was-that report-to-come-fact-Acc listening-were
 "The homeroom teacher was listening to his students reporting individually to him the fact that Koji was doing volunteer activities."

tanninkyoosi-wa seitotati-ga Koji-ga sibisibu hoosikatudoo-o
 homeroom teacher-Top students-Nom Koji-Nom unwillingly volunteer activity-Acc
 yatte-ita-to hookokusi-ni-kuru-no-o kiite-imasita.
 doing was-that report-to-come-fact-Acc listening-were
 "As for the homeroom teacher, he was listening to his students reporting to him the fact that Koji was unwillingly doing volunteer activities."

tanninkyoosi-wa seitotati-ga sorezore Koji-ga hoosikatudoo-o
 homeroom teacher-Top students-Nom individuallyt Koji-Nom volunteer activity-Acc
 yatte-ita-to hookokusi-ni-kuru-no-o kiite-imasita.
 doing was-that report-to-come-fact-Acc listening-were
 "As for the homeroom teacher, he was listening to his students reporting individually to him the fact that Koji was doing volunteer activities."

Did Koji go and talk to the teacher?

(NO)

- (9) kensatukan-ga tiikiuumin-ga Aoki-ga sengetu-no-maturi-de
 prosecutor-Nom residents-Nom Aoki-Nom last month's festival-during
 kinjo-o huratuite-ita-to shoogen-suru-to yosoo-site-iru.
 neighborhood-Acc wandering-was-that testimony-do-that expecting-is
 "The public prosecutor is expecting that the residents will testify that Aoki was wandering around the neighborhood during the festival last month."

kensatukan-ga tiikiuumin-ga asita-no-saiban-de Aoki-ga
 prosecutor-Nom residents-Nom tomorrow's trial-during Aoki-Nom
 kinjo-o huratuite-ita-to shoogen-suru-to yosoo-site-iru.
 neighborhood-Acc wandering-was-that testimony-do-that expecting-is
 "The public prosecutor is expecting that the residents will testify during the trial tomorrow that Aoki was wandering around the neighborhood."

kensatukan-wa tiikiuumin-ga Aoki-ga sengetu-no-maturi-de
 prosecutor-Top residents-Nom Aoki-Nom last month's festival-during
 kinjo-o huratuite-ita-to shoogen-suru-to yosoo-site-iru.
 neighborhood-Acc wandering-was-that testimony-do-that expecting-is
 "As for the public prosecutor, he is expecting that the residents will testify that Aoki was
 wandering around the neighborhood during the festival last month."

kensatukan-wa tiikiuumin-ga asita-no-saiban-de Aoki-ga
 prosecutor-Top residents-Nom tomorrow's trial-during Aoki-Nom
 kinjo-o huratuite-ita to shoogen-suru to yosoo-site-iru
 neighborhood-Acc wandering-was that testimony-do that expecting-is
 "As for the public prosecutor, he is expecting that the residents will testify during the
 trial tomorrow that Aoki was wandering around the neighborhood."

Has the public prosecutor already heard a story from the people? (NO)

- (10) yuubinhaitatui-ga kentiji-ga tuukoonin-ga toori-kara te-o
 mailman-Nom Governor-Nom pedestrians-Nom street-from hand-Acc
 futte-iru-no-ni kotaete-iru-no-o mite-ita.
 waving-are-fact-to responding-fact watching-was
 "The mailman was watching the Prefectural Governor responding to pedestrians waving (to
 him) from the street."

yuubinhaitatui-ga kentiji-ga shachuu-kara tuukoonin-ga te-o
 mailman-Nom Governor-Nom inside car-from pedestrians-Nom hand-Acc
 futte-iru-no-ni kotaete-iru-no-o mite-ita.
 waving-are-fact-to responding-fact watching-was
 "The mailman saw the Prefectural Governor responding from the car to the security guards
 saluting (to him)."

yuubinhaitatui-wa kentiji-ga tuukoonin-ga toori-kara te-o
 mailman-Top Governor-Nom pedestrians-Nom street-from hand-Acc
 futte-iru-no-ni kotaete-iru-no-o mite-ita.
 waving-are-fact-to responding-fact watching-was
 "As for the mailman, he was watching the Prefectural Governor responding to pedestrians
 waving (to him) from the street."

yuubinhaitatui-wa kentiji-ga shachuu-kara tuukoonin-ga te-o
 mailman-Top Governor-Nom inside car-from pedestrians-Nom hand-Acc
 futte-iru-no-ni kotaete-iru-no-o mite-ita.
 waving-are-fact-to responding-fact watching-was
 "As for the mailman, he saw the Prefectural Governor responding from the car to the
 security guards saluting (to him)."

Was the post-office worker waving to the Governor? (NO)

- (11) shachoo hisho-ga Kikue-ga osobayasan-ga kaigisitu-ni demae-o
 president secretary-Nom Kikue-Nom soba shop-Nom meeting room-to delivery-Acc
 todokeru-to hanasite-ita-no-o omoidasimasita.
 bring-that saying-was-fact-Acc remembered
 "The president's secretary remembered that Kikue said that the soba shop will deliver food
 to the meeting room."

shachoo hisho-ga Kikue-ga kyuukeijo-de osobayasan-ga demae-o
 president secretary-Nom Kikue-Nom resting room-in soba shop-Nom delivery-Acc
 todokeru-to hanasite-ita-no-o omoidasimasita.
 bring-that saying-was-fact-Acc remembered
 "The president's secretary remembered that Kikue said in the resting room that the soba shop will deliver food."

shachoo hisho-wa Kikue-ga osobayasan-ga kaigisitu-ni demae-o
 president secretary-Top Kikue-Nom soba shop-Nom meeting room-to delivery-Acc
 todokeru-to hanasite-ita-no-o omoidasimasita.
 bring-that saying-was-fact-Acc remembered
 "As for president's secretary, she remembered that Kikue said that the soba shop will deliver food to the meeting room."

shachoo hisho-wa Kikue-ga kyuukeijo-de osobayasan-ga demae-o
 president secretary-Top Kikue-Nom resting room-in soba shop-Nom delivery-Acc
 todokeru-to hanasite-ita-no-o omoidasimasita.
 bring-that saying-was-fact-Acc remembered
 "As for the president's secretary, she remembered that Kikue said in the resting room that the soba shop will deliver food."

Did Kikue talk to the secretary? (YES)

- (12) Yuko-ga yasasii buchoo-ga Tanaka-san-ga ookina taido-de gyoomu-o
 Yuko-Nom kind department chief-Nom Tanaka-Mr./Ms.Nom big attitude-wih job-Acc
 sabotte-iru-to donatta-no-ni odorkimasita.
 idling-is-that yelled-fact-at surprised was
 "Yuko was surprised that the gentle Department Chief yelled that Mr./Ms. Tanaka is idling on his job with a bad attitude."

Yuko-ga yasasii buchoo-ga hagesii kuchoo-de Tanaka-san-ga gyoomu-o
 Yuko-Nom kind department chief-Nom mad tone-in Tanaka-Mr./Ms.Nom job-Acc
 sabotte-iru-to donatta-no-ni odorkimasita.
 idling-is-that yelled-fact-at surprised was
 "Yuko was surprised that the gentle Department Chief yelled furiously that Mr./Ms. Tanaka is idling on his job."

Yuko-wa yasasii buchoo-ga Tanaka-san-ga ookina taido-de gyoomu-o
 Yuko-Top kind department chief-Nom Tanaka-Mr./Ms.Nom big attitude-wih job-Acc
 sabotte-iru-to donatta-no-ni odorkimasita.
 idling-is-that yelled-fact-at surprised was
 "As for Yuko, she was surprised that the gentle Department Chief yelled that Mr./Ms. Tanaka is idling on his job with a bad attitude."

Yuko-wa yasasii buchoo-ga hagesii kuchoo-de Tanaka-san-ga gyoomu-o
 Yuko-Top kind department chief-Nom mad tone-in Tanaka-Mr./Ms.Nom job-Acc
 sabotte-iru-to donatta-no-ni odorkimasita.
 idling-is-that yelled-fact-at surprised was
 "As for Yuko, she was surprised that the gentle Department Chief yelled furiously that Mr./Ms. Tanaka is idling on his job."

Is Mr./Ms. Tanaka lazy? (YES)

- (13) imoototati-ga Norio-ga Hiroaki-kun-ga kaeri-ni keeki-o
 younger sisters-Nom Norio-Nom Hiroaki-Mr.Nom way back-on cake-Acc
 katte-kite-kureru-to itta-koto-ni hashaide-imasu.
 buy-come-give-that said-fact-at excited are
 "The younger sisters are excited that Norio said that Hiroaki will buy and bring cakes on his way back."

imoototati-ga Norio-ga dekake-ni Hiroaki-kun-ga keeki-o
 younger sisters-Nom Norio-Nom departure-at Hiroaki-Mr.-Nom cake-Acc
 katte-kite-kureru-to itta-koto-ni hashaide-imasu.
 buy-come-give-that said-fact-at excited are
 "The younger sisters are excited that Norio said when he left that Hiroaki will buy and bring cakes."

imoototati-wa Norio-ga Hiroaki-kun-ga kaeri-ni keeki-o
 younger sisters-Top Norio-Nom Hiroaki-Mr.-Nom way back-on cake-Acc
 katte-kite-kureru-to itta-koto-ni hashaide-imasu.
 buy-come-give-that said-fact-at excited are
 "As for the younger sisters, they are excited that Norio said that Hiroaki will buy and bring cakes on his way back."

imoototati-wa Norio-ga dekake-ni Hiroaki-kun-ga keeki-o
 younger sisters-Top Norio-Nom departure-at Hiroaki-Mr.Nom cake-Acc
 katte-kite-kureru-to itta-koto-ni hashaide-imasu.
 buy-come-give-that said-fact-at excited are
 "As for the younger sisters, they are excited that Norio said when he left that Hiroaki will buy and bring cakes."

Will Norio go buy some cakes?

(NO)

- (14) jookyaku-ga untenshu-ga shoonentati-ga sunooboodo-de reesu-o
 passenger-Nom driver-Nom boys-Nom snowboard-with race-Acc
 site-iru-no-o mita-to omotta.
 doing-are-fact-Acc saw-that thought
 "The passenger thought that the driver saw that there were boys racing (with each other) on snowboards."

jookyaku-ga untenshu-ga bakkumiraa-de shoonentati-ga reesu-o
 passenger-Nom driver-Nom back mirror-with boys-Nom race-Acc
 site-iru-no-o mita-to omotta.
 doing-are-fact-Acc saw-that thought
 "The passenger thought that the driver saw with the rear-view mirror that there were boys racing (with each other)."

jookyaku-wa untenshu-ga shoonentati-ga sunooboodo-de reesu-o
 passenger-Top driver-Nom boys-Nom snowboard-with race-Acc
 site-iru-no-o mita-to omotta.
 doing-are-fact-Acc saw-that thought
 "As for the passenger, he thought that the driver saw that there were boys racing (with each other) on snowboards."

jookyaku-wa untenshu-ga bakkumiraa-de shoonentati-ga reesu-o
 passenger-Top driver-Nom back mirror-with boys-Nom race-Acc
 site-iru-no-o mita-to omotta.
 doing-are-fact-Acc saw-that thought

"As for the passenger, he thought that the driver saw with the rear-view mirror that there were boys racing (with each other)."

Were the boys racing with each other?

(YES)

- (15) henshuuchoo-ga Ito-kun-ga yuumeisakka-ga simekiri-maeni genkoo-o
 chief editor-Nom Ito-Mr.-Nom famous writer-Nom deadline-before draft-Acc
 okutte-kita-to hookokusite-kita-no-ni ansinsimasita.
 sent-has-that report-came-fact-Acc relieved-was
 "The chief editor was relieved that Ito reported (to him) that the famous
 writer has sent them a draft before its deadline."

henshuuchoo-ga Ito-kun-ga shussha-chokugoni yuumeisakka-ga genkoo-o
 chief editor-Nom Ito-Mr.-Nom arrival at work- right after famous writer-Nom draft-Acc
 okutte-kita-to hookokusite-kita-no-ni ansinsimasita.
 sent-has-that report-came-fact-Acc relieved-was
 "The chief editor was relieved that Ito reported (to him) right after Mr. Ito
 came to work that the famous writer has sent them a draft before its deadline."

henshuuchoo-wa Ito-kun-ga yuumeisakka-ga simekiri-maeni genkoo-o
 chief editor-Top Ito-Mr.-Nom famous writer-Nom deadline-before draft-Acc
 okutte-kita-to hookokusite-kita-no-ni ansinsimasita.
 sent-has-that report-came-fact-Acc relieved-was
 "As for the chief editor was relieved that Ito reported (to him) that the famous writer has sent
 them a draft before its deadline."

henshuuchoo-wa Ito-kun-ga shussha-chokugoni yuumeisakka-ga genkoo-o
 chief editor-Top Ito-Mr.-Nom arrival at work- right after famous writer-Nom draft-Acc
 okutte-kita-to hookokusite-kita-no-ni ansinsimasita.
 sent-has-that report-came-fact-Acc relieved-was
 "As for the chief editor, he was relieved that Ito reported (to him) right after
 Mr. Ito came to work that the famous writer has sent them a draft before its deadline."

Did Ito send the draft?

(NO)

- (16) Imai-san-ga koojoochoo-ga daiitsooko-ga tokkyuukamotu-de
 Imai-Mr./Ms.-Nom factory head-Nom First Warehouse-Nom super express truck-by
 chuumonhin-o shukkasita-sooda-to renrakusite-kita-to hanasita.
 order-Acc sent out-seem-that report-came-that spoke
 "Mr./Ms. Imai said that the factory head informed him that the First Warehouse sent out the
 ordered items by super express courier."

Imai-san-ga koojoochoo-ga keitaidenwa-de daiitsooko-ga
 Imai-Mr./Ms.-Nom factory head-Nom mobile phone-by First Warehouse-Nom
 chuumonhin-o shukkasita-sooda-to renrakusite-kita-to hanasita.
 order-Acc sent out-seem-that report-came-that spoke
 "Mr./Ms. Imai said that the factory head informed him by mobile phone that the First
 Warehouse sent out the ordered items."

Imai-san-wa koojoochoo-ga daiitsooko-ga tokkyuukamotu-de
 Imai-Mr./Ms.-Top factory head-Nom First Warehouse-Nom super express truck-by
 chuumonhin-o shukkasita-sooda-to renrakusite-kita-to hanasita.
 order-Acc sent out-seem-that report-came-that spoke
 "As for Mr./Ms. Imai, he/she said that the factory head informed him that the First Warehouse sent out the ordered items by super express courier."

Imai-san-wa koojoochoo-ga keitaidenwa-de daiitsooko-ga
 Imai-Mr./Ms.-Top factory head-Nom mobile phone-by First Warehouse-Nom
 chuumonhin-o shukkasita-sooda-to renrakusite-kita-to hanasita.
 order-Acc sent out-seem-that report-came-that spoke
 "As for Mr. Imai, he/she said that the factory head informed him by mobile phone that the First Warehouse sent out the ordered items."

Does the factory head have information from the warehouse?

(YES)

- (17) Satoo-san-ga uketukegakari-ga Kaneda-san-ga maikurobasu-de
 Sato-Mr./Ms.-Nom receptionist-Nom Kaneda-Mr./Ms.-Nom station wagon-by
 shain-o mukae-ni-kita-to itte-iru-to tutaeta.
 employee-Acc came to pick up-that saying-is-that informed
 "Mr./Ms. Sato reported that the receptionist said that Mr./Ms. Kaneda came by station wagon to pick up the employees."

Satoo-san-ga uketukegakari-ga intaahon-de Kaneda-san-ga
 Sato-Mr./Ms.-Nom receptionist-Nom interphone-on Kaneda-Mr./Ms.-Nom
 shain-o mukae-ni-kita-to itte-iru-to tutaeta.
 employee-Acc came to pick up-that saying-is-that informed
 "Mr./Ms. Sato reported that the receptionist said on the interphone that Mr./Ms. Kaneda came to pick up the section chief."

Satoo-san-wa uketukegakari-ga Kaneda-san-ga maikurobasu-de
 Sato-Mr./Ms.-Top receptionist-Nom Kaneda-Mr./Ms.-Nom station wagon-by
 shain-o mukae-ni-kita-to itte-iru-to tutaeta.
 employee-Acc came to pick up-that saying-is-that informed
 "As for Mr./Ms. Sato, he/she reported that the receptionist said that Mr./Ms Kaneda came by station wagon to pick up the employees."

Satoo-san-wa uketukegakari-ga intaahon-de Kaneda-san-ga
 Sato-Mr./Ms.-Top receptionist-Nom interphone-on Kaneda-Mr./Ms.-Nom
 shain-o mukae-ni-kita-to itte-iru-to tutaeta.
 employee-Acc came to pick up-that saying-is-that informed
 "As for Mr./Ms. Sato, he/she reported that the receptionist said on the interphone that Mr./Ms. Kaneda came to pick up the section chief."

Did Mr./Ms. Sato come to pick up the employees?

(NO)

- (18) komonkyoosi-ga jookyuuseitai-ga Ichiroo-ga mokumokuto renshuu-o
 coaching teacher-Nom senior students-Nom Ichiro-Nom very hard practice-Acc
 ganbatte-iru-to homete-iru-no-o kiite-imasita.
 doing best-ithat praising-are-fact-Acc hearing-was
 "The coach heard that the senior students were praising Ichiro for doing his very best in practice".

komonkyoosi-ga jookyuuseitai-ga kutiguti-ni Ichiroo-ga renshuu-o
 coaching teacher-Nom senior students-Nom chorus-in Ichiro-Nom practice-Acc
 ganbatte-iru-to homete-iru-no-o kiite-imasita.
 doing best-ithat praising-are-fact-Acc hearing-was

"The coach heard that the senior students were separately praising Ichiro for doing his best in practice."

komonkyoosi-wa jookyuuseitai-ga Ichiroo-ga mokumokuto renshuu-o
 coaching teacher-Top senior students-Nom Ichiro-Nom very hard practice-Acc
 ganbatte-iru-to homete-iru-no-o kiite-imasita.
 doing best-ithat praising-are-fact-Acc hearing-was

"As for the coach, he heard that the senior students were praising Ichiro for doing his very best in practice".

komonkyoosi-wa jookyuuseitai-ga kutiguti-ni Ichiroo-ga renshuu-o
 coaching teacher-Top senior students-Nom chorus-in Ichiro-Nom practice-Acc
 ganbatte-iru-to homete-iru-no-o kiite-imasita.
 doing best-ithat praising-are-fact-Acc hearing-was

"As for the coach, he heard that the senior students were separately praising Ichiro for doing his best in practice."

Do the seniors think Ichiro tries hard?

(YES)

- (19) kakarichoo-ga shokuin-ga Nakamura-san-ga mezasiku jimushori-o
 sec. chief-Nom workers-Nom Nakamura-Mr./Ms.-Nom unusually accounting-Acc
 matigaeta-koto-o hinan-site-iru-no-o tasinameta.
 made error-fact-at criticizing-is-fact-Acc reprimanded

"The section chief reprimanded the workers for being critical of the fact that Mr./Ms. Nakamura uncharacteristically made an accounting error."

kakarichoo-ga shokuin-ga itumademo Nakamura-san-ga jimushori-o
 sec. chief-Nom workers-Nom endlessly Nakamura-Mr./Ms.-Nom accounting-Acc
 matigaeta-koto-o hinan-site-iru-no-o tasinameta.
 made error-fact-at criticizing-is-fact-Acc reprimanded

"The section chief reprimanded the workers for being endlessly critical of the fact that Mr./Ms. Nakamura made an accounting error."

kakarichoo-wa shokuin-ga Nakamura-san-ga mezasiku jimushori-o
 sec. chief-Top workers-Nom Nakamura-Mr./Ms.-Nom unusually accounting-Acc
 matigaeta-koto-o hinan-site-iru-no-o tasinameta.
 made error-fact-at criticizing-is-fact-Acc reprimanded

"As for the section chief, he reprimanded the workers for being critical off the fact that Mr./Ms. Nakamura uncharacteristically made an accounting error."

kakarichoo-wa shokuin-ga itumademo Nakamura-san-ga jimushori-o
 sec. chief-Top workers-Nom endlessly Nakamura-Mr./Ms.-Nom accounting-Acc
 matigaeta-koto-o hinan-site-iru-no-o tasinameta.
 made error-fact-at criticizing-is-fact-Acc reprimanded

"As for the section chief, he reprimanded the workers for being endlessly critical of the fact that Mr./Ms. Nakamura made an accounting error."

Did the section chief make an error in accounting?

(NO)

- (20) ruumumeito-ga Keiko-ga kanrinin-ga kinoo-kara tegami-o
 roommate-Nom Keiko-Nom superintendent-Nom yesterday-from letter-Acc
 azukatte-kurete-iru-to osiete-ageta-no-o wasurete-iru.
 holding-giving-is-that inform-gave-fact-Acc forget
 "The roommate has forgotten that Keiko informed her that the superintendent has been holding a letter for her since yesterday."

ruumumeito-ga Keiko-ga imasigata kanrinin-ga tegami-o
 roommate-Nom Keiko-Nom just now superintendent-Nom letter-Acc
 azukatte-kurete-iru-to osiete-ageta-no-o wasurete-iru.
 holding-giving-is-that inform-gave-fact-Acc forget
 "The roommate has forgotten that Keiko just informed her that the superintendent has been holding a letter for her."

ruumumeito-wa Keiko-ga kanrinin-ga kinoo-kara tegami-o
 roommate-Top Keiko-Nom superintendent-Nom yesterday-from letter-Acc
 azukatte-kurete-iru-to osiete-ageta-no-o wasurete-iru.
 holding-giving-is-that inform-gave-fact-Acc forget
 "As for the roommate, she has forgotten that Keiko informed her that the superintendent has been holding a letter for her since yesterday."

ruumumeito-wa Keiko-ga imasigata kanrinin-ga tegami-o
 roommate-Top Keiko-Nom just now superintendent-Nom letter-Acc
 azukatte-kurete-iru-to osiete-ageta-no-o wasurete-iru.
 Holding-giving-is-that inform-gave-fact-Acc forget
 "As for the roommate, she has forgotten that Keiko just informed her that the superintendent has been holding a letter for her."

Did the superintendent speak with the roommate?

(NO)

- (21) Mayumi-tati-ga ten'in-ga ninki-kashu-ga tabitabi
 Mayumi-pl.-Nom sales person-Nom popolar-singer-Nom often
 atarasii NHK dorama-ni dete-iru-to osiete-kureta-to iimasita.
 new NHK drama-in appearing is-that inform-gave-that said
 "Mayumi and her friends said that the sales person let them know that the popular singer often appears in a new NHK drama."

Mayumi-tati-ga ten'in-ga wazawaza ninki-kashu-ga
 Mayumi-pl.-Nom sales person-Nom kindly popolar-singer-Nom
 atarasii NHK dorama-ni dete-iru-to osiete-kureta-to iimasita.
 new NHK drama-in appearing is-that inform-gave-that said
 "Mayumi and her friends said that the sales person kindly let them know that the popular singer appears in a new NHK drama."

Mayumi-tati-wa ten'in-ga ninki-kashu-ga tabitabi
 Mayumi-pl.-Top sales person-Nom popolar-singer-Nom often
 atarasii NHK dorama-ni dete-iru-to osiete-kureta-to iimasita.
 new NHK drama-in appearing is-that inform-gave-that said
 "As for Mayumi and her friends, they said that the sales person let them know that the popular singer often appears in a new NHK drama."

Mayumi-tati-wa ten'in-ga wazawaza ninki-kashu-ga
 Mayumi-pl.-Top sales person-Nom kindly popolar-singer-Nom
 atarasii NHK dorama-ni dete-iru-to osiete-kureta-to iimasita.
 new NHK drama-in appering is-that inform-gave-that said
 "As for Mayumi and her friends, they said that the sales person kindly let them know that
 the popular singer appears in a new NHK drama."

Did the sales person know about the drama?

(YES)

- (22) hanbaikachoo-ga jimuin-ga tokuisaki-ga kooza-ni nyuukin-o
 sales dept. chief-Nom accountant-Nom customer-Nom bank account-into deposit-Acc
 sitekita-to memosite-oita-no-o yomiagemasita.
 did-that jotted down fact-Acc read aloud
 "The sales department chief read aloud the fact that the accountant had jotted down that the
 special customer deposited money into their account."

hanbaikachoo-ga jimuin-ga choobo-ni tokuisaki-ga nyuukin-o
 sales dept. chief-Nom accountant-Nom account file-in customer-Nom deposit-Acc
 sitekita-to memosite-oita-no-o yomiagemasita.
 did-that jotted down fact-Acc read aloud
 "The sales department chief read aloud the fact that the accountant had jotted down that the
 special customer deposited money into their account."

hanbaikachoo-wa jimuin-ga tokuisaki-ga kooza-ni nyuukin-o
 sales dept. chief-Nom accountant-Nom customer-Nom bank account-into deposit-Acc
 sitekita-to memosite-oita-no-o yomiagemasita.
 did-that jotted down fact-Acc read aloud
 "As for the sales department chief, he read aloud the fact that the accountant had jotted
 down that the special customer deposited money into their account."

hanbaikachoo-wa jimuin-ga choobo-ni tokuisaki-ga nyuukin-o
 sales dept. chief-Top accountant-Nom account file-in customer-Nom deposit-Acc
 sitekita-to memosite-oita-no-o yomiagemasita.
 did-that jotted down fact-Acc read aloud
 "As for the sales department chief, he read aloud the fact that the accountant had jotted
 down that the special customer deposited money into their account."

Was the fact that the money was deposited communicated to the sales
 department chief?

(YES)

- (23) kenkyuuintati-ga shochoo-ga Murayama Hakase-ga Mitaka-de atarasii jikken-o
 researchers-Nom head-Nom Murayama-Dr. -Nom Mitaka-in new experiment-Acc
 kaisisita-to setumeisita-no-ni kikiitte-imasita.
 started-that explained-fact-to listening-were
 "The researchers were listening as the laboratory head explained that Dr. Murayama has
 started a new experiment in Mitaka."

kenkyuuintati-ga shochoo-ga kunji-de Murayama Hakase-ga atarasii jikken-o
 researchers-Nom head-Nom head's talk-in Murayama-Dr. -Nom new experiment-Acc
 kaisisita-to setumeisita-no-ni kikiitte-imasita.
 started-that explained-fact-to listening-were
 "The researchers were listening as the laboratory head explained in his address that Dr.
 Murayama has started a new experiment."

kenkyuuintati-wa shochoo-ga Murayama Hakase-ga Mitaka-de atarasii jikken-o
 researchers-Top head-Nom Murayama-Dr. -Nom Mitaka-in new experiment-Acc
 kaisisita-to setumeisita-no-ni kikiitte-imasita.
 started-that explained-fact-to listening-were
 "As for the researchers, they were listening as the laboratory head explained that Dr.
 Murayama has started a new experiment in Mitaka."

kenkyuuintati-wa shochoo-ga kunji-de Murayama Hakase-ga atarasii jikken-o
 researchers-Top head-Nom head's talk-in Murayama-Dr. -Nom new experiment-Acc
 kaisisita-to setumeisita-no-ni kikiitte-imasita.
 started-that explained-fact-to listening-were
 "As for the researchers, they were listening as the laboratory head explained in his address
 that Dr. Murayama has started a new experiment."

Has the doctor begun anything new?

(YES)

- (24) suchuwaadesu-ga kichoo-ga kanseitoo-ga sibaraku taiki-o mejite-iru-to
 stewardess-Nom pilot-Nom control tower-Nom for a while wait-Acc ordering-is-that
 renrakusite-kita-to hoosoosita.
 report-came-that announced
 "The stewardess announced that the pilot reported that the control tower ordered (them) to
 wait for a while."

suchuwaadesu-ga kichoo-ga sakihodo kanseitoo-ga taiki-o mejite-iru-to
 stewardess-Nom pilot-Nom a while ago control tower-Nom wait-Acc ordering-is-that
 renrakusite-kita-to hoosoosita.
 report-came-that announced
 "The stewardess announced that the pilot reported a while ago that the control tower
 ordered (them) to wait."

suchuwaadesu-wa kichoo-ga kanseitoo-ga sibaraku taiki-o mejite-iru-to
 stewardess-Top pilot-Nom control tower-Nom for a while wait-Acc ordering-is-that
 renrakusite-kita-to hoosoosita.
 report-came-that announced
 "As for the stewardess, she announced that the pilot reported that the control tower ordered
 (them) to wait for a while."

suchuwaadesu-wa kichoo-ga sakihodo kanseitoo-ga taiki-o mejite-iru-to
 stewardess-Top pilot-Nom a while ago control tower-Nom wait-Acc ordering-is-that
 renrakusite-kita-to hoosoosita.
 report-came-that announced
 "As for the stewardess, she announced that the pilot reported a while ago that the control
 tower ordered (them) to wait."

Did the pilot make an announcement?

(NO)

Appendix G-1: Self-Paced Whole-Sentence Reading Task, Single Embedding Test Sentences, Experiment 2

- (1) そそっかしい母親が次郎が難しい宿題が授業中にできてしまったとかんちがいた。
そそっかしい母親が次郎が難しい宿題を授業中にやってしまったとかんちがいた。
そそっかしい母親は次郎が難しい宿題が授業中にできてしまったとかんちがいた。
そそっかしい母親は次郎が難しい宿題を授業中にやってしまったとかんちがいた。

宿題は授業が終わる前に仕上がりましたか。

(いいえ)

- (2) お抱え運転手が首相が財政問題が解決できていないことを批判してしまった。
お抱え運転手が首相が財政問題を考えていないことを批判してしまった。
お抱え運転手は首相が財政問題が解決できていないことを批判してしまった。
お抱え運転手は首相が財政問題を考えていないことを批判してしまった。

運転手は財政への取り組み方について支持的ですか。

(いいえ)

- (3) 洋子が妻想いな夫が夕食がうまく作れることを密かに期待していました。
洋子が妻想いな夫が夕食をうまく作ることを密かに期待していました。
洋子は妻想いな夫が夕食がうまく作れることを密かに期待していました。
洋子は妻想いな夫が夕食をうまく作ることを密かに期待していました。

夫は家事をするように望まれていましたか。

(はい)

- (4) 朝刊が与党政治家がワイロが大好きだと大々的に報道した。
朝刊が与党政治家がワイロを受け取ったと大々的に報道した。
朝刊は与党政治家がワイロが大好きだと大々的に報道した。
朝刊は与党政治家がワイロを受け取ったと大々的に報道した。

収賄問題は新聞で取り上げられましたか。

(はい)

- (5) 新人賞受賞歌手がマスコミがスキャンダルが欲しいのに気付きました。
新人賞受賞歌手がマスコミがスキャンダルを探しているのに気付きました。
新人賞受賞歌手はマスコミがスキャンダルが欲しいのに気付きました。
新人賞受賞歌手はマスコミがスキャンダルを探しているのに気付きました。

報道陣はこの歌手に関心がありましたか。

(はい)

- (6) 国語教師が生徒が漢字書取がいつも不得意なことに落胆している。
国語教師が生徒が漢字書取をいつも避けていることに落胆している。
国語教師は生徒が漢字書取がいつも不得意なことに落胆している。
国語教師は生徒が漢字書取をいつも避けていることに落胆している。

生徒は漢字の練習をがんばっていますか。

(いいえ)

- (7) おじいちゃんが澄子ちゃんがお小遣いが要ることをちゃんと知っていました。
おじいちゃんが澄子ちゃんがお小遣いをねだることをちゃんと知っていました。
おじいちゃんは澄子ちゃんがお小遣いが要ることをちゃんと知っていました。
おじいちゃんは澄子ちゃんがお小遣いをねだることをちゃんと知っていました。

おじいさんは澄子の欲しいものが分かっていたか。(はい)

- (8) 忘年会幹事が宴会出席者が生魚があまり好きでないと連絡してきた。
忘年会幹事が宴会出席者が生魚をあまり食べないと連絡してきた。
忘年会幹事は宴会出席者が生魚があまり好きでないと連絡してきた。
忘年会幹事は宴会出席者が生魚をあまり食べないと連絡してきた。

食べ物について連絡をしたのは幹事ですか。(はい)

- (9) 新聞配達少年がやせた野良猫が餌が欲しそうなのに気付いた。
新聞配達少年がやせた野良猫が餌を探しているのに気付いた。
新聞配達少年はやせた野良猫が餌が欲しそうなのに気付いた。
新聞配達少年はやせた野良猫が餌を探しているのに気付いた。

猫はお腹が減っているようでしたか。(はい)

- (10) 完太君が園長先生がなぞなぞがまだ解けないのを不思議がっています。
完太君が園長先生がなぞなぞをまだやっていないのを不思議がっています。
完太君は園長先生がなぞなぞがまだ解けないのを不思議がっています。
完太君は園長先生がなぞなぞをまだやっていないのを不思議がっています。

園長はなぞなぞを答え終わりましたか。(いいえ)

- (11) コーチが一番打者が盗塁が得意なことにととても満足していた。
コーチが一番打者が盗塁を試みたことにととても満足していた。
コーチは一番打者が盗塁が得意なことにととても満足していた。
コーチは一番打者が盗塁を試みたことにととても満足していた。

コーチは盗塁は良くないと思いましたか。(いいえ)

- (12) 子供好きな田村夫婦が息子夫婦が子供がやっと思えたことと大喜びです。
子供好きな田村夫婦が息子夫婦が子供をやっと思えたことと大喜びです。
子供好きな田村夫婦は息子夫婦が子供がやっと思えたことと大喜びです。
子供好きな田村夫婦は息子夫婦が子供をやっと思えたことと大喜びです。

赤ちゃんができたのは田村夫婦ですか。(いいえ)

- (13) 指揮者がピアニストがリハーサルができていないのに戸惑っていました。
指揮者がピアニストがリハーサルを終えていないのに戸惑っていました。
指揮者はピアニストがリハーサルができていないのに戸惑っていました。
指揮者はピアニストがリハーサルを終えていないのに戸惑っていました。

ピアニストはもう準備万端ですか。(いいえ)

- (14) 感傷的な父が祖母が怠け者が心底嫌いだったと話しています。
 感傷的な父が祖母が怠け者を心底嫌っていたと話しています。
 感傷的な父は祖母が怠け者が心底嫌いだったと話しています。
 感傷的な父は祖母が怠け者を心底嫌っていたと話しています。

お父さんはおばあさんのことを話していますか。

(はい)

- (15) 見物人が美しい手品師がナイフ投げが上手なことに感動していた。
 見物人が美しい手品師がナイフ投げを見せたことに感動していた。
 見物人は美しい手品師がナイフ投げが上手なことに感動していた。
 見物人は美しい手品師がナイフ投げを見せたことに感動していた。

観客はナイフを投げましたか。

(いいえ)

- (16) 選挙事務所が三上代議士が地元支持者が必要なことを必死に宣伝し廻っている。
 選挙事務所は三上代議士が地元支持者が必要なことを必死に宣伝し廻っている。
 選挙事務所が三上代議士が地元支持者を募っていることを必死に宣伝し廻っている。
 選挙事務所は三上代議士が地元支持者を募っていることを必死に宣伝し廻っている。

この代議士はもっと支援者が欲しいですか。

(はい)

- (17) 高橋さんが請負業者が補修工事が仕上がったとファックスで伝えてきた。
 高橋さんが請負業者が補修工事を開始したとファックスで伝えてきた。
 高橋さんは請負業者が補修工事が仕上がったとファックスで伝えてきた。
 高橋さんは請負業者が補修工事を開始したとファックスで伝えてきた。

請負業者はファックスを送りましたか。

(いいえ)

- (18) 看護婦さんが入院患者が飲み物が欲しいことをすっかり忘れてしまいました。
 看護婦さんは入院患者が飲み物が欲しいことをすっかり忘れてしまいました。
 看護婦さんが入院患者が飲み物を頼んだことをすっかり忘れてしまいました。
 看護婦さんは入院患者が飲み物を頼んだことをすっかり忘れてしまいました。

患者さんは何か欲しかったですか。

(はい)

- (19) 電気屋さんが伊藤さんが一番安いエアコンが欲しいのを見抜いていた。
 電気屋さんが伊藤さんが一番安いエアコンを買うつもりなのを見抜いていた。
 電気屋さんは伊藤さんが一番安いエアコンが欲しいのを見抜いていた。
 電気屋さんは伊藤さんが一番安いエアコンを買うつもりなのを見抜いていた。

伊藤さんは出費を少なくしようとしていますか。

(はい)

- (20) 店長が食品売場が開店準備ができていないのに怒っています。
 店長が食品売場が開店準備を始めていないのに怒っています。
 店長は食品売場が開店準備ができていないのに怒っています。
 店長は食品売場が開店準備を始めていないのに怒っています。

お店はもう開店できる状態ですか。

(いいえ)

- (21) 妹が叔母が分厚いセーターがもう編み上がったと驚いていました。
妹が叔母が分厚いセーターをもう着込み始めたと驚いていました。
妹は叔母が分厚いセーターがもう編み上がったと驚いていました。
妹は叔母が分厚いセーターをもう着込み始めたと驚いていました。

お婆さんはセーターのことでびっくりしましたか。

(いいえ)

- (22) 腹べこな生徒達が給食当番が盛りつけが下手くそなことにいらついています。
腹べこな生徒達が給食当番が盛りつけをさぼっていることにいらついています。
腹べこな生徒達は給食当番が盛りつけが下手くそなことにいらついています。
腹べこな生徒達は給食当番が盛りつけをさぼっていることにいらついています。

給食の準備は順調に進んでいますか。

(いいえ)

- (23) 小林君が鈴木さんが担任教師が大嫌いだと言いました。
小林君が鈴木さんが担任教師を嫌がっていると言いました。
小林君は鈴木さんが担任教師が大嫌いだと言いました。
小林君は鈴木さんが担任教師を嫌がっていると言いました。

鈴木さんは先生のことを不愉快に感じていますか。

(はい)

- (24) 秘書が森下社長がタクシーが必要だと受付まで言いに来た。
秘書が森下社長がタクシーを呼んでであると受付まで言いに来た。
秘書は森下社長がタクシーが必要だと受付まで言いに来た。
秘書は森下社長がタクシーを呼んでであると受付まで言いに来た。

秘書は受付に行きましたか。

(はい)

Appendix G-2: Self-Paced Whole-Sentence Reading Task, Single Embedding Test Sentences, Experiment 2, English Translation

- (1) **sosokkasii hahaoya-ga Jiro-ga muzukasii shukudai-ga jugyoochuu-ni**
careless mother-Nom Jiro-Nom difficult homework-Nom class-in
dekite-simatta-to kantigai-sita.
finished-has-that misunderstanding-did
"The careless mother misunderstood that Jiro had been able to finish (his) difficult homework in class."
- sosokkasii hahaoya-ga Jiro-ga muzukasii shukudai-o jugyoochuu-ni**
careless mother-Nom Jiro-Nom difficult homework-Acc class-in
yatte-simatta-to kantigai-sita.
done -has-that misunderstanding-did
"The careless mother misunderstood that Jiro had done (his) difficult homework in class."
- sosokkasii hahaoya-wa Jiro-ga muzukasii shukudai-ga jugyoochuu-ni**
careless mother-Top Jiro-Nom difficult homework-Nom class-in
dekite-simatta-to kantigai-sita.
finished-has-that misunderstanding-did
"As for the careless mother, she misunderstood that Jiro had been able to finish (his) difficult homework in class."
- sosokkasii hahaoya-wa Jiro-ga muzukasii shukudai-o jugyoochuu-ni**
careless mother-Top Jiro-Nom difficult homework-Acc class-in
yatte-simatta-to kantigai-sita.
done -has-that misunderstanding-did
"As for the careless mother, she misunderstood that Jiro had done (his) difficult homework in class."
- Was the homework completed before the class was over? (NO)**
- (2) **okakae-untenshu-ga shushoo-ga zaiseimondai-ga kaiketu-dekite-i-nai**
chauffeur-Nom prime minister-Nom financial problem-Nom solve-able-has-not
koto-o hihan-site-simatta.
fact-Acc criticism-done-has
"The chauffeur has criticized the fact that the Prime Minister has not been able to solve financial problems."
- okakae-untenshu-ga shushoo-ga zaiseimondai-o kangaete-i-nai**
chauffeur-Nom prime minister-Nom financial problem-Acc considering-is-not
koto-o hihan-site-simatta.
fact-Acc criticism-done-has
"The chauffeur has criticized the fact that the Prime Minister has not considered financial problems."

okakae-untenshu-wa shushoo-ga zaiseimondai-ga kaiketu-dekite-i-nai
 chauffeur-Top prime minister-Nom financial problem-Nom solve-able-has-not
 koto-o hihan-site-simatta.
 fact-Acc criticism-done-has
 "As for the chauffeur, he has criticized the fact that the Prime Minister has not been able to solve financial problems."

okakae-untenshu-wa shushoo-ga zaiseimondai-o kangaete-i-nai
 chauffeur-Top prime minister-Nom financial problem-Acc considering-is-not
 koto-o hihan-site-simatta.
 fact-Acc criticism-done-has
 "As for the chauffeur, he has criticized the fact that the Prime Minister has not considered financial problems."

Is the chauffeur supportive of how the financial problems are dealt with? (NO)

- (3) Yoko-ga tumaomoina otto-ga yuushoku-ga umaku tukur-eru-koto-o
 Yoko-Nom wife-loving husband-Nom dinner-Nom successfully prepare-can-fact-Acc
 hisokani kitaisite-imasita.
 secretly hoping-was
 "Yoko was secretly hoping that her wonderful husband would be able to prepare dinner successfully."

Yoko-ga tumaomoina otto-ga yuushoku-o umaku tukuru-koto-o
 Yoko-Nom wife-loving husband-Nom dinner-Acc successfully prepare-fact-Acc
 hisokani kitaisite-imasita.
 secretly hoping-was
 "Yoko was secretly hoping that her wonderful husband would prepare dinner successfully."

Yoko-wa tumaomoina otto-ga yuushoku-ga umaku tukur-eru-koto-o
 Yoko-Top wife-loving husband-Nom dinner-Nom successfully prepare-can-fact-Acc
 hisokani kitaisite-imasita.
 secretly hoping-was
 "As for Yoko, she was secretly hoping that her wonderful husband would be able to prepare dinner successfully."

Yoko-wa tumaomoina otto-ga yuushoku-o umaku tukuru-koto-o
 Yoko-Top wife-loving husband-Nom dinner-Acc successfully prepare-fact-Acc
 hisokani kitaisite-imasita.
 secretly hoping-was
 "As for Yoko, she was secretly hoping that her wonderful husband would prepare dinner successfully."

Was the husband expected to do a domestic chore? (YES)

- (4) chookan-ga yotoo seijika-ga wairo-ga daisuki-da-to
 morning paper-Nom government-party politician-Nom bribe-Nom loving-is-that
 daidaiteki-ni hoodoosita.
 extensively reported
 "The morning paper reported extensively that politicians in the Government party love bribery."

chookan-ga yotoo seijika-ga wairo-o uketotta-to
 morning paper-Nom government-party politician-Nom bribe-Acc received-that
 daidaiteki-ni hoodoosita.
 extensively reported
 "The morning paper reported extensively that politicians in the Government party received bribes."

chookan-wa yotoo seijika-ga wairo-ga daisuki-da-to
 morning paper-Top government-party politician-Nom bribe-Nom loving-is-that
 daidaiteki-ni hoodoosita.
 extensively reported
 "As for the morning paper, it reported extensively that politicians in the Government party love bribery."

chookan-wa yotoo seijika-ga wairo-o uketotta-to
 morning paper-Top government-party politician-Nom bribe-Acc received-that
 daidaiteki-ni hoodoosita.
 extensively reported
 "As for the morning paper, it reported extensively that politicians in the Government party received bribes."

Were the bribery problems covered by the newspaper? (YES)

- (5) sinjinshoo-jushoo-kashu-ga masukomi-ga sukyandaru-ga hosii-no-ni
 award-winning new singer-Nom paparazzi-Nom scandal-Nom want-fact-at
 kizukimasita.
 noticed
 "The new award-winning singer noticed that paparazzi want to exploit (his) scandals."

sinjinshoo-jushoo-kashu-ga masukomi-ga sukyandaru-o sagasite-iru-no-ni
 award-winning new singer-Nom paparazzi-Nom scandal-Acc searching-is-fact-at
 kizukimasita.
 noticed
 "The new award-winning singer noticed that paparazzi are looking to exploit (his) scandals."

sinjinshoo-jushoo-kashu-wa masukomi-ga sukyandaru-ga hosii-no-ni
 award-winning new singer-Top paparazzi-Nom scandal-Nom want-fact-at
 kizukimasita.
 noticed
 "As for the new award-winning singer, he noticed that paparazzi want to exploit (his) scandals."

sinjinshoo-jushoo-kashu-wa masukomi-ga sukyandaru-o sagasite-iru-no-ni
 award-winning new singer-Top paparazzi-Nom scandal-Acc searching-is-fact-at
 kizukimasita.
 noticed
 "As for the new award-winning singer, he noticed that paparazzi are looking to exploit (his) scandals."

Were reporters interested in this singer? (YES)

- (6) kokugokyoosi-ga seito-ga kanji-kakitori-ga itsumo hutokuina-koto-ni
 Japanese teacher-Nom student-Nom kanji-writing-Nom always poor-fact-at
 rakutansite-iru.
 disappointed-is
 "Japanese-language teachers are disappointed that (their) students are always poor at
 writing kanji."

kokugokyoosi-ga seito-ga kanji-kakitori-o itsumo sakete-iru-koto-ni
 Japanese teacher-Nom student-Nom kanji-writing-Acc always avoiding-is-fact-at
 rakutansite-iru.
 disappointed-is
 "Japanese-language teachers are disappointed that (their) students always avoid writing
 kanji."

kokugokyoosi-wa seito-ga kanji-kakitori-ga itsumo hutokuina-koto-ni
 Japanese teacher-Top student-Nom kanji-writing-Nom always poor-fact-at
 rakutansite-iru.
 disappointed-is
 "As for Japanese-language teachers, they are disappointed that (their) students are always
 poor at writing kanji."

kokugokyoosi-wa seito-ga kanji-kakitori-o itsumo sakete-iru-koto-ni
 Japanese teacher-Top student-Nom kanji-writing-Acc always avoiding-is-fact-at
 rakutansite-iru.
 disappointed-is
 "As for Japanese-language teachers, they are disappointed that (their) students always
 avoid writing kanji."

Do the students excel at learning kanji?

(NO)

- (7) ojiichan-ga Sumiko-chan-ga okozukai-ga iru-koto-o chanto
 grandpa-Nom Sumiko-Ms.-Nom pocket money-Nom need-fact-Acc clearly
 sitte-imasita.
 knowing-was
 "Grandpa knows well that Sumiko needs some pocket money."

ojiichan-ga Sumiko-chan-ga okozukai-o nedaru-koto-o chanto
 grandpa-Nom Sumiko-Ms.-Nom pocket money-Acc ask for-fact-Acc clearly
 sitte-imasita.
 knowing-was
 "Grandpa knows well that Sumiko will ask him for some pocket money."

ojiichan-wa Sumiko-chan-ga okozukai-ga iru-koto-o chanto
 grandpa-Top Sumiko-Ms.-Nom pocket money-Nom need-fact-Acc clearly
 sitte-imasita.
 knowing-was
 "As for Grandpa, he knows well that Sumiko needs some pocket money."

ojiichan-wa Sumiko-chan-ga okozukai-o nedaru-koto-o chanto
 grandpa-Top Sumiko-Ms.-Nom pocket money-Acc ask for-fact-Acc clearly
 sitte-imasita.
 knowing-was
 "As for Grandpa, he knows well that Sumiko will ask him for some pocket money."

Does the grandfather understand what his granddaughter wants?

(YES)

- (8) boonenkai-kanji-ga enkai-shussekisha-ga namazakana-ga amari
 forgetting-year-party-organizer-Nom party-attendants-Nom raw-fish-Nom so much
 sukide-nai-to renraku-site-kita.
 like-not-that report-do-came
 "The organizer of the year-end party informed (me/someone) that the party attendants do not like raw fish very much."

boonenkai-kanji-ga enkai-shussekisha-ga namazakana-o amari
 forgetting-year-party-organizer-Nom party-attendants-Nom raw-fish-Acc so often
 tabe-nai-to renraku-site-kita.
 eat-not-that report-do-came
 "The organizer of the year-end party informed (me/someone) that the party attendants do not eat raw fish so often."

boonenkai-kanji-wa enkai-shussekisha-ga namazakana-ga amari
 forgetting-year-party-organizer-Top party-attendants-Nom raw-fish-Nom so much
 sukide-nai-to renraku-site-kita.
 like-not-that report-do-came
 "As for the organizer of the year-end party, he informed (me/someone) that the party attendants do not like raw fish very much."

boonenkai-kanji-wa enkai-shussekisha-ga namazakana-o amari
 forgetting-year-party-organizer-Top party-attendants-Nom raw-fish-Acc so often
 tabe-nai-to renraku-site-kita.
 eat-not-that report-do-came
 "As for the organizer of the year-end party, he informed (me/someone) that the party attendants do not eat raw fish so often."

Was it the organizer who informed (pro) about food? (YES)

- (9) sinbun-haitatu-shoonen-ga yaseta noraneko-ga esa-ga hosii-soona-no-ni
 newspaper-delivery-boy-Nom skinny stray-cat-Nom food-Nom want-seem-fact-at
 kizuita.
 noticed
 "The newspaper delivery boy noticed that the skinny stray cat seems to want some food."

sinbun-haitatu-shoonen-ga yaseta noraneko-ga esa-o sagasite-iru-no-ni
 newspaper-delivery-boy-Nom skinny stray-cat-Nom food-Acc seeking-is-fact-at
 kizuita.
 noticed
 "The newspaper delivery boy noticed that the skinny stray cat is looking for some food."

sinbun-haitatu-shoonen-wa yaseta noraneko-ga esa-ga hosii-soona-no-ni
 newspaper-delivery-boy-Top skinny stray-cat-Nom food-Nom want-seem-fact-at
 kizuita.
 noticed
 "As for the newspaper delivery boy, he noticed that the skinny stray cat seems to want some food."

sinbun-haitatu-shoonen-wa yaseta noraneko-ga esa-o sagasite-iru-no-ni
 newspaper-delivery-boy-Top skinny stray-cat-Nom food-Acc seeking-is-fact-at
 kizuuta.
 noticed

"As for the newspaper delivery boy, he noticed that the skinny stray cat is looking for some food."

Does the cat seem to be hungry?

(YES)

- (10) Kanta-kun-ga enchoosensei-ga nazonazo-ga mada tok-e-nai-koto-o
 Kanta-Mr.-Nom kindergarten principal-Nom riddle-Nom yet solve-able-not-fact-Acc
 husigigatte-imasu.
 wondering-is

"Kanta thinks it's strange that the kindergarten principal has not yet been able to solve the riddle.

Kanta-kun-ga enchoosensei-ga nazonazo-o mada yatte-i-nai-koto-o
 Kanta-Mr.-Nom kindergarten principal-Nom riddle-Acc yet done-has-not-fact-Acc
 husigigatte-imasu.
 wondering-is

"Kanta thinks it's strange that the kindergarten principal has not yet solved the riddle.

Kanta-kun-wa enchoosensei-ga nazonazo-ga mada tok-e-nai-koto-o
 Kanta-Mr.-Top kindergarten principal-Nom riddle-Nom yet solve-able-not-fact-Acc
 husigigatte-imasu.
 wondering-is

"As for Kanta, he thinks it's strange that the kindergarten principal has not yet been able to solve the riddle.

Kanta-kun-wa enchoosensei-ga nazonazo-o mada yatte-i-nai-koto-o
 Kanta-Mr.-Top kindergarten principal-Nom riddle-Acc yet done-has-not-fact-Acc
 husigigatte-imasu.
 wondering-is

"As for Kanta, he thinks it's strange that the kindergarten principal has not yet solved the riddle.

Has the principal figured out the answer to the riddle?

(NO)

- (11) kooti-ga itiban dasha-ga toorui-ga tokuina-koto-ni manzoku-site-ita.
 coach-Nom first batter-Nom base stealing-Nom good-fact-with satisfaction-doing-was
 "The coach was satisfied with the fact that the leadoff man was good at stealing bases."

kooti-ga itiban dasha-ga toorui-o kokoromita-koto-ni manzoku-site-ita.
 coach-Nom first batter-Nom base stealing-Acc attempted-fact-with satisfaction-doing-was
 "The coach was satisfied with the fact that the leadoff man attempted a steal."

kooti-wa itiban dasha-ga toorui-ga tokuina-koto-ni manzoku-site-ita.
 coach-Top first batter-Nom base stealing-Nom good-fact-with satisfaction-doing-was
 "As for the coach, he was satisfied with the fact that the leadoff man was good at stealing bases."

kooti-wa itiban dasha-ga toorui-o kokoromita-koto-ni manzoku-site-ita.
 coach-Top first batter-Nom base stealing-Acc attempted-fact-with satisfaction-doing-was
 "As for the coach, he was satisfied with the fact that the leadoff man attempted a steal."

Does the coach think that base stealing isn't good? (NO)

- (12) kodomo-zukina Tamura-husai-ga musuko-huuhu-ga kodomo-ga yatto
 child-loving Mr.& Ms. Tamura-Nom son-couple-Nom child-Nom finally
 dekita-to ooyorokobi-desu.
 make could-that big joy-is
 "The child-loving Mr.& Ms. Tamura are elated that their son and his wife could finally have a baby."

kodomo-zukina Tamura-husai-ga musuko-huuhu-ga kodomo-o yatto
 child-loving Mr.& Ms. Tamura-Nom son-couple-Nom child-Acc finally
 tukutta-to ooyorokobi-desu.
 made-that big joy-is
 "The child-loving Mr.& Ms. Tamura are elated that their son and his wife finally produced a child."

kodomo-zukina Tamura-husai-wa musuko-huuhu-ga kodomo-ga yatto
 child-loving Mr.& Ms. Tamura-Top son-couple-Nom child-Nom finally
 dekita-to ooyorokobi-desu.
 make could-that big joy-is
 "As for the child-loving Mr.& Ms. Tamura, they are elated that their son and his wife could finally have a baby."

kodomo-zukina Tamura-husai-wa musuko-huuhu-ga kodomo-o yatto
 child-loving Mr.& Ms. Tamura-Top son-couple-Nom child-Acc finally
 tukutta-to ooyorokobi-desu.
 made-that big joy-is
 "As for the child-loving Mr.& Ms. Tamura, they are elated that their son and his wife finally produced a child."

Was it Mr. & Ms. Tamura who had the baby? (NO)

- (13) sikisha-ga pianisuto-ga rihaasaru-ga dekite-i-nai-no-ni tomadotte-imasita.
 conductor-Nom pianist-Nom rehearsal-Nom do able-has-not-fact-at embarrassed-was
 "The conductor was embarrassed by the fact that the pianist hadn't yet been able to do her rehearsal."

sikisha-ga pianisuto-ga rihaasaru-o oete-i-nai-no-ni tomadotte-imasita.
 conductor-Nom pianist-Nom rehearsal-Acc finished-has-not-fact-at embarrassed-was
 "The conductor was embarrassed by the fact that the pianist hadn't finished her rehearsal yet."

sikisha-wa pianisuto-ga rihaasaru-ga dekite-i-nai-no-ni tomadotte-imasita.
 conductor-Top pianist-Nom rehearsal-Nom do able-has-not-fact-at embarrassed-was
 "As for the conductor, he was embarrassed by the fact that the pianist hadn't yet been able to do her rehearsal."

sikisha-wa pianisuto-ga rihaasaru-o oete-i-nai-no-ni tomadotte-imasita.
 conductor-Top pianist-Nom rehearsal-Acc finished-has-not-fact-at embarrassed-was
 "As for the conductor, he was embarrassed by the fact that the pianist hadn't finished her rehearsal yet."

Was the pianist completely ready?

(NO)

- (14) kanshootekina titi-ga sobo-ga namakemono-ga kokorokara
 my melancholic father-Nom my grand mother-Nom idle person-Nom bottom of the heart
 kirai-datta-to hanasite-imasu.
 unfond-was-that speaking-is
 "My melancholic father is saying that my grandmother was deeply scornful of idle people."

kanshootekina titi-ga sobo-ga namakemono-o kokorokara
 my melancholic father-Nom my grand mother-Nom idle person-Acc bottom of the heart
 kiratte-ita-to hanasite-imasu.
 hated-that speaking-is
 "My melancholic father is saying that my grandmother hated idle people from the bottom of her heart."

kanshootekina titi-wa sobo-ga namakemono-ga kokorokara
 my melancholic father-Top my grand mother-Nom idle person-Nom bottom of the heart
 kirai-datta-to hanasite-imasu.
 unfond-was-that speaking-is
 "As for my melancholic father, he is saying that my grandmother was deeply scornful of idle people."

kanshootekina titi-wa sobo-ga namakemono-o kokorokara
 my melancholic father-Top my grand mother-Nom idle person-Acc bottom of the heart
 kiratte-ita-to hanasite-imasu.
 hated-that speaking-is
 "As for my melancholic father, he is saying that my grandmother hated idle people from the bottom of her heart."

Is the father talking about the grandmother?

(YES)

- (15) kenbutunin-ga utukusii tejinasi-ga naihu-nage-ga joozuna-koto-ni
 audience-Nom beautiful magician-Nom throw-knife-Nom good-fact-by
 kandoosite-ita.
 impressed-was
 "The audience was impressed with the fact that the beautiful magician was good at throwing knives."

kenbutunin-ga utukusii tejinasi-ga naihu-nage-o miseta-koto-ni
 audience-Nom beautiful magician-Nom throw-knife-Acc showed-fact-by
 kandoosite-ita.
 impressed-was
 "The audience was impressed with the fact that the beautiful magician performed knife-throwing."

kenbutunin-wa utukusii tejinasi-ga naihu-nage-ga joozuna-koto-ni
audience-Top beautiful magician-Nom throw-knife-Nom good-fact-by
kandoosite-ita.
impressed-were

"As for the audience, they were impressed with the fact that the beautiful magician was good at throwing knives."

kenbutunin-wa utukusii tejinasi-ga naihu-nage-o miseta-koto-ni
audience-Top beautiful magician-Nom throw-knife-Acc showed-fact-by
kandoosite-ita.
impressed-were

"As for the audience, they were impressed with the fact that the beautiful magician performed knife-throwing."

Did the audience throw knives?

(NO)

- (16) senkyo jimusho-ga Mikami daigisi-ga jimoto sijisha-ga
election office-Nom Congressman Mikami-Nom local supporter-Nom
hituyoona-koto-o kenmeini senden-si-mawatte-iru.
necessary-fact-Acc desperately publicity-making-around-is
"The election office is desperately publicizing the fact that Congressman Mikami needs local supporters."

senkyo jimusho-ga Mikami daigisi-ga jimoto sijisha-o
election office-Nom Congressman Mikami-Nom local supporter-Acc
tunotte-iru-koto-o kenmeini senden-si-mawatte-iru.
recruiting-is-fact-Acc desperately publicity-making-around-is
"The election office is desperately publicizing the fact that Congressman Mikami is recruiting local supporters."

senkyo jimusho-wa Mikami daigisi-ga jimoto sijisha-ga
election office-Top Congressman Mikami-Nom local supporter-Nom
hituyoona-koto-o kenmeini senden-si-mawatte-iru.
necessary-fact-Acc desperately publicity-making-around-is
"As for the election office, it is desperately publicizing the fact that Congressman Mikami needs local supporters."

senkyo jimusho-wa Mikami daigisi-ga jimoto sijisha-o
election office-Top Congressman Mikami-Nom local supporter-Acc
tunotte-iru-koto-o kenmeini senden-si-mawatte-iru.
recruiting-is-fact-Acc desperately publicity-making-around-is
"As for the election office, it is desperately publicizing the fact that Congressman Mikami is recruiting local supporters."

Does this congressman want more supporters?

(YES)

- (17) Takahasi-san-ga ukeoigyosha-ga hoshuukooji-ga siagatta-to
Takahashi-Mr./Ms.-Nom contractor-Nom maintenance work-Nom completed-that
fakkusu-de tutaete-kita.
fax-by report-came
"Mr./Ms. Takahashi reported by fax that the contractor had completed the maintenance work."

Takahasi-san-ga ukeoigyoosha-ga hoshuukooji-o kaisisita-to
 Takahashi-Mr./Ms.-Nom contractor-Nom maintenance work-Acc began-that
 fakkusu-de tutaete-kita.
 fax-by report-came
 "Mr./Ms. Takahashi reported by fax that the contractor had begun the maintenance work."

Takahasi-san-wa ukeoigyoosha-ga hoshuukooji-ga siagatta-to
 Takahashi-Mr./Ms.-Top contractor-Nom maintenance work-Nom completed-that
 fakkusu-de tutaete-kita.
 fax-by report-came
 "As for Mr./Ms. Takahashi, he/she reported by fax that the contractor had completed the maintenance work."

Takahasi-san-wa ukeoigyoosha-ga hoshuukooji-o kaisisita-to
 Takahashi-Mr./Ms.-Top contractor-Nom maintenance work-Acc began-that
 fakkusu-de tutaete-kita.
 fax-by report-came
 "As for Mr. Takahashi, he/she reported by fax that the contractor had begun the maintenance work."

Did the contractor send a fax? (NO)

- (18) kangohu-san-ga nyuuin-kanja-ga nomimono-ga hosii-koto-o sukkari
 nurse-Hon-Nom hospitalized-patient-Nom drink-Nom want-fact-Acc totally
 wasurete-simaimasita.
 forgotten-has
 "The nurse has totally forgotten that the inpatient wants something to drink."

kangohu-san-ga nyuuin-kanja-ga nomimono-o tanonda-koto-o sukkari
 nurse-Hon-Nom hospitalized-patient-Nom drink-Acc asked-fact-Acc totally
 wasurete-simaimasita.
 forgotten-has
 "The nurse has totally forgotten that the inpatient asked for something to drink."

kangohu-san-wa nyuuin-kanja-ga nomimono-ga hosii-koto-o sukkari
 nurse-Hon-Top hospitalized-patient-Nom drink-Nom want-fact-Acc totally
 wasurete-simaimasita.
 forgotten-has
 "As for the nurse, she has totally forgotten that the inpatient wants something to drink."

kangohu-san-wa nyuuin-kanja-ga nomimono-ga tanonda-koto-o sukkari
 nurse-Hon-Top hospitalized-patient-Nom drink-Nom asked-fact-Acc totally
 wasurete-simaimasita.
 forgotten-has
 "As for the nurse, she has totally forgotten that the inpatient asked for something to drink."

Does the inpatient want something? (YES)

- (19) denkiyasan-ga Ito-san-ga itiban yasui eakon-ga
 electric appliance sales person-Nom Ito-Mr./Ms.-Nom cheapest air conditioner-Nom
 hosii-no-o minuite-ita.
 want-fact-Acc seeing through-was
 "The electric-appliance sales person could see into the fact that Mr./Ms. Ito wants the cheapest air conditioner."

denkiyasana-ga Ito-san-ga itiban yasui eakon-o
electric appliance sales person-Nom Ito-Mr./Ms.-Nom cheapest air conditioner-Acc
kau-tumorina-no-o minuute-ita.
buy-will-fact-Acc seeing through-was
“The electric-appliance sales person could see into the fact that Mr./Ms. Ito is going to buy
the cheapest air conditioner.”

denkiyasen-wa Ito-san-ga itiban yasui eakon-ga
electric appliance sales person-Top Ito-Mr./Ms.-Nom cheapest air conditioner-Nom
hosii-no-o minuite-ita.
want-fact-Acc seeing through-was
“As for the electric-appliance sales person, he could see into the fact that Mr./Ms. Ito wants
the cheapest air conditioner.”

denkiyasen-wa Ito-san-ga itiban yasui eakon-o
electric appliance sales person-Top Ito-Mr./Ms.-Nom cheapest air conditioner-Acc
kau-tumorina-no-o minuite-ita.
buy-will-fact-Acc seeing through-was
"As for the electric-appliance sales person, he could see into the fact that Mr./Ms. Ito is
going to buy the cheapest air conditioner."

Is Mr./Ms. Ito trying to reduce his expenses? (YES)

(20) tenchoo-ga shokuhin-uriba-ga kaiten-junbi-ga
store owner-Nom food-department-Nom store opening-preparation-Nom
dekite-i-nai-no-ni ikatte-imasu.
done-has-not-fact-at angry-is
"The store owner is angry that the food department is not prepared to open the store."

tenchoo-ga shokuhin-uriba-ga kaiten-junbi-o
store owner-Nom food-department-Nom store opening-preparation-Acc
hajimete-i-nai-no-ni ikatte-imasu.
started-has-not-fact-at angry-is
"The store owner is angry that the food department has not started to prepare for the store opening."

tenchoo-wa	shokuhin-uriba-ga	kaiten-junbi-ga
store owner-Top	food-department-Nom	store opening-preparation-Nom
dekite-i-nai-no-ni	ikatte-imasu.	
done-has-not-fact-at	angry-is	
"As for the store owner, he is angry at the fact that the food department is not prepared to open the store."		

tenchoo-wa	shokuhin-uriba-ga	kaiten-junbi-o
store owner-Top	food-department-Nom	store opening-preparation-Acc
hajimete-i-nai-no-ni	ikatte-imasu.	
started-has-not-fact-at	angry-is	
"As for the store owner, he is angry that the food department has not started to prepare for the store opening."		

Is the store ready to open now? (NO)

- (21) imooto-ga oba-ga buatui seetaa-ga moo ami-agatta-to
 younger sister-Nom my aunt-Nom bulky sweater-Nom already knitting-finished-that
 odorote-imasita.
 surprised-was
 "The younger sister was surprised that my aunt has already finished knitting the bulky sweater."

imooto-ga oba-ga buatui seetaa-o moo kikomi-hajimeta-to
 younger sister-Nom my aunt-Nom bulky sweater-Acc already wearing-started-that
 odorote-imasita.
 surprised-was
 "The younger sister was surprised that my aunt has already started to wear the bulky sweater."

imooto-wa oba-ga buatui seetaa-ga moo ami-agatta-to
 younger sister-Top my aunt-Nom bulky sweater-Nom already knitting-finished-that
 odorote-imasita.
 surprised-was
 "As for the younger sister, she was surprised that my aunt has already finished knitting the bulky sweater."

imooto-wa oba-ga buatui seetaa-o moo kikomi-hajimeta-to
 younger sister-Top my aunt-Nom bulky sweater-Acc already wearing-started-that
 odorote-imasita.
 surprised-was
 "As for the younger sister, she was surprised that my aunt has already started to wear the bulky sweater."

Was the aunt surprised at something about the sweater? (NO)

- (22) harapekona seitotati-ga kyuushokutooban-ga morituke-ga
 hungry students-Nom students-in-charge-of-school lunch-Nom dishing-up-Nom
 hetakusona-koto-ni iratuite-imasu.
 poor-fact-by irritated-are
 "The hungry students are irritated that the students in charge of school lunch were poor at dishing out the food."

harapekona seitotati-ga kyuushokutooban-ga morituke-o
 hungry students-Nom students-in-charge-of-school lunch-Nom dishing-up-Acc
 sabotte-iru-koto-ni iratuite-imasu.
 neglecting-are-fact-by irritated-are
 "The hungry students are irritated that the students in charge of school lunch were neglecting dishing out the food."

harapekona seitotati-wa kyuushokutooban-ga morituke-ga
 hungry students-Top students-in-charge-of-school lunch-Nom dishing-up-Nom
 hetakusona-koto-ni iratuite-imasu.
 poor-fact-by irritated-are
 "As for the hungry students, they are irritated that the students in charge of school lunch were poor at dishing out the food."

harapekona seitotati-wa kyuushokutooban-ga morituke-o
 hungry students-Top students-in-charge-of-school lunch-Nom dishing-up-Acc
 sabotte-iru-koto-ni iratuite-imasu.
 neglecting-are-fact-by irritated-are
 "As for the hungry students, they are irritated that the students in charge of school lunch
 were neglecting dishing out the food."

Is the preparation for school lunch going smoothly?

(NO)

- (23) Kobayasi-kun-ga Suzuki-san-ga tannin-kyoosi-ga daikirai-da-to
 Kobayashi-Mr.-Nom Suzuki-Mr./Ms.-Nom homeroom-teacher-Nom unfond-is-that
 iimasita.
 said
 "Kobayashi said that Mr./Ms. Suzuki is scornful of her homeroom teacher."

Kobayasi-kun-ga Suzuki-san-ga tannin-kyoosi-o kiratte-iru-to
 Kobayashi-Mr.-Nom Suzuki-Mr./Ms.-Nom homeroom-teacher-Acc hating-is-that
 iimasita.
 said
 "Kobayashi said that Mr./Ms. Suzuki hates her homeroom teacher."

Kobayasi-kun-wa Suzuki-san-ga tannin-kyoosi-ga daikirai-da-to
 Kobayashi-Mr.-Top Suzuki-Mr./Ms.-Nom homeroom-teacher-Nom unfond-is-that
 iimasita.
 said
 "As for Kobayashi, he said that Mr./Ms. Suzuki is scornful of her homeroom teacher."

Kobayasi-kun-wa Suzuki-san-ga tannin-kyoosi-o kiratte-iru-to
 Kobayashi-Mr.-Top Suzuki-Mr./Ms.-Nom homeroom-teacher-Acc hating-is-that
 iimasita.
 said
 "As for Kobayashi, he said that Mr./Ms. Suzuki hates her homeroom teacher."

Does Mr./Ms. Suzuki feel unpleasant toward the teacher?

(YES)

- (24) hisho-ga Morisita Shachoo-ga takusii-ga hituyooda-to uketsuke-made
 secretary-Nom Morishita President-Nom taxi-Nom need-that reception desk-to
 ii-ni-kita.
 tell-to-came
 "The secretary came down to the reception desk to say that President Morishita needs a
 taxi."

hissho-ga Morisita Shachoo-ga takusii-o yonde-arui-to uketsuke-made
 secretary-Nom Morishita President-Nom taxi-Acc called-has-that reception desk-to
 ii-ni-kita.
 tell-to-came
 "The secretary came down to the reception desk to say that President Morishita had called
 a taxi."

hisho-wa Morisita Shachoo-ga takusii-ga hituyooda-to uketsuke-made
 secretary-Top Morishita President-Nom taxi-Nom need-that reception desk-to
 ii-ni-kita.

tell-to-came

"As for the secretary, she came down to the reception desk to say that President Morishita needs a taxi."

hisho-wa Morisita Shachoo-ga takusii-o yonde-arui-to uketsuke-made
 secretary-Top Morishita President-Nom taxi-Acc called-has-that reception desk-to
 ii-ni-kita.

tell-to-came

"As for the secretary, she came down to the reception desk to say that President Morishita had called a taxi."

Did the secretary go to the receptionist?

(YES)

Appendix H-1: Self-Paced Whole-Sentence Reading Task, Filler Sentences, Experiment 2

- (1) あれだけ何度も電話で確認しておいたのに契約書類がまだ1つも揃っていない。
書類はもう届いているはずでしたか。 (はい)
- (2) 昔なつかしい友達とうっかり長電話をしていたのでスープがすっかり冷めてしまいました。
スープはまだ温かいですか。 (いいえ)
- (3) 売り出しのチラシを見る前に母がもう買い物かごいっぱい野菜を買ってきてしまいました。
母親はたくさん野菜を買ってきましたか。 (はい)
- (4) 夕暮れに越後の駅に降り立つと人影がすっかりまばらになっていた。
駅にはたくさんの方がいましたか。 (いいえ)
- (5) 何軒もはしごをしたあとで五十嵐係長がわけもなく突然部下にからまり出した。
係長は部下と飲みに行きましたか。 (はい)
- (6) もし建物の中で迷ったら受付係が快く私の事務所まで案内してくれるでしょう。
受付の人は不親切そうですか。 (いいえ)
- (7) いつもより少し早く教室に行ってみると日直は黒板を拭いていた。
教室には誰もいませんでしたか。 (いいえ)
- (8) もし旅行中に荷物をなくしたらその保険会社は全額保証してくれるはずだ。
この保険は荷物にはききますか。 (はい)
- (9) 東京から大急ぎで車を飛ばしたのに飛行機は欠航になっていました。
空港には新幹線で行きましたか。 (いいえ)
- (10) もったいぶった講演を半分も聞かないうちに大部分の人はもう家に帰る用意をしていました。
聴衆は早く帰りたいと思っていましたか。 (はい)
- (11) 暑い日にずっと留守にしたままだったので部屋の観葉植物はほとんど枯れかかっていた。
不在だったのは寒いときでしたか。 (いいえ)
- (12) 史上最大の名作映画を見た後で頑固な父はこっそり涙を拭っていた。
お父さんは映画に感動したようですか。 (はい)
- (13) 弘子に先週プロポーズした商社マンが突然外国に赴任してしまいました。
弘子は結婚を申し込まれましたか。 (はい)

- (14) 小さい子供達を親切にお世話して差し上げたのは専務のお嬢さんです。
専務は子供の面倒をみましたか。 (いいえ)
- (15) 1年前に文雄を女社長に紹介した不動産屋が先月から行方不明になっている。
文雄は行方不明になりましたか。 (いいえ)
- (16) 路地から飛び出してきた通り魔は信吉の目の前を猛烈なスピードで走りぬけていった。
信吉は無事でしたか。 (はい)
- (17) 美代子の家に近所から遊びに来た友達が弟たちにたくさんお菓子を持って来てくれました。
友達は美代子を訪ねましたか。 (はい)
- (18) 犬を亡くしてしょげている男の子は寂しそうに砂場で遊んでいた。
少年は楽しそうでしたか。 (いいえ)
- (19) 能登半島一周ツアーの参加者はバスガイドが次々と歌った演歌にしばらく聞きほれていました。
ガイドは歌が下手でしたか。 (いいえ)
- (20) 英男がアメリカの知り合いから送られてきた派手なＴシャツを同級生に自慢していました。
英男は知人から何かもらいましたか。 (はい)
- (21) 門下生は師範が繰り広げる高度な技をくいいるように見つめていた。
生徒は真剣に習おうとしていますか。 (はい)
- (22) 応援団長が連続三振に静まり返ったファンたちを必死に盛り上げようとしていました。
応援している野球チームは調子がいいですか。 (いいえ)
- (23) 修理工場の責任者は怒った客がかけてきた電話をゆううつな思いでつないでもらった。
工場のした仕事は客に満足されていましたか。 (いいえ)
- (24) 東京の弁護士が誤診で患者に訴えられた年とった診療所の医者に会いにやって来た。
医者診断は間違えでしたか。 (はい)
- (25) 夫は東北地方の山奥の小さな部落の出身で伝統的な農家の次男である。
夫にはお兄さんがいますか。 (はい)
- (26) 野村氏は所属議員に直ちに賛同を呼びかけ本国会中の君が代法案成立を目指す。
野村氏は法案の否決を望んでいますか。 (いいえ)
- (27) 両親はかなり高めの七宝焼きの花瓶をデパートで買い求め春代さんの結婚祝いに贈りました。
結婚祝いのプレゼントは高価でしたか。 (はい)

- (28) 大型台風 12 号は日本各地で猛烈な勢力を振るい農作物すべてに決定的な被害をもたらした。
穀物は大丈夫でしたか。(いいえ)
- (29) 親友の和江は盲腸で救急病院に運ばれて今し方手術を受けたばかりです。
手術はこれからですか。(いいえ)
- (30) 祖母は連休中に町内会で佐渡へ出かけ楽しいひとときを過ごしたようです。
おばあさんは旅行に行きましたか。(はい)
- (31) 木村さんは子供の日に一家で草むしりをして季節の花を植え見事な花壇を作りました。
木村家の庭にはまだ雑草がありますか。(いいえ)
- (32) 宅急便の配達員は届け先への道順を地図で調べ電話で確認して倉庫を出発する。
配達員は能率よく配達できるようにしていますか。(はい)
- (33) 子猫は窓辺で通りを眺めたりカーテンにじゃれたり毛づくろいをしたりしていました。
猫は眠っていましたか。(いいえ)
- (34) 美容師は茂樹の伸びきった髪を入社試験用に短く切り茶髪を黒く染め直して洗髪した。
茂樹の髪は今まで茶色の長髪でしたか。(はい)
- (35) 今年の卒業生は卒業記念に沖縄まで飛行機で行って三泊し宮古島に船で渡る予定です。
旅行は沖縄と宮古島ですか。(はい)
- (36) 大山倍達氏は 9 才頃から拳法を学び 24 才で全日本を制覇し 30 才で道場を設立した。
大山氏は 24 才の時道場を開きましたか。(いいえ)
- (37) 知り合いの息子さんが叔母の紹介した娘さんに会いすぐにお付き合いを始めました。
叔母さんのもちかけた話はうまく行っていますか。(はい)
- (38) 隣のおじさんは歌えなかった曲をカラオケで練習し今度の宴会に備えている。
おじさんはもう練習の成果を披露しましたか。(いいえ)
- (39) 父が高崎駅から電話してきた昔の友人を迎えに行つてにぎやかに帰って来た。
父親は駅から電話をしましたか。(いいえ)
- (40) 川上社長は海外出張が多い企画部の社員に同情してボーナスを増やそうと考えています。
社長は海外出張は大変だと考えていますか。(はい)
- (41) はるばるシベリアから渡って来た鳥が湖畔に降り立ち疲れをいやしている。
この湖には渡り鳥が来ますか。(はい)

- (42) 受験勉強で毎日忙しい弟はときどきふさぎ込んだり急にはしゃいだりしています。
弟は精神的に安定していますか。 (いいえ)
- (43) 重役会議は定例会を開き白井氏を合併の話を進める交渉役に推薦した。
合併はもう実現しましたか。 (いいえ)
- (44) 年の暮れが近づいて郵便局では年賀状を出す人々が真夜中まで絶えることはありません。
この郵便局は遅くまでやっていますか。 (はい)
- (45) 石原さんは事故で頭を強く打ち一緒に仕事をしてきた仲間も分からなくなった。
石原さんは記憶を失いましたか。 (はい)
- (46) 真理子さんがめずらしく朝早く出勤して自分で作ったおむすびを食べていました。
真理子はいつも早く会社に来ますか。 (いいえ)
- (47) ショー会場の係員は手際がよく長い列を作っていた客をあっという間に入場させた。
会場に入るのには時間がかかりましたか。 (いいえ)
- (48) 主治医が緊急手術の必要性を認め良い設備がある国立の総合病院に父を紹介してくれました。
総合病院ではお父さんの手術ができますか。 (はい)

Appendix H-2: Self-Paced Whole-Sentence Reading Task, Filler Sentences, Experiment 2, English Translation

- (1) *pro* aretake nando-mo denwa-de kakunin-site-oita-noni
pro that much many times-Emp phone-by check-done-had-although
 keiyaku-shorui-ga mada hitotumo sorotte-i-nai.
 contract-document-Nom yet one even gathered-has-not
 "Although *someone* had checked many times by phone, not even one of the contract documents had been collected yet."

Are the documents supposed to have arrived already? (YES)

- (2) *pro* mukasi-natukasii tomodati-to ukkari nagadena-o siteita-node suupu-ga
pro good old friend-with carelessly long call-Acc doing-is soup-Nom
 sukkari samete-simaimasita.
 completely cold-has become
 "The soup became completely cold because *someone* was carelessly talking on the phone for a long time with an old friend."

Is the soup still warm? (NO)

- (3) *pro* uridasi-no tirasi-o miru-maeni haha-ga moo kaimono-kago
pro sale-Gen flyer-Acc see-before mother-Nom already shopping-basket
 ippai-no yasai-o katte-kite-simaimasita.
 one's full-Gen vegetable-Acc buy-come-has
 "The mother had already bought a basket-full of vegetables before anyone saw a sale flyer."

Did the mother buy a lot of vegetables? (YES)

- (4) *pro* yuugure-ni Etigo-no eki-ni ori-tatu-to hitokage-ga
pro dusk-in Echigo-Gen Station-at get off-stand-when person shadow-Nom
 sukkari mabarani natte-ita.
 quite sparse become-has
 "When *pro* got off at Echigo Station at dusk, the commuter/pedestrian traffic had become quite sparse."

Were there many people at the station? (NO)

- (5) *pro* nangen-mo hasigo-o sita-atode Igarasi kakarichoo-ga
pro many-Emp bar hopping-Acc did-after Igarashi Section Chief-Nom
 wake-mo-naku totsuzen buka-ni karamari-dashita.
 reason-without suddenly subordinates-to fighting-started
 "After a lot of barhopping, Section Chief Igarashi suddenly started to fight with his men for no reason."

Did the section chief go out drinking with his men? (YES)

- (6) mosi *pro* tatemono-no-nakade mayotta-ra uketukegakari-ga watasi-no
 if *pro* building-Gen-inside lost was-if receptionist-Nom I-Gen
 jimusho-made kokoroyoku annai-site-kureru-deshoo.
 office-as far as willingly show-do-give-will
 "If *you* are lost inside the building, the receptionist will gladly show the way to my office."

Does the person at the reception desk seem to be unkind? (NO)

- (7) *pro* itumo-yori sukosi hayaku kyoositu-ni itte-miru-to nicchoku-wa
pro usual-than a little early classroom-to go-and-see-when day-duty student-Top
 kokuban-o huite-ita.
 blackboard-Acc wiping-was
 "As for the student on day duty, he/she was cleaning the blackboard when *pro* went to the classroom a little earlier than usual."

Was there nobody in the classroom? (NO)

- (8) mosi *pro* ryokoo-chuuni nimotu-o nakusita-ra hokengaisha-wa
 if *pro* trip-during luggage-Acc lost-if the insurance company-Top
 zengaku hoshoo-site-kureru-hazu-da.
 all price warranty-do-give-supposed-is
 "As for the insurance company, it will warranty the entire price if *pro* happens to lose his/her luggage."

Does this insurance cover luggage? (YES)

- (9) *pro* Tookyoo-kara oisogi-de kuruma-o tobasita-noni hikooki-wa kekkooni
pro Tokyo-from big hurry-in car-Acc flew-although airplane-Top canceled
 natte-imashita.
 become-had
 "As for the flight, it had been canceled even though *pro* drove his/her car to Tokyo in a big hurry."

Did this person go to the airport by *shinkansen* (bullet train)? (NO)

- (10) *pro* mottaibutta kooen-o hanbun-mo kika-nai-utini daibubun-no hito-wa
pro arrogant lecture-Acc half-even hear-not-before majority-Gen person-Top
 moo ie-ni kaeru yooi-o site-imasita.
 already home-to return preparation-Acc doing-were
 "As for the people, most were already preparing to go home without even listening to half of the arrogant lecture."

Did the audience want to return (home) early? (YES)

- (11) *pro* atui hi-ni zutto rusuni-sita-mama-datta-node heya-no
pro hot day-on long time absence from home-did-left-because room-Gen
 kanyooshokubutu-wa hotondo kare-kakatte-imasita.
 foliage plant-Top almost dying-almost-was
 "As for the foliage plants in the room, most were almost dying because *pro* was away from home for a while during some hot days."

Was it during a cold season that this person was away from home? (NO)

- (12) *pro* sijoo-saidai-no meisaku-eiga-o mita-atode titi-wa kossori
pro history-greatest-Gen masterpiece-film-Acc saw-after my father-Top secretly
 namida-o huite-ita.
 tears-Acc wiping-was
 "As for my father, he was secretly wiping away his tears after *he* watched the greatest
 masterpiece film in history."

Did the father seem to be impressed by the movie? (YES)

- (13) Hiroko-ni senshuu purupoozu-sita shooshaman-ga totuzen gaikoku-ni
 Hiroko-to last week propose-did businessman-Nom suddenly foreign country-to
 huninnsite-simaimasita.
 left for a new post-has
 "The businessman who proposed to Hiroko last week has suddenly left for a new post in a
 foreign country."

Was Hiroko proposed to? (YES)

- (14) tiisai kodomotati-o kokoro-o komete o-sewa-site-sasiageta musume-wa
 little children-Acc heart-Acc enclosing Hon-care-do-gave girl-Top
 senmu-no ojoosan-desu.
 department chief-Gen daughter-is
 "The girl who gave tender care to the young children is the department chief's daughter."

Is it the department chief who took care of children? (NO)

- (15) Fumio-o onna-shachoo-ni shookai-sita hudoosanya-ga yukuehumeini-natta.
 Fumio-Acc female-president-Dat introduction-did realtor-Nom missing-became
 "The realtor who introduced Fumio to the (female) president went missing."

Is Fumio the person who is missing? (NO)

- (16) roji-kara tobidasite-kita toorima-wa Sinkiti-no me-no-mae-o
 side-street-from jumping out-came phantom-Top Shinkichi-Gen eye-Gen-front-Acc
 mooretuna supiido-de hasirimukete-itta.
 terrific speed-in runnig through-went
 "As for the phantom robber who jumped out from the side street, he ran before Shinkichi's
 eyes in terrific speed."

Was Shinkichi safe? (YES)

- (17) Miyoko-no ie-ni kinjo-kara asobi-ni-kita tomodati-ga ototoo-tati-ni
 Miyoko-Gen house-to neighbor-from play-to-came friend-Nom younger brother-pl-for
 takusan okasi-o mottekite-kuremasita.
 many candy-Acc bring-gave
 "The friend who came to Miyoko's house from her neighborhood to play brought many
 candies for Miyoko's younger brother."

Did a friend visit Miyoko? (YES)

- (18) inu-o nakusite shogete-iru otokonoko-wa sabisisoo-ni hitoride sunaba-de
 dog-Acc loosing discouraged-is boy-Top lonely alone sand box-in
 asonde-ita.
 playing-was
 "As for the boy who lost his dog and was discouraged, he was playing in
 the sandbox all by himself."

Did the boy look happy? (NO)

- (19) notohantoo-issuu-tuaa-no sankasha-wa basugaido-ga tugitugito
 Noto Peninsula-around tour-Gen participants-Top bus-tour guide-Nom one after another
 utatta enka-ni sibiraku kiki-horete-imasita.
 sang soul music-Dat for a while listening-like-were
 "As for the participants in the Noto Peninsula circle tour, they were impressed by and
 listening to the Enka songs the tour-bus guide sang, one after another."

Was the guide poor at singing? (NO)

- (20) Hideo-ga amerika-no siriai-kara okur-arete-kita hadeana tiishatu-o
 Hideo-Nom America-Gen acquaintance-from sent-be-came tacky T shirt-Acc
 dookyuuusei-ni jimansite-imasita.
 classmate-to showing off-was
 "Hideo was showing off to his classmates the tacky T shirt which was sent him from his
 acquaintance in America."

Did Hideo receive something from his acquaintance? (YES)

- (21) monkasei-wa sihan-ga kurihirogeru koodona waza-o kuiiru-yooni
 student-Top master-Nom demonstrate highly technical technique-Acc very carefully
 mitumete-ita.
 gazing-were
 "As for the students, they were watching very carefully the very complicated techniques that
 their master demonstrated."

Are the students trying seriously to learn? (YES)

- (22) ooendanchoo-ga renzoku-sansin-ni sizumarikaetta fan-tati-o hissini
 cheer leader-Nom consecutive-strikeouts-by were discouraged fan-pl-Acc desperately
 moriage-yoo-to-site-imasita.
 cheer up-try- to-doing-was
 "The cheerleader was trying desperately to cheer up the fans who were discouraged by the
 consecutive strikeouts."

Is the baseball team they were cheering doing well? (NO)

- (23) shuurikoujou-no sekininsha-wa okotta kyaku-ga kakete-kita denwa-o
 repair shop-Gen head-Top angry costomer-Nom call-came phone-Acc
 yuuutuna omoi-de tunaide-moratta.
 unwilling feeling-with connected-got
 "As for the head of the repair shop, he had the phone call that the angry customer made
 transferred to himself."

Was the shop's service satisfactory for the customer? (NO)

- (24) tookyoo-no bengosi-ga gosin-de kanja-ni uttaer-areta tositotta
 Tokyo-Gen lawyer-Nom misdiagnosis-for patient-by sued-was old
 sinryoojo-no isha-ni ai-ni-kita.
 clinic-Gen doctor-Dat meet-to-came
 "A lawyer from Tokyo came to meet with the old clinic-doctor who was sued by his patient for a misdiagnosis."

Was the doctor's diagnosis wrong?

(YES)

- (25) otto-wa Toohoku-no yamaoku-no tiisana buraku-no shussin-de
 my husband-Top Tohoku-Gen deep mountain-Gen small village-Gen origin-and
pro dentootekina nooka-no jinan-dearu.
pro traditional farmer-Gen second son-is
 "As for my husband, he is from a small village in the deep mountains of the Tohoku region, and is the second son of a traditional farmer."

Does the husband have an older brother?

(YES)

- (26) Nomura-si-wa shozoku-giin-ni sandoo-o yobikak-e *pro*
 Nomura-Mr./Ms.-Top affiliated-Diet man-to approval-Acc ask for-and *pro*
 hon-kokkai-chuu-no Kimi-ga-Yo-hooan-seiritu-o Mezasu.
 this-Diet-during-Gen Kimi-ga-Yo-bill-establishment-Acc attempt
 "As for Mr./Ms. Nomura, he/she will immediately ask the affiliated Diet members for their approval, and will attempt to pass the Kimi-ga-Yo Bill during this National Diet meeting."

Is Mr. Nomura hoping for rejection of the bill?

(NO)

- (27) ryousin-wa kanari takamena Sippooyaki-no kabin-o depaato-de
 my parents-Top quite expensive Sippoyaki-Gen vase-Acc department store-at
 kaimotom-e *pro* Haruyo-san-no kekconiwai-ni okurimasita.
 bought-and *pro* Haruyo-Ms.-Gen wedding gift-as gave
 "As for my parents, they bought quite an expensive cloisonne vase at a department store, and gave it to Haruyo as a wedding gift."

Was the wedding gift highly-priced?

(YES)

- (28) oogata-taihuu juunigou-wa nihon-kakuti-de mooretuna seiryoku-o huru-i
 big scale-typhoon # 12-Top Japan-various areas-in violent power-Acc wielded-and
pro noosakumotu-ni boodaina higai-o motarasita.
pro crops-to tremendous harm-Acc did
 "As for the large-scale Typhoon Number 12, it wielded its violent power in various areas of Japan, and did tremendous harm to crops."

Was agricultural produce safe?

(NO)

- (29) sinyuu-no Kazue-wa moochoo-de kyuukyubyooiin-ni hakobar-e-te
 best friend-Gen Kazue-Top appendix-for emergency room-to taken-was-and
pro imasigata shujutsu-o uketa-bakari-desu
pro just now operation-Acc received-just-has
 "As for my best friend Kazue, she was taken to an emergency room for her appendix, and has just had surgery."

Is the operation yet to be done?

(NO)

- (30) sobo-wa renkyuu-chuuni choonai-kai-de Sado-e
 my grandmother-Top holidays-during community members-with Sado-to
 dekak-e *pro* tanosii hitotoki-o sugosita-yoodesu
 went-and *pro* good time-Acc had-seem
 "As for my grandmother, she went to Sado Island with community members during the holidays, and seems to have had a good time."

Did the grandmother go on a trip?

(YES)

- (31) Kimura-san-wa kodomo-no-hi-ni ikka-de niwa-no kusamusiri-o
 Kimura-Mr./Ms.-Top children-Gen-day-on family-with garden-Gen deweeding-Acc
 s-i *pro* kisetu-no hana-o u-e migotona kadan-o
 did-and *pro* season-Gen flower-Acc planted-and wonderful flower bed-Acc
 tukurimasita.
 made

"As for Mr./Ms. Kimura, he/she weeded the garden with his/her family on Children's Day, planted seasonal flowers, and made a wonderful flowerbed."

Are there still any weeds in the Kimura's garden?

(NO)

- (32) takkyuubin-no haitatuin-wa todokesaki-e-no mitijun-o tizu-de sirab-e
 express courier-Gen delivery-Top addressee-to-Gen route-Acc map-on check-and
pro denwa-de kakunins-ite *pro* sooko-o deru.
pro phone-by confirm-and *pro* warehouse-Acc. leave
 "As for express couriers, they find routes to addressees on the map, confirm them on the phone, and leave the warehouse."

Do the deliverers try to deliver (packages) efficiently?

(YES)

- (33) koneko-wa madobe-de toori-o nagame-tari *pro* kaaten-ni jare-tari
 kitten-Top window side-at street-Acc viewing-and *pro* curtain-with playing-and
pro kezukuroi-o si-tari site-imasita.
pro grooming-Acc doing-etc doing-was
 "As for the kitten, it was on the window sill viewing the street, playing with the curtain, and grooming itself."

Was the cat sleeping?

(NO)

- (34) biyoosi-wa Shigeki-no nobikitta kami-o nyuushasiken-yooni mijikaku
 hair cutter-Top Shigeki-Gen grown long hair-Acc job interview-for short
 kir-i *pro* chahasu-o kuroku some-naos-ite *pro* senpatu-sita.
 cut-and *pro* brown hair-Acc black dyed-back-and *pro* washing hair-did
 "As for the hair cutter, he cut Shigeki's long hair short for the job interview, dyed his brown hair back to black, and washed it."

Was Shigeki's hair brown and long until now?

(YES)

- (35) kotosi-no sotugyoosei-wa sotugyoo-kinen-ni Okinawa-made hikooki-de
 this year-Gen graduate-Top graduation-remembrance-as Okinawa-up to plane-by
 i-tte *pro* sanpaku-si *pro* Miyakojima-ni hune-de wataru yotei-desu.
 go-and *pro* three nights-stay-and *pro* Miyakojima-to boat-by sail plan-is
 "As for this year's graduates, they are planning (as a graduation remembrance) to fly to
 Okinawa by plane, to stay there for three nights, and to sail to Miyakojima Island."

Is the trip to Okinawa and Miyakojima? (YES)

- (36) Ooyama Taizoo-si-wa kyuusai-nokoro-kara kenpoo-o manabi *pro*
 Oyama Taizo-Mr.-Top 9 years-about-since Kenpoo-Acc learned-and *pro*
 nijuuuyonsai-de zennihon-o seihasi *pro* sanjussai-de doojoo-o Seturitusita.
 24 years-at all Japan-Acc conquered-and *pro* 30 years-at dojo-Acc established
 "As for Taizo Oyama, he has practiced Kung fu since nine years of age, won the All Japan
 Championship at twenty-four years, and established a dojo at thirty."

Did Mr. Oyama open his dojo when he was twenty-four years old? (NO)

- (37) siriai-no musuko-san-ga oba-no shookaisita musumesan-ni
 acquaintance-Gen son-Hon-Nom my aunt-Gen introduced girl-Dat
 a-i *pro* suguni otikiai-o Hajimemasita.
 met-and *pro* soon date-Acc started
 "An acquaintance's son met with a young lady to whom he was introduced by my aunt, and
 started to date her immediately."

Is the aunt's matchmaking going well? (YES)

- (38) tonari-no ojisan-wa uta-e-nakatta kyoku-o karaoke-de renshuus-i
 neighbor-Gen man-Top sing-could-not song-Acc karaoke-on practiced-and
pro kondo-no enkai-ni sonaete-iru.
pro next-Gen party-for ready-is
 "The middle-aged man next door practiced the karaoke song he couldn't sing, and is ready
 for the next party."

Has the man already demonstrated the result of his practice? (NO)

- (39) titi-ga Takasaki Eki-kara denwa-site-kita mukasi-no yuujin-o
 my father-Nom Takasaki Station-from telephone-do-came old day-Gen friend-Acc
 mukae-ni itt-e *pro* nigiyakani kaette-kita.
 pick up-to went-and *pro* excited return-came
 "My father went to pick up an old friend who called from Takasaki Station, and came home
 excited."

Did the father telephone from the station? (NO)

- (40) Kawakami Shachoo-wa kaigai-shucchoo-ga ooi shain-ni
 President Kawakami-Top overseas-business trip-Nom many worker-Dat
 doojooos-ite *pro* boonasu-o huyasoo-to kangaete-imasu.
 sympathetic-and *pro* bonus-Acc increase-to considering-is
 "As for President Kawakami, he is sympathetic toward the company workers who have
 many overseas business trips, and is considering an increase to their bonuses."

Does the president think that oversea business trips are difficult? (YES)

- (41) harubaru siberia-kara watatte-kita tori-ga kohan-ni
 all the way Siberia-from migrate-came bird-Nom lake shore-to
 oritat-i pro tukare-o iyasite-iru
 landed-and pro fatigue curing-is
 "The birds that migrated all the way from Siberia landed on the lake shore, and are relieving themselves of fatigue."

Do migrating birds come to this lake?

(YES)

- (42) jukenbenkyoo-de mainiti isogasii ootoo-wa tokidoki
 entrance exam study-with every day busy younger brother-Top sometimes
 husagikon-dari pro kyuuni hashaidarisite-imasu.
 quiet-is-and pro suddenly excited-become
 "As for the younger brother who is busy every day with preparation for the entrance exam, he is occasionally melancholy but then becomes suddenly very excited."

Is the younger brother mentally stable?

(NO)

- (43) juuyakukaigi-wa teireikai-o hirak-i pro Shirai-si-o gappei-no
 Board of directors-Top regular meeting-Acc held-and pro Shirai-Mr.-Acc merge-Gen
 hanasi-o susumeru kooshooyaku-ni suisensita.
 talk-Acc develop negotiator-Dat recommended
 "The board of directors held its regular meeting and recommended Mr. Shirai as negotiator for advancing the merger talks."

Has the merger been completed?

(NO)

- (44) tosi-no kure-ga tikazu-ite yuubinkyoku-de-wa nengajoo-o dasu
 year-Gen end-Nom got closer-and post office-at-Top new year's card-Acc mail
 hitobito-ga mayonaka-made taeru-koto-ga Arimasen.
 people-Nom midnight-until stop-fact-Nom not
 "The end of the year drew closer, and at the post office, the lines of people who mail new-year's cards didn't cease until midnight."

Is this post office open late?

(YES)

- (45) Ishihara-san-wa jiko-de atama-o tuyoku ut-i pro issmoni sigoto-o
 Ishihara-Mr./Ms.-Top accident-in head-Acc hard hit-and pro together work-Acc
 site-kita nakama-mo wakar-anaku-natta.
 doing-came colleagues-even recognize-not-could
 "Mr. Ishihara hit his head hard during an accident, and couldn't even recognize colleagues with whom he had worked together."

Has Mr./Ms. Ishihara lost his/her memory?

(YES)

- (46) Mariko-san-ga mezurasiku asa hayaku shukkinsh-ite pro jubun-de
 Mariko-Ms.-Nom remarkably morning early came to work-and pro herself-by
 tukutta omusubi-o tabete-imashita.
 made rice ball-Acc eating-was
 "Remarkably, Mariko came to work early in the morning and was eating rice balls which she made herself."

Does Mariko always come to work early?

(NO)

- (47) shookaijoo-no kakariin-wa tegiwa-ga yok-u *pro* nagai
 show theater-Gen people in charge-Top efficiency-Nom good-and *pro* long
 retu-o tukutte-ita kyaku-o atto-iu-ma-ni nyuujoo-saseta.
 line-Acc making-was guests-Acc in a second enter-made
 "The people in charge of the performance theater were very efficient, and ushered the long
 line of guests into the theater in no time at all."

Did it take long to get into the theater?

(NO)

- (48) shujii-ga kinkyuushujutu-no hituyoosei-o mitom-e *pro*
 physician in charge-Nom urgent operation-Gen necessity-Acc noticed-and *pro*
 yoi setubi-ga aru kokuritu-no soogoobyooiin-ni titi-o
 good facility-Nom has federal-Gen general hospital-Dat my father-Acc
 shookaisite-kuremasita.
 introduce-gave

"The physician in charge recognized the necessity of an emergency operation, and
 introduced my father to a federal general hospital which has good facilities."

Can they give the father an operation at the hospital?

(YES)

Appendix I-1: Self-Paced Whole-Sentence Reading Task, Practice Items, Experiment 2

Explicit Practice Sentences

- (1) 隣の家の猫と犬は仲が良くていつもいっしょにじゃれあっています。
おとなりはペットを飼っていますか。 (はい)
- (2) 道代が前からずっと買おうと思っていた青いハイヒールは売り切れてしまいました。
道代は靴が買えましたか。 (いいえ)
- (3) 中山さんはおばあちゃんがお煎餅が大嫌いなのを知らなかったんです。
おばあさんはお煎餅を食べますか。 (いいえ)
- (4) たまにはこんな日があってもいいと幸夫は芝生に寝ころんで本を読んでみた。
幸夫は外で読書をしましたか。 (はい)
- (5) けたたましい消防車のサイレンがいくつもだんだん近づきすぐそばまで来てぴたりと止まった。
火事は遠くですか。 (はい)
- (6) 校長先生が6年生が計算問題が良くと朝から上機嫌です。
校長は喜んでいきますか。 (はい)
- (7) 久しぶりのすごい夕立が道路につもっていたほこりを一挙に洗い流してしまった。
激しい雨が降ったのはしばらくぶりですか。 (はい)
- (8) 獣医は真奈美が心配そうにポチがエサを食べないと言ったのを聞いていました。
ポチは食欲がありますか。 (いいえ)
- (9) 政府は何カ所かに避難所を設けて用意しておいた毛布や食料を運び込んだ。
避難所では食べ物がもらえますか。 (はい)
- (10) 現在の放送時間は一日18時間ですがこれを24時間にする予定です。
放送時間は減りますか。 (いいえ)
- (11) 取調官が参考人が坂本が以前老人をいたわっていたと主張するかもしれないと言った。
取調官はもう参考人の話を聞きましたか。 (いいえ)
- (12) ガソリンスタンドで洗車が終わるのを待っていると偶然友達がボーイフレンドとやって来ました。
友達とは合う約束をしていましたか。 (いいえ)
- (13) 守衛は訪問客たちが身分証明書を提示するのを一人一人慎重に確認した。
守衛は注意深く仕事をしていますか。 (はい)
- (14) 海外生活を長く経験している神坂部長がこの春ついに専務に昇任しました。
神坂氏はずっと日本で暮らしていましたか。 (いいえ)

- (15) ニュース速報が警察が人質を全員無事救出したと繰り返し伝えた。
捕らわれていた人たちは元気ですか。 (はい)
- (16) 忙しい生活に心底疲れ切っていたので近藤さんは奥さんと温泉に出かけようと決意した。
近藤さんは夫婦で出かけるつもりですか。 (はい)

Implicit Practice Sentences

- (1) 夜中に突然かかってきた電話の聞き慣れない声は吉田の妻にいやな予感を与えました。
吉田家への電話は知人からでしたか。 (いいえ)
- (2) うちの郁美はいろいろな会社からちょくちょく英語の通訳を頼まれる。
郁美は英語が良くできますか。 (いいえ)
- (3) 大須賀さんの神経質さは普通ではなく社内のどの課にも有名です。
大須賀のことを同僚たちはみんな知っていますか。 (はい)
- (4) 道代が中国人の大金持ちと電撃結婚したという噂はすぐに近所中にくまなく広まった。
道代の結婚はまだあまり知られていませんか。 (いいえ)

Appendix I-2: Self-Paced Whole-Sentence Reading Task, Practice Items, Experiment 2, English Translation

Explicit Practice Sentences

- (1) tonari-no ie-no inu-to neko-wa naka-ga yoku-te *pro* itumo
 next door-Gen house-Gen dog-and cat-Top relation-Nom good-and *pro* always
 isshoni jwareatte-imasu.
 together playing together-are
 "As for the neighbor's cat and dog, they have a good relationship, and always play together."

Does the neighbor keep any pets? (YES)

- (2) Michiyo-ga zutto mae-kara *t*, kaoo-to omotte-ita aoi haihiiru,-wa
 Michiyo-Nom long before-since *t*, buy-to wanting-was blue high heels,-Top
 uri-kirete-simaimasita.
 sold-out-have
 "The blue high heels that Michiyo wanted to buy for a long time are sold out."

Could Michiyo buy the shoes? (NO)

- (3) Nakayama-san-wa obaachan-ga osenbei-ga daikirai-na-no-o
 Nakayama-Mr./Ms.-Top grandmother-Nom rice cracker-Nom dislike-is-fact-Acc
 sir-ana-katta-n-desu.
 know-not-did-fact-is
 "Mr./Ms. Nakayama did not know that the grandmother disliked rice crackers."

Does the grandmother eat rice crackers? (NO)

- (4) tamani-wa konna hi-ga atte-mo ii-to Yukio-wa sibahu-ni
 once in a while-Top like this day-Nom exist-Emp good-that Yukio-Top lawn-on
 nekoron-de hon-o yon-de mita.
 lie down-and book-Acc read-to tried
 "Thinking it's good that a day like this exists occasionally, Yukio lied down on the lawn and tried to read a book."

Did Yukio read outside? (YES)

- (5) ketatamasii shooboosha-no sairen-ga ikutumo dandan tikazuk-i *pro*
 noisy fire engine-Gen siren-Nom many gradually came closer-and *pro*
 soba-made kit-e *pro* pitari-to tomatta.
 near-by came-and *pro* suddenly stopped
 "Many noisy fire engine sirens gradually got nearer, drew nearby and suddenly stopped."

Is the fire far off? (NO)

- (6) koochoosensei-ga rokunennsei-ga keisanmondai-ga yoku dekiru-to asa-kara
 principal-Nom 6 graders-Nom algebra-Nom well can do-that morning-from
 jookigen desu.
 good mood is
 "The principal has been in a good mood since this morning because the sixth graders can do algebra well."

Is the principal pleased? (YES)

- (7) hisasiburi-no sugoi yuudati-ga *t*, dooro-ni tumotteita hokori,-o
 after a long time-Gen hard shower-Nom *t*, street-on accumulated dust,-Acc
 ikkoni arai-nagasite-simaimasita.
 all at once washed-away-has
 "A heavy and long awaited shower has all at once washed away the dust that accumulated on the street."

Has it been a long time since it last rained hard? (NO)

- (8) juui-wa Manami-ga sinpaisoo-ni Pochi-ga esa-o tabe-nai-to
 veterinarian-Top Manami-Nom Worryingly Pochi-Nom food-Acc eat-not-that
 itta-no-o kiite-imasita.
 said-fact-Acc listening-was
 "The veterinarian heard that Manami worryingly said that Pochi does not eat food."

Does Pochi have an appetite? (NO)

- (9) seihu-wa nankashoka-ni hinanjo-o mooket-e *pro t*,
 government-Top some places-in shelter-acc built-and *pro t*,
 yoisite-oita moohu-ya shokuryoo,-o hakobi-konda
 prepared-had blanket-and food,-Acc brought-in
 "The government built shelters in some places, and brought to there the blankets and food that they had prepared."

Can people get food at the shelters? (YES)

- (10) genzai-no hoosoojikan-wa iti-niti juuhati-jikan desu-ga *pro kore-o*
 now-Gen broadcast hours-Top one-day 18 hours is-although *pro this-Acc*
 nijuu-yo-jikan-ni suru-tumori-desu.
 24 hours-to make-plan-is
 "The current broadcast period is eighteen hours per day, although the plan is to make it 24 hours."

Will the broadcast hours decrease? (NO)

- (11) torisirabekan-ga sankoonin-ga Sakamoto-ga izen roojin-o
 investigator-Nom witness-Nom Sakamoto-Nom before old man-Acc
 itawatte-ita-to shuchoosuru-kamosirenai-to itta.
 taking care-was-that insist-may-that said

"The investigator said that the witness may insist that Sakamoto used to take care of the old man."

Did the investigator hear the witness's story in court yet? (NO)

- (12) *pro* gasorinstando-de sensha-ga owaru-no-o matte-iru-to guuzen
pro gas station-at car wash-Nom finish-ing-Acc waiting-was-when by chance
 tomodati-ga booihurendo-to yattekimasita.
 friend-Nom boyfriend-with came
 "While *pro* was waiting for the car to be washed, his/her friend came in by chance with her boyfriend."

Had this person promised to meet his/her friend ? (NO)

- (13) shuei-wa hoomonkyakutati-ga mibunshoomeisho-o teijisuru-no-o
 guard-Top visitors-Nom ID-Acc show-fact-Acc
 hitori-hitori sinchooni kakuninsita.
 person-by-person cautiously confirmed
 "The guard cautiously confirmed that, one after another, the visitors showed ID."

Is the guard doing his job carefully? (YES)

- (14) *t*, kaigai-seikatu-o nagaku keikensite-iru Kamisaka-buchoo,-ga
t, overseas-life-Acc for a long time experienced-has Kamisaka-Dept.Director, -Nom
 kono haru tuini senmu-ni shoosinsimasita.
 this spring finally managing director-to got promoted
 "Department Director Kamisaka, who has experienced living abroad for a long time, finally got promoted to executive director."

Has Mr. Kamisaka lived in Japan all his life? (NO)

- (15) nyuusu-sokuhoo-ga keisatu-ga hitojiti-o buji kyuushutusita-to kurikaesi
 news flash-Nom police-Nom hostage-Acc safely rescued-that repeatedly
 tutaeta.
 reported
 "The news flash repeatedly reported that the police safely rescued all the hostages."

Are the people who were saved fine? (YES)

- (16) *pro* isogasii seikatu-ni tukare-kitte-ita-node Kondo-san-wa okusan-to
pro busy life-of tired-completely-were-because Kondo-Mr.-Top wife-with
 onsen-ni dekakeyoo-to ketuisita.
 hot spring resort-to go-to decided
 "Completely tired of his busy life, Mr. Kondo decided to go to a hot spring with his wife."

Will Mr. Kondo go out as a couple? (YES)

Implicit Practice Sentences

- (1) *t, yonaka-ni kakattekita denwa,-no kikinarenai koe-wa Yoshida-no*
t, midnight-at came phone call,-Gen unfamiliar voice-Top Yoshida-Gen
tuma-ni iyana yokan-o ataeta.
wife-to uneasy feeling-Acc gave
 "The unfamiliar voice in the phone call that came at midnight gave Yoshida's wife an unpleasant feeling."

Was the call to the Yoshida's from their acquaintance? (NO)

- (2) *uti-no Ikumi-wa iroiorna kaisha-kara chokuchoku tuuyaku-o tanom-areru.*
home-Gen Ikumi-Top various company-from frequently translation-Acc asked for-is
 "My (daughter/wife) Ikumi is often asked for English translations by various companies."

Is Ikumi good at English? (YES)

- (3) *Osuga-san-no sinkeisitusa-wa hutuu-de-ha na-ku shanai-no dono*
Osuga-Mr./Ms.-Gen nervousness-Top normal-is-Emp not-and company-Gen any
ka-ni-mo yuumei desu.
section-in-Emp famous is
 "Mr./Ms. Osuga's nervousness is out of the ordinary and well known to every section of the company."

Do his co-workers know about Osuga? (YES)

- (4) *Michiyo-ga chuugokujin-no ooganemoti-to kekkonsita toiu uwasa-wa suguni*
Michiyo-Nom Chinese-Gen wealthy man-to married that rumor-Top quickly
kinjojuu-ni kumanaku hiromatta.
neighbor-to completely spread
 "The rumor that Michiyo was married to a wealthy Chinese man spread quickly throughout the entire neighborhood."

Is Michiyo's marriage not yet known by so many people? (NO)

Appendix J-1: Instructions for Self-Paced Whole-Sentence Reading Task, Experiment 2

読み取りテストの行い方

本日はお忙しいところ、御協力有難うございます。この実験は心理言語学の発展への寄与として学会で発表する等の学術的な目的を持つものです。実験の結果は「参加者全体」として分析されます。あなたの個人的な能力をテストしたり、個人名を出すなど、プライバシーを侵害するものではありません。

この実験はコンピューターの画面に現れる文を読み、その内容に関する質問に「はい」か「いいえ」で答えていただくものです。あなたに最も適した速度で読んでいただくために、以下に示す方法であなた自身文と質問を画面に呼び出す速度を調節していただきます。

- ◆ 文を画面に呼び出すには、「黄色のスイッチ」を押して下さい。
- ◆ 文が読み終わり、質問に答える準備ができたなら「みどりのスイッチ」を押して質問文を画面に呼び出して下さい。
- ◆ 質問に「はい」と答えるには、「みどりのスイッチ」を押してください。
- ◆ 質問に「いいえ」と答えるには、「赤のスイッチ」を押してください。
- ◆ 質問に答え終わり、次の文を画面に呼び出すには、「黄色のスイッチ」を押してください。

質問に答えると、あなたの答えが正解か誤りかが画面に表示されます。誤りの場合は×のみが、また、正解の場合は○と回答に要した時間が1000分の1秒単位で表示されます。

実験はおおよそ30分弱で終了します。実験は次のように4つの部分で構成されています。一度実験を開始したら、休憩以外は気をそらすせずに最後まで集中して行ってください。

①「読み取りテスト」の行い方の確認

② 練習問題 — これが終わるとブザーが鳴ります。実験の担当者にテストを行う要領がつかめたかどうかを報告し、また、分からないことは何でも遠慮なく質問して下さい。ただし、他の人が集中して実験を行っている場合は、静かに合図して下さい。

③ 本番前半 — これが終わるとブザーが鳴ります。休憩が必要な場合はその場を離れずに2～3分休んで下さい。休まずにそのまま後半に入っていただいても結構です。

④ 本番後半 — これが終わるとブザーが鳴ります。

重要事項：

- 読むときにメガネが必要な方は、忘れずにメガネを使用して下さい。
- 楽な姿勢で実験に臨めるように、あらかじめコンピューターの画面を調節して下さい。
- どの文も意味を良く理解することに集中して、しっかり読み取ってください。これを忘れて、文の内容を良く理解しないで速く読み過ぎると、質問に答えるのがとても難しくなります。

めったにあることではありませんが、極端にゆっくり読み過ぎるとコンピューターが「時間切れ」と判断し、自動的に質問に移ってしまいます。また、質問に答えるのにあまり時間がかかりすぎても「時間切れ」となり、誤答としてあつかわれ×が表示されてしまいます。自然な速度で文の意味にしっかり集中して読むことを忘れないで下さい。

Appendix J-2: Instructions for Self-Paced Whole-Sentence Reading Task, Experiment 2, English Translation

Instructions for the Reading Experiment

Thank you for your participation in this experiment. This experiment is not to test and evaluate your ability. The results will be analyzed as a whole and used only for academic purposes, such as for presentations at technical conferences as psycholinguistic contributions. Your name will be kept anonymous, and your privacy will not be violated.

* * * * *

In this experiment, you will read a set of sentences presented on the computer screen. Each sentence will be followed by a YES/NO question about the meaning of the sentence. In order to read at the most comfortable pace, you will be controlling the speed to call each sentence and its question onto the screen in the following way:

- ◆ To call a sentence to read onto the screen, please push the "yellow key".
- ◆ After you have read the sentence and become ready for the question, please push the "green key" to call the question onto the screen.
- ◆ To answer "YES", please use the "green key".
- ◆ To answer "NO", please use the "red key".
- ◆ After answering the question, please push the "yellow key" to call the next sentence onto the screen.

As soon as you answer a question, the program will let you know whether your answer is correct or incorrect. If your answer was incorrect, X will appear. If your answer is correct, you will see ○ and the time in milliseconds it took you to read and answer the question.

It usually takes less than 30 minutes to complete the task. The experiment has four parts as follows:

- (1) Review of the instructions for the reading experiment.
- (2) Practice session — After completing this section, you will here a buzzer. Please let the experimenter know that you understand the process. If you have any questions, please feel free to ask them to the experimenter. Please be considerate of other participants who are still engaged in the practice session.
- (3) First half of the experiment — After completing this half, you will here a buzzer. If you need a small break, please relax for two to three minutes without leaving your seat. If you do not need a break, you may start the second half immediately.
- (4) Second half of the experiment — After completing this half, you will hear a buzzer.

Once you have started the task, please concentrate all the way through until the end.

Important Notes:

- If you use reading glasses, please use them for this experiment.
- Please sit comfortably and adjust the screen if necessary before you start.
- Please read all the sentences, focusing on their meaning. If you read too fast, it becomes very difficult to answer the questions accurately.

This does not happen so often, but if you read too slowly, the program will interpret it as "TIME EXPIRED" and automatically proceed to the question. Also, if you spend too much time to answer a question, the program will also interpret it as "TIME EXPIRED", and X will appear on the screen. Please always try to read at a pace natural for you, neither too fast nor too slow, and to concentrate on the meaning of the sentence.

Appendix K-1: Sentence Completion Task, Core Stimulus Subset, Experiment 3

(Fragment numbers correspond to those in Chapter 7.)

- (1) いとこが良雄に留学生が
- (2) 弟が恵一を酔っ払いが
- (3) 幸男が後輩に弟が部員を
- (4) 老婦人が平井さんを知り合いがおまわりさんに
- (5) 叔父が課長に佐藤さんを老紳士が
- (6) 部長が金井さんを親類に得意先が
- (7) 山田さんに学生が映画俳優を先輩が
- (8) 秘書を内藤さんが係長に子供が
- (9) お手伝いさんが孝が祖母に
- (10) 看護婦が兄が健二を
- (11) 渡辺さんに母が検事が
- (12) 横山さんを父が車掌が
- (13) 正明が老人が兄に弁護士を
- (14) 同級生が幸子が真理子を兄弟に
- (15) 妹に弘志が犯人が守を
- (16) 美容師を娘が川田さんが斎藤さんに
- (17) 田中さんに友人を同僚が恵子が
- (18) 母親を美智子に友達がセールスマンが
- (19) 小学生が姉に杉田先生を
- (20) 太郎が親戚を先生に
- (21) 小川さんに校長が来客を
- (22) 恋人を美紀が両親に
- (23) 不動産屋に姪を次郎が
- (24) 妹をウェ이터に由美子が

Appendix K-2: Sentence Completion Task, Core Stimulus Subset, Experiment 3, English Translation

(Fragment numbers correspond to those in Chapter 7.)

- (1) itoko-ga Yoshio-ni ryuugakusei-ga
cousin-Nom Yoshio-Dat international student-Nom
- (2) ootoo-ga Keiichi-o yopparai-ga
younger brother-Nom Keiichi-Acc drunk man-Nom
- (3) Yukio-ga koohai-ni ootoo-ga buin-o
Yukio-Nom junior (student/worker)-Dat younger brother-Nom club member-Acc
- (4) roohujin-ga Hirai-san-o siriai-ga omawarisan-ni
elderly woman-Nom Hirai-Mr./Ms.-Acc acquaintance-Nom cop-Dat
- (5) oji-ga kachoo-ni Sato-san-o roosinsi-ga
my uncle-Nom section chief-Dat Sato-Mr./Ms.-Acc elderly gentleman-Nom
- (6) buchoo-ga Kanai-san-o sinrui-ni tokuisaki-ga
managing director-Nom Kanai-Mr./Ms.-Acc relative-Dat good client-Nom
- (7) Yamada-san-ni gakusei-ga eigahaiyuu-o senpai-ga
Yamada-Mr./Ms.-Dat student-Nom movie actor-Acc senior (student/worker)-Nom
- (8) hisho-o Naito-san-ga kakarichoo-ni kodomo-ga
secretary-Acc Naito-Mr./Ms.-Nom section chief child-Nom
- (9) otetudaisan-ga Takashi-ga sobo-ni
house keeper-Nom Takashi-Nom my grandmother-Dat
- (10) kangohu-ga ani-ga Kenji-o
nurse-Nom my older brother-Nom Kenji-Acc
- (11) Watanabe-san-ni haha-ga kenji-ga
Watanabe-Mr./Ms.-Dat my mother-Nom prosecutor-Nom
- (12) Yokoyama-san-o titi-ga shashoo-ga
Yokoyama-Mr./Ms.-Acc my father-Nom (bus/train) conductor-Nom
- (13) Masaaki-ga roojin-ga ani-ni bengosi-o
Masaaki-Nom elderly man-Nom my older brother-Dat lawyer-Acc
- (14) dookyuusei-ga Sachiko-ga Mariko-o kyoodai-ni
classmate-Nom Sachiko-Nom Mariko-Acc brother/sister-Dat
- (15) imooto-ni Hiroshi-ga hannin-ga Mamoru-o
younger sister-Dat Hiroshi-Nom criminal-Nom Mamoru-Acc
- (16) biyoosi-o musume-ga Kawada-san-ga Saito-san-ni
hair cutter-Acc daughter-Nom Kawada-Mr./Ms.-Nom Saito-Mr./Ms.-Dat

- (17) Tanaka-san-ni yuujin-o dooryoo-ga Keiko-ga
 Tanaka-Mr./Ms.-Dat friend-Acc co-worker-Nom Keiko-Nom
- (18) hahoya-o Michiko-ni tomodati-ga seerusuman-ga
 mother-Acc Michiko-Dat friend-Nom salesperson-Nom
- (19) shoogakusei-ga ane-ni Sugita-sensei-o
 elementary school student-Nom my older sister-Dat Sugita-TeacherAcc
- (20) Taro-ga sinseki-o sensei-ni
 Taro-Nom relative-Acc teacher-Dat
- (21) Ogawa-san-ni koochoo-ga raikyu-o
 Ogawa-Mr./Ms.-Dat principal-Nom guest-Acc
- (22) koibito-o Miki-ga ryoosin-ni
 lover-Acc Miki-Nom parents-Dat
- (23) hudoosan'ya-ni mei-o Jiroo-ga
 realtor-Dat niece-Acc Jiroo-Nom
- (24) imooto-o ueitaa-ni Yumiko-ga
 younger sister -Acc waiter-Dat Yumiko-Nom

Appendix L-1: Sentence Completion Task, Supplementary Stimulus Subset, Experiment 3

(Fragment numbers correspond to those in Chapter 7.)

- (25) 姉は誠が
- (26) 母が主任医師は孝が
- (27) 教授が佐藤さんが
- (28) 父親が道夫が有名作家が
- (29) 孫は清水さんは青年が
- (30) 両親は運転手が進は
- (31) 叔母が店主は学生は
- (32) 中学生は花嫁は今井さんは
- (33) ソニーが社員が態度が
- (34) ジャイアンツは投手が腕力が

Appendix L-2: Sentence Completion Task, Supplementary Stimulus Subset, Experiment 3, English Translation

(Fragment numbers correspond to those in Chapter 7.)

- (25) ane-wa Makoto-ga
my older sister-Top Makoto-Nom

- (26) hahaoya-ga shunin'ishi-wa Takashi-ga
mother-Nom chief doctor-Top Takashi-Nom

- (27) kyooju-ga Sato-san-ga
professor-Nom Sato-Mr./Ms.-Nom

- (28) titioya-ga Michio-ga yuumeigaka-ga
father-Nom Michio-Nom famous writer-Nom

- (29) mago-wa Shimizu-san-wa seinen-ga
grandchild-Top Shimizu-Mr./Ms.-Top young man-Nom

- (30) ryooshin-wa untenshu-ga Susumu-wa
parents-Top (bus/car) driver-Nom Susumu-Top

- (31) oba-ga tenshu-wa gakusei-wa
my aunt-Top store owner-Top college student-Top

- (32) chuugakusei-wa hanayome-wa Imai-san-wa
junior high school student-Top bride-Top Imai-Mr./Ms.-Top

- (33) Sonii-ga shain-ga taido-ga
Sony-Nom company worker-Nom attitude-Nom

- (34) Jaiantsu-wa tooshu-ga wanryoku-ga
Giants-Top pitcher-Nom arm power-Nom

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