

Sentence Comprehension Disturbances in Japanese Aphasics

by

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## Abstract

### SENTENCE COMPREHENSION DISTURBANCES IN JAPANESE APHASICS

In this thesis, sentence comprehension disturbances in Japanese aphasics are investigated, focusing on the role of word order, thematic role order, case-markers and postpositions. Assuming the framework of Government-Binding theory (Chomsky, 1981) and the Case-theory of Japanese (Saito, 1982, 1985), three hypotheses are developed concerning language-universal and language-specific characteristics of sentence-processing mechanisms.

The data from Japanese aphasics show that the sentence-processing mechanism of brain-damaged patients is not entirely determined by primitive notions such as "precedence" and "agent-of-action", and that the ease of sentence processing is determined by the thematic role order in a given sentence.

It is claimed that the linguistic factors accounting for the language of brain-damaged subjects may differ from language to language: for case-marking languages such as Japanese, Case theory may be the crucial factor, while for non-case-marking languages like English theta-theory might be more important.

It is also claimed that Case-assignment, theta-role assignment and their directionalities in a given language play a role in the theory of sentence comprehension, and that they can be a basis for aphasic patients' heuristic strategies of sentence comprehension.

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## Résumé

### TROUBLES DE LA COMPRÉHENSION CHEZ LES APHASIQUES JAPONAIS

Les troubles de la compréhension chez les aphasiques japonais sont étudiés en mettant l'accent sur le rôle de l'ordre des mots, l'ordre des rôles thématiques, les marqueurs de cas, et les postpositions. Dans le cadre de la théorie du gouvernement et liage (Chomsky, 1981), trois hypothèses sont formulées concernant les caractéristiques spécifiques à chaque langue et les caractéristiques universelles des mécanismes de traitement des phrases.

Les données recueillies auprès d'aphasiques japonais montrent que le mécanisme de traitement des phrases chez les cérébrolésés n'est pas entièrement déterminé par les notions primitives telles que "priorité" et "agent-d'action" et que la facilité du traitement des phrases est déterminée par l'ordre thématique d'une phrase donnée.

Les facteurs linguistiques qui contraignent le langage des sujets cérébrolésés sont considérés comme différant d'une langue à l'autre: Pour les langues à cas comme le japonais, la théorie des cas pourrait être le facteur crucial, tandis que pour les langues sans marques de cas, comme l'anglais, la théorie des rôles thématiques pourrait se révéler plus importante.

Cette thèse soutient également que l'assignation des cas, l'assignation des rôles thématiques, et leurs directionnalités respectives dans une langue donnée jouent un rôle dans la théorie de la compréhension des phrases, et qu'elles peuvent servir de base aux stratégies heuristiques de compréhension des phrases pour le patient.

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## Chapter 1

### Introduction

The study of the impairment of sentence comprehension in brain-damaged patients is interesting not only for its therapeutic potential but also because it may reveal the mechanisms of normal language processing. It is the task of the psycholinguist to provide a systematic description and explanation of the patterns of such impairments in aphasics' performance on sentence comprehension. It is also important to investigate the patterns of impairment in aphasics who speak languages which are structurally different from each other. Such studies will provide useful information concerning the language-universal nature of sentence-processing mechanisms in normals as well as in aphasics.

The aim of this thesis is to investigate the nature of disturbances of the comprehension of syntactic form in Japanese brain-damaged patients, and to try to provide further insights into the language-universal nature of comprehension deficits involving the sentence-processing mechanisms of aphasics. We will be concerned with (1) deficits resulting in a failure to assign thematic relations to nouns during sentence comprehension, (2) deficits involving closed class vocabulary in comprehension and grammaticality judgement tasks, and (3) the role of word order, case-markers and postpositions in determining syntactic deficits in aphasia.

Chapter 2 will clarify the issues concerning the nature of the disturbances of syntactic form manifested in aphasics' sentence comprehension, and present the rationale for the Japanese experimental studies to be described in the following chapters.

Chapter 3 presents the theoretical framework underlying the analysis of the data and explores the characteristics of the Japanese language in greater detail within that framework.

In Chapter 4, I discuss the hypotheses to be tested in the present thesis. In addition, the methodology adopted in the experiments will be discussed.

Chapter 5 and Chapter 6 are devoted to a report on the series of experiments designed to test the hypotheses proposed in Chapter 4. Chapter 5 focuses on the role of word order with respect to the assignment of thematic relations in sentence comprehension. The language-universal nature of sentence comprehension and language-specific patterns of sentence interpretation in Japanese aphasics will be discussed.

Chapter 6 is devoted to the role of case-markers and postpositions in sentence comprehension. The first section will deal with the patients' ability to detect case-markers in sentence comprehension tasks and grammaticality judgement tasks. A theoretical explanation for the aphasics' performance on case-markers and its implications for the structure of Japanese will be discussed. The second part will investigate a specific hypothesis concerning the language of aphasic patients by means of their performance on case-markers and postpositions in the grammaticality judgement task. The implications of the findings for our understanding of the disturbance of sentence comprehension in aphasics will then be discussed.

Chapter 7 summarizes the findings of my experiments on syntactically-based disturbances of sentence comprehension in Japanese aphasics, and discusses their implications for accounts of sentence comprehension disturbances in aphasics in general.

## Chapter 2

### Disturbances of Syntactic Form in Sentence Comprehension

A major focus of research activity in the past decade has been directed to the question of whether the language of brain-damaged patients reflects a selective impairment to a component of the language faculty which specialized for sentence-processing. Many researchers have investigated the exact nature of such impairments and a large number of significant studies has emerged. Nevertheless, there is still considerable debate over the nature of the impairments seen in patients.

Although the major goal of this thesis is to provide experimental evidence regarding the syntactic determinants of comprehension disturbances in Japanese aphasics, with particular emphasis on word order and case-marking, it is necessary first to clarify some of the issues that are crucial for the understanding of the language-universal and language-specific aspects of syntactic impairments of sentence comprehension in aphasics. This is particularly important at the present stage of linguistic aphasiology. We will start by exploring the basic aspects of disturbances of syntactic form in sentence comprehension.

## 2.1 Fundamental Aspects of Disturbances of Syntactic Form in

### Sentence Comprehension

#### 2.1.1 Caramazza and Zurif's "Asyntactic Hypothesis"

One of the earliest attempts to describe sentence comprehension disturbances in aphasics was made by Caramazza and Zurif (1976) and Zurif and Caramazza (1976). Based on their findings in a series of psycholinguistic experiments, they made several important claims. One of their most fundamental assertions is that aphasic patients of a certain type are "Asyntactic", in that they use no syntactic structures in sentence interpretation (Caramazza and Zurif, 1976), and that they use only semantic features as a heuristic device in the comprehension of sentences (Zurif and Caramazza, 1976).

Caramazza and Zurif (1976) tested five Broca's aphasics, five Conduction aphasics and five Wernicke's aphasics on sentence comprehension.<sup>1</sup> Four types of sentences were used: three types of center-embedded object relative constructions and a set of control sentences. Examples of each type are as follow:

- 
1. The classical aphasic syndromes, Broca's, Wernicke's and Conduction aphasia, can be roughly defined as follows: Broca's aphasics have non-fluent speech with relatively well retained auditory comprehension, whereas Wernicke's aphasics are fluent in speech but impaired in auditory comprehension. Conduction aphasics are fluent in speech with relatively well retained comprehension abilities; in these patients it is primarily repetition that is affected. This classical typology was formulated at a time when it was considered important to define the different types of aphasia. Now it is generally felt that this approach may no longer be useful, particularly for purposes of theory construction. For further discussion see Section 4.2.1.

- (2.1) a. The apple that the boy is eating is red. (Type 1)  
b. The boy that the girl is chasing is tall. (Type 2)  
c. The boy that the dog is patting is fat. (Type 3)  
d. The boy is eating a red apple. (Control)

(Caramazza and Zurif 1976, p. 575)

The two nouns in each sentence were either semantically nonreversible, as in (2.1a), semantically reversible, as in (2.1b), or semantically implausible as in (2.1c). Control sentences, based on the nonreversible center-embedded sentences, were presented in a non-embedded form, where the embedded verb became the main verb, and the predicate adjective became the object NP modifier. Patients had to choose between two pictures, i.e. the correct representation and a distractor, which was one of four types, representing: (1) a change in the matrix complement (predicate adjective); (2) an incorrect embedded transitive verb; (3) both (1) and (2) combined; and (4) matrix and embedded nouns reversed. The results show that when semantic constraints were absent, i.e. in sentences such as (2.1b) and (2.1c), the performance of Broca's and Conduction aphasics dropped drastically. Furthermore, Broca's and Conduction aphasics made most errors on type (4) distractors, i.e. syntactic distractors (68% correct), while they performed quite well on distractors of other types, i.e. lexical distractors (83% to 92% correct). On choices involving type (4) distractors, Broca's and Conduction patients chose the correct picture about 90% of the time for semantically nonreversible sentences, 40% to 50% of the time for semantically reversible sentences, and about 40% of the time for semantically implausible sentences.

Caramazza and Zurif interpreted these results as meaning that Broca's and Conduction aphasics are unable to use syntactic-like algorithmic processes, whereas they have retained the capacity to use heuristic procedures to assign a semantic interpretation to an incomplete syntactic representation of these sentences. They further state that these heuristics are based on the regularity of word sequence probability, where an N-V sequence can be mapped onto the relation Actor-Action as in the control sentences.



Their claim is significant in that it represents the first attempt to explain the comprehension deficit apparent in sentence interpretation by aphasics. There are, however, many problems in their experimental design, as well as in their basic premises. First, most of the sentence types used were inappropriate for the sentence-picture matching task. For instance, for sentence (2.2) (Type 1), the syntactic distractor would be (2.3).

(2.2) The apple that the boy is eating is red.

(2.3) The boy that the apple is eating is red.

It would be very difficult to draw the appropriate picture for (2.3). In other words, there is a possibility that the pictures used may have resulted in the confusion evident in the patients' answers. The use of the sentence-picture matching task to evaluate aphasics' comprehension imposes significant limitations on the nature of their responses, especially when testing complex sentences which contain more than two nouns.

Secondly, the number of stimulus sentences was quite small (8 for each type) and the same lexical items were used many times. Since each type of distractor appeared with only a quarter of the stimulus sentences, the amount of data obtained must have been extremely small, considering the small sample size.

The third problem is that the center-embedded relative clause structure Caramazza and Zurif used is considered to be one of the most difficult relative clause constructions for aphasics to interpret. As was later shown by many researchers (e.g. Caplan and Futter, 1986; Grodzinsky, 1984), other types of relative clauses, e.g. right-branching relative clauses, are much easier for aphasics to interpret than the center-embedded relative clause construction. Thus, the insufficient data shed doubts on their claim that aphasics are 'asyntactic'.

In addition, Caramazza and Zurif claim that the patients' better performance on the non-embedded control sentences, such as (2.4)

(2.4) The girl is kicking a green ball.

stems from the fact that the control sentences are semantically plausible, in that the N-V sequence of word order is correctly mapped as the Actor-Action relation. This hypothesis leads the authors to claim that the patients used word order as a heuristic. It is, however, equally plausible that their good performance is due to the fact that there is only one predicate in the non-embedded sentence (2.4), as opposed to two in the embedded sentences (2.1a), (2.1b), and (2.1c).

Finally, it is not entirely clear whether Caramazza and Zurif distinguish between the syntactic component and general processing mechanisms when they claim that the patients are "asyntactic".<sup>2</sup> The authors state that

The present data ... suggest that, at least for Broca's aphasics, brain damage affects a general language processing mechanism that subserves the syntactic component of both comprehension and production.

(Caramazza and Zurif 1976, p. 581, emphasis mine)

### 2.1.2 Schwartz, Saffran and Marin's "Word Order Problem"

A similar proposal for a syntactic account of aphasia is made by Schwartz, Saffran and Marin (1980). Disputing the phonological account of agrammatism proposed by Kean (1977), they claim that the disturbance in sentence comprehension is located in the syntactic component (specifically, at D-structure), and has the specific effect that agrammatic aphasics are not able to assign thematic roles properly to the nouns around verbs even in simple active declarative sentences.

-----  
2. Kamio (1982) has also pointed this out.

Schwartz et al. (1980) tested five agrammatic aphasic patients for their comprehension of simple active and passive sentences with semantically reversible animate subjects and objects. Examples of the sentences used are given in (2.5) and (2.6).

- (2.5) a. The clown applauds the dancer.  
b. The clown is applauded by the dancer.

(Schwartz et al. 1980, p.253)

- (2.6) The square is shooting the circle.

(Schwartz et al. 1980, p.259)

The aphasics were required to choose between two pictures, the correct one and a distractor with reversed NPs. In comprehension of sentences in the active voice with animate agent and theme (e.g. (2.5a)), the patients gave in average of 74% correct responses. In comprehension of passive sentences such as (2.5b) the patients averaged 52.5% correct responses. For sentences of type (2.6), the patients produced an average of 70.8% correct responses. For each sentence type only two patients performed at better than chance levels (over 71%), which, according to Schwartz et al., sheds doubt on whether word order in these patients is preserved.

The authors later proposed that the knowledge of thematic relations is not available to agrammatic aphasics even at underlying levels, and that they select the salient elements of a cognitive representation and map them onto the surface word sequence (Saffran, Schwartz and Marin, 1980). For a re-evaluation of these data by Caplan (1983b), see section 2.1.3.

### **2.1.3 Caplan's "Lexical Node Hypothesis"**

Caplan (1983a, 1985) opposes the "asyntactic" claim made by the researchers whose work is described above by providing a more precise description of the nature of the

disturbance in aphasics' sentence comprehension. Caplan (1983a) claims that the syntactic representation available to aphasics comprises the information which is contained in the lexical entries of open class items, i.e. the syntactic labels of the major lexical categories, N, A, and V. Other lexical information available to the patients includes syntactic features such as subcategorization frames, and semantic information such as the thematic roles assigned by these lexical items. What is *not* available to the patient is the phrase structural hierarchy. According to Caplan, although phrasal category nodes such as NP, AP, PP, and S are not directly generated, it is possible that these nodes are available through reconstruction from lexically provided information such as subcategorization frames.

Some of the evidence that lexical node labels are assigned to lexical items comes from the results of the experiment reported by Caplan, Matthei, and Gigley (1981). They tested comprehension of several types of gerundive constructions using eleven Broca's aphasic patients. Examples of the sentences used are given in (2.7), (2.8) and (2.9).

(2.7) Can you show Bill walking the dog?

(2.8) Can you show Bill the walking dog?

(2.9) Can you show Bill the walking of the dog?

(Caplan et al. 1981, p. 148)

These sentences differ syntactically in the following ways. In (2.7), sentence containing a verbal gerund, Bill is the subject and the dog the object of the gerund, walking. In (2.8), containing an NP, Bill is obligatorily the indirect object of show and dog the subject of walking, which is a participle modifying dog. In (2.9), also containing an NP, Bill is obligatorily the indirect object of show, but the dog can be either the subject or the object of walking; in the latter case, the subject of the gerund may be pragmatically supplied, i.e. available in the discourse context.

In an object manipulation task, a group of four Broca's aphasics generally did not assign the Agent thematic role to the pregerundive noun Bill in sentences like (2.8) and (2.9), while they invariably did so in sentences like (2.7). They utilized a pragmatic Agent for walking more frequently in (2.9) than in (2.7) and (2.8). This high level of performance caused Caplan et al. to suggest that the patients could distinguish nominal, adjectival, and verbal forms of the gerund-participle. That is, these patients seem to assign and interpret at least the major lexical category nodes N, A, and V.

More evidence supporting the Lexical Node Hypothesis comes from a reanalysis of the results of Schwartz et al.'s (1980) experiment on word order, as was mentioned above. Reinterpreting their data by examining it on a patient-by-patient basis, Caplan (1983b) suggests that these patients do have the notion of thematic relations available but that they cannot map them onto grammatical relations. Two patients performed correctly, demonstrating the operation of a decoding strategy that assigns Agency to preverbal nouns. Two others show close to two-thirds correct responses, their results being complicated by an animacy effect which worked to confound the role of word order in assigning thematic roles to the strings presented.<sup>3</sup> Thus, he states that the principles governing these aphasics' interpretation of sentences such as (2.5) and (2.6) are the following:

- (2.10) The patient recognizes the voice of the sentence.
- (2.11) In the active, assign the noun before the verb as Agent.
- (2.12) In the active, assign an animate noun as Agent.

(Caplan 1983b, p. 157)

He states that a "word-order problem" does not exist in aphasics' linguistic representations. Denying Schwartz et al.'s (1980) claim, he claims that aphasic patients do appreciate the

3. The term "animacy effect" is used to denote the fact that aphasics tend to assign the Agent theta-role to the animate noun (if there is only one in the sentence).

linguistic semantic notion of thematic relations and can map them onto category strings, and that these strings include the major lexical categories N, A, and V.<sup>4</sup>

Further evidence that aphasics interpret the thematic relations holding between Ns and Vs on the basis of the linear order of these categories is provided by the systematic interpretation patterns exhibited by the patient S.P., as reported by Caplan and Futter (1986). They tested this patient's comprehension of various types of sentences using the object-manipulation task. The sentence types tested included active, passive, cleft, dative, and relative clause constructions, with 6 examples of each type of simple sentence and 10 examples of each type of complex sentence being used.

They reported that S.P. showed striking regularities in interpreting a wide variety of these sentences. In simple sentences, she interpreted the first noun as Agent and the second as Theme (and the third noun, if present, as Goal). S.P. interpreted all structures of the type presented in (2.13) according to a very simple interpretive rule similar to that given in (2.14).

- (2.13) a. N1-V-N2  
b. N1-V-N2-N3  
c. N1-V1-N2-V2-N3  
(Caplan and Futter 1986, p. 128)

- (2.14) Assign the thematic roles of Agent, Theme, and Goal to N1, N2, and N3 in structures of the form N1-V-N2-N3, where N1 does not already bear a thematic role.  
(Caplan and Futter 1986, p. 128)

S.P. used this linear order strategy only for sentences of the types depicted in (2.13). Thus, she did not apply interpretive rule (2.14) to passives or cleft object sentences like (2.15), nor to dative passives or dative cleft object sentences like (2.16), nor to Subject-Object relatives like (2.17), performing randomly on all these sentence types.

-----  
4. It is also suggested by Caplan (1985, pp.143-145) that, although they do not interpret phrasal categories, they may construct them at an intermediate stage of processing, but that they do not analyze categories in hierarchical structures for the purpose of semantic interpretation.

- (2.15) It was the frog that the monkey chased.  
(2.16) a. It was the frog that the monkey gave to  
the elephant.  
b. It was to the elephant that the monkey gave  
the frog.  
(2.17) The frog that chased the monkey bumped the bear.

As a result, she scored 3 out of 6 correct responses for passives, 2 out of 6 for cleft object sentences, 3 out of 6 for sentences of type (2.16a), and 1 out of 6 for those of type (2.16b).

In complex sentences, she was tested on conjoined sentences and all four types of relative clauses.

- (2.18) The frog chased the monkey and bumped the bear. (C)  
(2.19) The frog that chased the monkey bumped the bear. (SS)  
(2.20) The frog that the monkey chased bumped the bear. (SO)  
(2.21) The frog chased the monkey that bumped the bear. (OS)  
(2.22) The frog chased the monkey that the bear bumped. (OO)

S.P. consistently assigned the first noun as Agent of the first verb, the second noun as theme of the first verb, and the third noun as Theme of the second verb. The first and second nouns were randomly assigned as the Agent of the second verb. There is very little deviation from this pattern, and such deviation as exists arises mainly in object relatives such as (2.20) and (2.22). The characteristic feature common to sentences (2.15), (2.16), (2.20) and (2.22), but not to the others, is the existence of an N-N sequence. Thus, the authors suggest that linear sequences of categories are mapped onto thematic roles; on the other hand, the hierarchical organization of categories, i.e. more complex configurational notions such as "subject" or "object", does not enter into this patient's analysis of these sentences. What is involved in this patient's analysis of the sentences are notions such as "noun preceding the verb" and "noun following the verb". If this patient's analytical device for sentence interpretation is based on such notions as "precedes" and "follows", without any

configurational structure, then it seems quite possible that the presence of the category sequence N-N-(V) (i.e. two nouns preceding the verb) might cause difficulties in interpreting sentences such as (2.15), (2.16) and (2.17).

On the basis of this evidence, Caplan (1983b) proposes that

The distinction between notions like precedence and configurationally defined grammatical relations is related to a fundamental idea expressed by Chomsky (1981), that of a "primitive basis of concepts" from which others are derivable. Such a primitive basis, for universal grammar, must meet a number of conditions, one of which is "epistemological priority":  
(Caplan 1983b, p.162, emphasis mine)

Caplan invokes the idea of "epistemological priority", articulated by Chomsky as follows:

The primitive basis must meet a condition of epistemological priority. That is, still assuming the idealization to instantaneous language acquisition, we want the primitives to be concepts that can plausibly be assumed to provide a preliminary, prelinguistic analysis of a reasonable selection of presented data, that is, to provide the primary linguistic data that are mapped by the language faculty onto a grammar; relaxing the idealization to permit transitional states, similar considerations still hold. It would, for example, be reasonable to suppose that such concepts as "precedes" or "is voiced" enter into the primitive basis, and perhaps such notions as "agent-of-action" if one believes, say, that the human conceptual system permits analysis of events in these terms independently of acquired language. But it would be unreasonable to incorporate, for example, such notions as "subject of a sentence" or other grammatical relations within the class of primitive notions, since it is unreasonable to suppose that these notions can be directly applied to linguistically unanalyzed data.

(Chomsky 1981, p.10, emphasis mine)

Assuming such notions as the "primitive basis of concepts" and "epistemological priority", Caplan (1983b, p. 162) raises the intriguing possibility that "agrammatic patients, or some



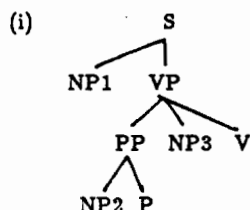
other group of language-impaired subjects, may retain this primitive basis and not the structures complexly defined over it."

## 2.2 The Epistemological Hypothesis

If the grammar of language-impaired patients comprises this "primitive basis of concepts", and if it is forced to rely on "epistemologically" available analyses, independently of the structure of the acquired language, then what follows is that the language-processing mechanism which interacts with the grammar of the acquired language is also operating on this structure-independent basis. If this is the case, then lexical categories such as nouns and verbs and the notion of "precedence" which defines the order of these categories play a significant role in the sentence-processing mechanism of language-impaired patients. Normals, on the other hand, have access to structural notions such as "dominance", as well as the grammatical relations, such as "subject" or "object", which are defined in terms of this notion.<sup>5</sup>

If this is true, it may also be true that the order of the major lexical categories such as nouns and verbs forms a crucial aspect of sentence processing for brain-damaged subjects, regardless of whether their native language is configurational or not. Data from a language

5. The term "dominance" is used to define structural relations of syntactic configurations in such a way that, for example in (i), NP1 is dominated by S; and NP2 is dominated by PP, VP and S.



Grammatical relations such as "subject" and "object" are structurally defined in that the "subject" is the NP immediately dominated by S and the direct object is the NP immediately dominated by VP.

like Japanese, which permits a relatively free category order of nouns and verbs, may prove crucial for determining whether such primitive yet fundamental linguistic notions are retained by brain-damaged subjects, as well as for determining whether they form the basis of these patients' grammar. In other words, if these prelinguistic notions are spared in brain-damaged subjects and do determine the nature of the sentence-processing mechanism, it would be reasonable to say that the ease of processing various category orders is also determined by the factor of "epistemological priority". If this is the case, it would also be reasonable to hypothesize that a sequence with two nouns before the verb (N-N-V) is harder for brain-damaged subjects to process than one with only one noun before the verb (N-V-N), regardless of whether the canonical category order of their native language is N-V-N or N-N-V.<sup>6</sup>

At this point an interesting question arises. In studies of English-speaking aphasics, it is reported that object cleft sentences like example (2.15), cleft object dative sentences like (2.16), and object relatives such as (2.20) and (2.22) are more difficult for aphasics to interpret than simple active sentences, cleft subject sentences, simple dative sentences and subject relatives. It has been suggested by Caplan (in press) that the difficulty of the former sentence types may be due to the fact that they contain the sequence N-N-V, which is not the canonical English word order. If the sequence N-N-V creates difficulties in sentence interpretation for English aphasics because it is not the canonical order, does a similar argument apply in the case of aphasics speaking other languages?

If the sentence-processing mechanism of brain-damaged patients is ultimately determined by primitive notions such as "epistemological priority", then sentences with the N-N-V order should be more difficult than those with the sequence N-V-N, irrespective of

6. Throughout this thesis, when speaking of N-V-N and N-N-V orders, N and V are being used to specify type of category not level of projection. Therefore N-V-N simply indicates the order [+N] [+V] [+N] without making any claim as to whether Ns or NPs are involved.

the canonical word order of the patient's language. If this is the case, then what about aphasics whose native language has the canonical category sequence N-N-V, as, for example, Japanese does? Is it the case that Japanese aphasics also have more trouble understanding sentences with the sequence N-N-V, which is their canonical word order, than those with N-V-N?

We can imagine several different forms that the data from Japanese aphasics might take. If the aphasics prefer the N-V-N order to the canonical N-N-V order, then the data would confirm the hypothesis concerning the "epistemological basis" of the language of brain-damaged subjects. Given that, "epistemologically", sentences with one noun before the verb should be easier than those with two nouns before the verb, such data from Japanese aphasics would support the hypothesis that only the "primitive basis" of language is retained by brain-damaged subjects.

On the other hand, if Japanese aphasics prefer the N-N-V order to the N-V-N order, it would indicate that the grammar of the brain-damaged subjects retains not only the "primitive notions" but also the structural basis of language.

If, however, Japanese aphasics perform equally well on sentences with the N-N-V order and sentences with the N-V-N order, then how shall we interpret their performance? Several possibilities would arise in this case. First, we would have to say that the data from Japanese aphasics neither confirm nor refute the "epistemological" hypothesis. Instead, such results would indicate that the order of nouns and verbs is not the only or even the most important factor affecting sentence comprehension in Japanese, contrary to the findings for English aphasics. Rather, it would suggest that factors other than category order are operating as determinants of sentence comprehension. These might perhaps include case-markers.

If one pushes this line of speculation further, some interesting ideas emerge. For instance, Japanese has a nominative/accusative system of case-marking, in addition to a number of postpositions. Supposing that case-markers influence the ease of sentence processing in Japanese, it would confirm the idea that aphasics do have access to some closed class lexical items. If this is found to be the case, then the next step is to ask which case-markers play a dominant role in sentence interpretation. Do Japanese aphasics use the nominative case-marker as a cue for the interpretation of sentences, or is it the accusative case-marker which is more salient and which participates in their sentence-processing mechanism? Or are both case-markers important? If the availability of the two case-markers differs for aphasics, how would this be interpreted in relation to a theory explaining language impairment patterns in Japanese aphasics? Which case-markers might be available is a question which is of particular interest with respect not only to the "function word theory" of aphasics' language as proposed by Bradley, Garrett, and Zurif (1980), but also to the language-specific mechanisms of sentence comprehension by aphasics. The data from aphasics may also be able to provide indirect evidence concerning the configurationality or otherwise of normal Japanese.

Thus, the data obtained from Japanese brain-damaged subjects will be quite important not only because they will provide an answer to the question of whether or not the ease of sentence processing is determined by "epistemological priority", but also because they may be able to provide some input towards a universal definition of syntactically based comprehension disturbances in aphasics. Such a definition may be articulated either in terms of such notions as "epistemologically primitive" analyses or in terms of a theory involving linguistic structure.

These are the questions which I shall be considering in this study; I shall provide answers to at least some of them in this thesis. The following chapter will explain the theoretical framework on which our analyses are based.

## Chapter 3

### Theoretical Framework

#### 3.1 Theoretical Framework

What a speaker knows about his language includes that knowledge which enables him to distinguish grammatical sentences from ungrammatical sentences. For example, a speaker of English is able to recognize sentence (3.1) as grammatical and sentence (3.2) as ungrammatical.

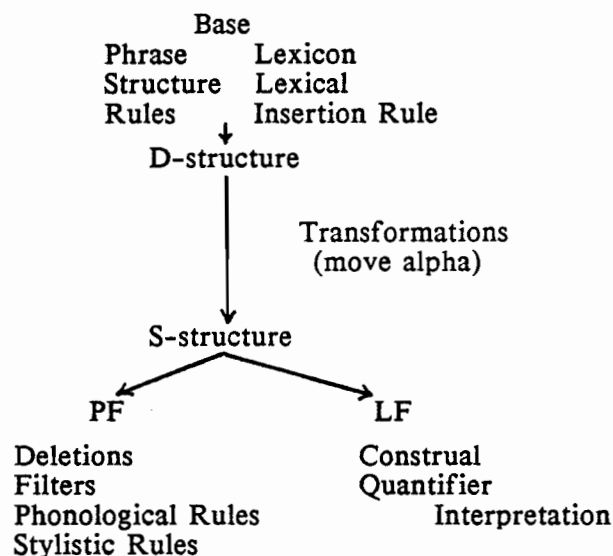
(3.1) John was hit by Mary.

(3.2) \*Was hit John by Mary.

In this thesis, I will assume the theoretical framework referred to as "Government-Binding" theory, which is presented in Chomsky (1981, 1982). This framework comprises a set of basic principles which apply universally to govern the well-formedness of linguistic representations, and a number of parameters which vary from language to language and thus account for the individual characteristics of particular languages, such as Japanese and English.

The model of grammar assumed here can be schematically represented as follows:

(3.3)



The Base consists of a set of Phrase Structure Rules and a Lexicon which contains a list of lexical items specified both for syntactic features such as subcategorization frames, thematic role assignment and Case-assignment, and for semantic features such as animacy, etc. A Lexical Insertion Rule inserts lexical items into appropriate syntactic configurations generated by the Phrase Structure Rules. The output of the Base, the level of D-structure, serves as the input to the transformations, which produce S-structure. S-structure representations map onto representations in Phonetic Form (PF) by means of various rules, e.g. Deletion and Stylistic Rules, as well as onto Logical Form (LF).

Every level of representation in this model is subject to certain well-formedness conditions. The principles which are directly relevant to the present research involve the theory of thematic relations (or theta theory) and Case theory; these theories will be discussed below.

### 3.1.1 Thematic Relations and Argument Structure

The theory of thematic relations is very important to the present study of sentence comprehension in aphasics. Chomsky (1981) points out that thematic relations such as "agent-of-action" and "goal-of-action" play a role in the semantic interpretation of sentences. They enter into the primitive notion of event logic, which analyzes, e.g. John ran quickly as: there is an event e which is a running event with John as its agent, and e is quick. As was shown in Section 2.1, the notion of thematic relations is considered to be "a primitive basis of concepts" for language; "the human conceptual system permits analysis of events in these terms independently of acquired language." (Chomsky 1981, p.35)

Knowledge of a language includes knowledge of the fact that a given verb is a one-, two- or three-place predicate. In English, for instance, verbs like sleep, read, and give are one-, two- and three-place predicates, respectively; they are said to assign one, two and three thematic roles, respectively. Thematic roles are sometimes referred to as Agent, Theme, Goal, Instrument, and so on. These thematic roles are assigned to nominal expressions. Thus, for example, in the following sentence,

(3.4) John read a book.

the noun John, as Agent, receives a thematic role from the verb phrase read a book; the noun a book, as Theme, also receives a thematic role from read. Nominal expressions such as John and a book, which can be assigned theta-roles, are referred to by Chomsky as "arguments".

How and to which elements theta-roles are assigned is governed by the Theta Criterion.



### Theta Criterion

Each argument bears one and only one theta-role,  
and each theta-role is assigned to one and only  
one argument.

(Chomsky 1981, p.36)

This principle, as a condition on the well-formedness of syntactic representations, may be invoked to account for the ungrammaticality of a sentence like the following:

(3.5) \*John cried Mary.

This sentence contains two arguments, John and Mary. The verb cry, however, is assumed to assign only one thematic role, i.e. Agent. Because "each theta-role is assigned to one and only one argument" - the Agent role in this case being assigned to John - the second argument, Mary, does not receive a thematic role. The requirement that each argument bear a theta-role is thus violated, yielding an ungrammatical sentence.

While the Theta Criterion is a principle which is a part of the grammars of all languages, the way in which theta-roles are assigned may vary from language to language. In non-configurational languages, the Agent thematic role is determined in the lexicon by linking rules (Hale 1980, 1982, Farmer 1980). Since this thematic role is not assigned structurally, word order is free. On the other hand, in configurational languages such as English, the Agent thematic role is assigned structurally, i.e. to the noun in a particular position with respect to the verb, and thematic relations are realized at the level of Logical Form for semantic interpretation.

There are two types of theta-role assignment, according to Chomsky; they are referred to as direct theta-marking and indirect theta-marking. For example, in sentence (3.4), the verb read would directly theta-mark a book, since both are within VP. The NP

John, on the other hand, would be indirectly theta-marked by the verb, since it is the subject, and is outside VP.<sup>7</sup>

A further proposal with respect to the theory of thematic relations is made by Williams (1981). Adopting the notion of arguments proposed by Gruber (1965), he claims that every lexical item may have associated with it an "argument structure". One of the main claims of Williams' theory of argument structure is that there is a distinction between the "external argument", which is realized outside the maximal projection of which the lexical item in question is the head, and the "internal argument" which appears inside the maximal phrasal projection of that lexical item. Notationally, the external argument is indicated by underlining. Thus, for example, the argument structure of the verb read would be represented as follows:

(3.6) read: (Agent, Theme)

Williams (1981) claims that argument structure of a lexical item may be affected by two rules, "Externalization" and "Internalization", which are formulated as follows:

(3.7) Externalize : E(X)  
Internalize : I(X)

The notion of "Internalization" is important in the formation of one of the so-called "complex predicates" in Japanese as we will see in Section 3.2.1, and thus has direct relevance to the present thesis. The definition of I(X) is given below:

-----  
7. The formal definition of these two types of theta-role assignment is given in Chomsky (1981, p.38) as follows:

$$\begin{array}{l} [\dots \alpha \dots \beta \dots] \\ \gamma \\ [\dots \beta \dots \alpha \dots] \\ \gamma \end{array}$$

When  $\gamma$  is a first level projection of  $\alpha$  (i.e. when  $\gamma = \alpha'$ ), then  $\alpha$  directly theta-marks  $\beta$ . On the other hand, if  $\beta$  is the subject of  $\alpha$ , then the lexical head of  $\alpha$  indirectly theta-marks  $\beta$ .

(3.8) Internalize X

- I(X): (a) Set the external argument of the  
input word "equal to" X in the  
output word;  
(b) Add a new external argument, A  
for verbs, R for nouns.

(Williams 1981, p.99)

One example of "Internalization of Theme", I(Th), given by Williams is associated with sase suffixation, a process which creates causative verbs from simple verbs in Japanese. The modifications in the argument structure in the derivation of V-sase from a simple intransitive verb is shown below:

(3.9) I(Th): V (A) ----> V-sase (A, Th=A)

In (3.9), the Theme of V-sase is a new argument, and is set to be "equal to" the Agent of V. Since V-sase is a verb, the external argument Agent is added. When I(Th) applies to a sentence, for instance (3.10a), we get a causative sentence like (3.10b).

- (3.10) a. Bill-ga aruk-u.  
          -nom walk-pres.  
          "Bill walks."  
      b. John-ga Bill-o aruk-ase-ru.  
          -nom -acc walk-cause-pres  
          "John makes Bill walk."

A detailed explanation and some proposed modification of this rule, as well as its consequences for the comprehension disturbance found in Japanese aphasics, will be discussed in Chapter 4.

### 3.1.2 Case Theory

Case theory is one of the central notions in the framework adopted here; it is one of the most crucial notions for the present thesis. It is assumed that (abstract) Case is assigned to NPs in certain syntactic positions. One of the positions in which an NP can receive Case is when it is governed by a verb or preposition. One definition of government is proposed by Aoun and Sportiche (1983):

#### Government

a governs b iff

(i) a is an  $x^0$ , b =  $y^n$

and

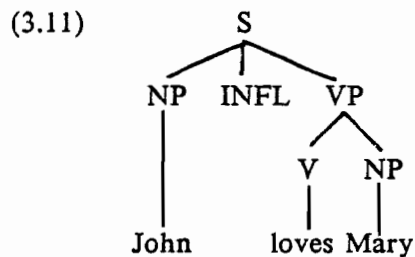
(ii) a c-commands b and b c-commands a.

The term c-command is defined by Aoun and Sportiche as follows:

#### C-command

X c-commands Y iff every maximal projection that dominates X also dominates Y.

Thus, in the following sentence the noun Mary receives Case from the verb which governs it.



The subject of the above sentence, John, must also be Case-marked. It is assumed that the subject NP of a sentence is governed and assigned Case by INFL in English (Chomsky 1981, p.52)

Syntactic representations are assumed to be subject to the Case Filter, which requires an NP to be marked for Case.

Case Filter

\*NP, if NP has phonetic content and  
has no Case.  
(Chomsky 1981, p.49)

The Case Filter is appealed to in order to account for the structural relationship between active and passive sentences. While the active form of a verb can assign Case to its governed complement, the passive form cannot. Thus in the following example, the object Mary is not Case-marked, since the verb's passive morphology absorbs the Case which would have been assigned to the NP.

(3.12) [ ] was [loved Mary] [by John]  
NP INFL VP PP

Thus, (3.12) violates the Case Filter; however, if Mary is moved to the subject position it will be Case-marked by INFL, and the resulting representation will be grammatical.

While the Case Filter is a principle which is a part of the grammars of all languages, the way in which Case is assigned may vary from language to language. In non-case-marking languages such as English, Case is assigned structurally to certain positions in the sentence. In case-marking languages such as Japanese, the notion of (abstract) Case and the system of Case-assignment might be confounded by the presence of overt case-markers. It is possible that certain overt case-markers may play a role in the (abstract) Case theory. We will explore this point in the next chapter.

### 3.1.3 Other Aspects of the Theory

In addition to the subtheories discussed above, several other important features must be mentioned. One of them is the notion of subcategorization. The strict subcategorization frame of a lexical item specifies the complements of that lexical item. For instance, the verb give takes an NP and a PP complement, which would be represented in a strict subcategorization frame such as the following:

(3.13) give: [+\_\_\_\_\_ NP PP]

The condition for strict subcategorization is that the head of a phrase must govern the complements for which it is subcategorized.

Another type of restriction which a lexical item may impose on the properties of its complements is semantic in nature; these are referred to by Chomsky (1965) as selectional restrictions. Although strict subcategorization must meet the requirements of government, selectional restrictions do not have to do so. Thus, a verb may impose selectional restrictions not only on constituents which it governs but also on its subject NP. For instance, the verb swim requires a [+animate] subject, as is shown in (3.14) and (3.15):

(3.14) John swims.

(3.15) \* The tree swims.

On the basis of these notions of linguistic theory, the Japanese language will be analyzed in greater detail in the following section.

### 3.2 An Analysis of the Japanese Language

Japanese is an S-O-V language. The grammatical functions of NPs are indicated by case-markers (e.g. nominative, accusative), postpositions, and the topic-marker wa. Neither NPs nor verbs are marked for gender, person or number; thus, there is no subject-verb agreement. There are no determiners and no relative pronouns.

Until a few years ago, Japanese was assumed to be a non-configurational language since NPs are ordered relatively freely within the sentence. There is, however, a growing body of evidence arguing against this claim (e.g. Kuroda 1983, Saito 1982, 1983a, 1983b, 1985, Hoji 1985, Whitman 1982).<sup>8</sup> In the present thesis, it is assumed that Japanese is a configurational language, and that the phrase structure rules for Japanese are as follows:

- (3.16) S --> NP VP INFL  
           VP --> NP V  
           (Subject - Object - Verb - INFL)

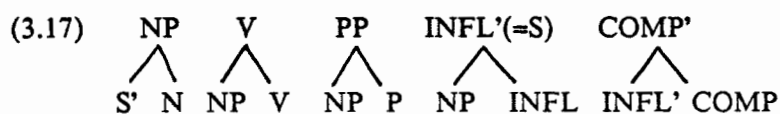
Furthermore, it is assumed that in the unmarked case all lexical categories have the same complement structure, and that all complements occur in the same position with respect to -----

8. One of the pieces of evidence in favour of configurationality comes from an analysis based on Binding Theory. The following sentences are taken from Saito (1983a, p.80).

- (i) a. John-no sensei-ga kare-o syookai-sita.  
           i                                  i  
           -gen teacher-nom he-acc introduced  
           "John's teacher introduced him (to the audience)."  
       b. \*Kare-ga John-no sensei-o syookai-sita.  
           i                                  i  
           -nom -gen -acc introduced  
           "He introduced John's teacher (to the audience)."

In (ia) the pronoun kare is free and can be coreferential with John, whereas in (ib) Kare and John must have disjoint reference. According to a condition on Binding Theory, R-expressions must be free. In other words, a referential expression cannot be c-commanded by a co-referential NP. Sentence (ib) is ruled out because John is c-commanded by a co-referential NP, in this case kare, in the subject position. In (ia) kare is in the object position and its antecedent can be John, which is embedded in the subject position. If kare and sensei are sisters, that is, if the structure is "flat", then kare must c-command John and (ia) should be ruled out. The grammaticality of (ia) suggests that there must be a VP-node in this sentence at the grammatical level at which Binding Theory applies.

their heads. Japanese is a head-final language in that complements precede their heads, as shown in (3.17).<sup>9</sup>

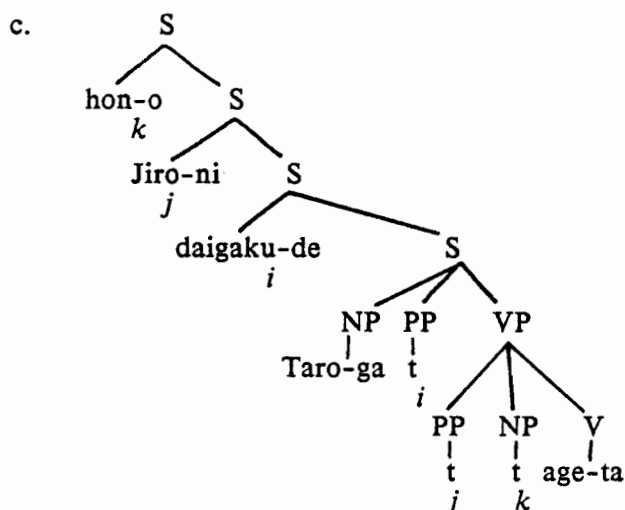


An explanation for the relatively free order of NPs in Japanese is given by Saito (1985), who proposes that a "scrambled" NP is moved to the sentence-initial position and attached to the S-node by Chomsky adjunction. Adjunction to the S-node is permitted to any number of NPs. Thus, sentence (3.18b), which is a scrambled version of (3.18a), has roughly the internal structure shown in (3.18c).

-----  
 9. Calling S INFL' simply makes transparent the fact that INFL is the head of S. Calling S' COMP' also shows that COMP is the head of S'. See Chomsky (1986).



- (3.18) a. Taro-ga daigaku-de Jiro-ni hon-o ageta.  
           -nom university-at   -dat book-acc gave  
           "Taro gave a book to Jiro at the university."  
       b. Hon-o Jiro-ni daigaku-de Taro-ga ageta.  
           book-acc   -dat university-at   -nom gave.  
           "Taro gave a book to Jiro at the university."



### 3.2.1 Thematic Relations and Argument Structure

The theory of thematic relations and argument structure (theta theory) plays an important role in the present study of sentence comprehension in Japanese. When we refer to knowledge of Japanese, it implies knowledge of the fact that a given verb is a one-, two- or three-place predicate. For instance, verbs such as oyog-u "swim", yom-u "read", and age-ru "give", which are one-, two-, and three-place predicates respectively, assign one, two and three thematic roles respectively. These thematic roles (theta-roles) are usually referred to as Agent, Theme, Goal, Source, Location, and so on.

Thus, an intransitive verb like oyog-u "swim" takes an NP which carries the thematic role of Agent. A transitive verb like yom-u "read" takes one NP with the Agent

theta-role and one with the Theme theta-role. Verbs like age-ru "give" take three NPs, carrying the Agent, Theme, and Goal theta-roles, respectively.

As was explained earlier, these properties of predicates are sometimes called argument structures and are expressed in the formal notation shown in (3.17).

	<u>Types of Predicate</u>	<u>Example</u>
(3.19)	One-place predicate	oyog-u: ( <u>Agent</u> )
	Two-place predicate	yom-u: ( <u>Agent</u> , Theme)
	Three-place predicate	age-ru: ( <u>Agent</u> , Theme, Goal)

According to Williams (1981), there are two kinds of arguments, external arguments and internal arguments. All lexically specified arguments with the exception of that assigned to the subject are internal. The subject position contains external argument which is distinguished notationally by means of underlining, as shown in (3.19). Thus, for a verb like yom- "read" Agent is an external argument and Theme an internal argument.

In Japanese, there are other types of predicates, the so-called "complex predicates". One such predicate appears in causative sentences, as shown in (3.20).

- (3.20) a. Hanako-ga kono hon-o yom-da  
           -nom this book-acc read-past  
           "Hanako read this book."  
       b. Taro-ga Hanako-ni kono hon-o yom-ase-ta.  
           -nom       -dat this book-acc read-cause-past  
           "Taro made Hanako read this book."

In sentence (3.20b) the causative morpheme -(s)ase- appears on the main verb yom-; in the non-causative form in (3.20a), the predicate is simply a transitive verb.

Adapting Williams' theory of argument structure, Inoue (1985) proposes that the causative morpheme -(s)ase- carries the theta grid of external Agent and internal Theme, as shown in (3.21).

- (3.21) -(s)ase-: (Agent, Theme)

When sase attaches to the main verb yom- in (3.20), the sentence is causativized and the morphological operation known as "Internalization of Theme" takes place.<sup>10</sup>

(3.22) yom-: (Agent, Theme) ----->  
                   yom-ase- (Agent, Theme=Agent, 0=Theme)

As shown in (3.22), the external Agent argument in yom- is internalized and becomes the Theme in yom-ase, as the notation "Theme=Agent" indicates. This means that Hanako, which had the theta-role of Agent in (3.20a), has the Theme theta-role in (3.20b). Kono hon has the same theta-role in (3.20a) and (3.20b); thus it has the theta-role of Theme in (3.20b). In addition, an external Agent argument is introduced. This argument corresponds to the subject NP Taro in (3.20b).

It is important to note that the morphological operation in (3.22) changes not only the thematic roles of nouns but also the case-markers attached to them. Thus, the case-marker ga attached to the subject NP Hanako in (3.20a) is changed to the case-marker ni in (3.20b). This fact is quite significant for the present study of sentence comprehension in Japanese aphasics. We will discuss this point further in the following section.

Regardless of the predicate type, thematic roles are assigned to nominal expressions, e.g. nouns, by heads of phrases, e.g. verbs and postpositions in Japanese. The distinction between the two types of expressions is usually referred to as a distinction between theta-role assignees and theta-role assigners. Consider, for example, the following sentence.

-----  
 10. The analysis presented in (3.20) is Inoue's version of "Internalization of Theme", which is a slightly modified version of the analysis proposed by Williams (1981). Inoue's analysis is better in that, in the argument structure of yom-ase, the internalized Theme is demoted, as the notation "0=Theme" indicates. As a result, the representation at the surface level, i.e. as presented to the left of each equals sign, does not violate the Theta Criterion. A sentence like (3.20b) still has two Theme arguments, i.e. Hanako and kono hon, because the formulation in (3.22) denotes two Themes at different levels. Williams' formulation, on the other hand, has two Themes at the same level, i.e. (Agent, Theme=Agent, Theme), which does violate the Theta Criterion. (For the formal rule of "Internalization", see Williams (1981, p.99).)

- (3.23) Taro-ga gakko-de Hanako-ni zibun-no hon-o age-ta.  
 -nom school-loc -dat self-gen book-acc give-past  
 "Taro gave his book to Hanako at school."

The nominal expressions, i.e. Taro, gakko, Hanako, and zibun-no hon, receive the thematic roles of Agent, Location, Goal, and Theme respectively, from the verb phrase, the postposition de, the dative case-marker ni, and the verb respectively. Since Japanese is a head-final language, theta-roles are invariably assigned to the left.

### 3.2.2 Case Theory

In non-case-inflecting languages such as English, (abstract) Case is assigned to the particular contexts or positions in which a lexical NP may appear. On the other hand, in case-inflecting languages such as Japanese, the term "case" can refer to two different phenomena, i.e. "surface" case and "abstract" Case.<sup>11</sup>

In Japanese, there is a large number of particles, i.e. case-markers and postpositions. The following particles are the main ones used to mark the various surface cases.

- (3.24) wa : topic  
 ga : nominative  
 o : accusative  
 ni : dative, agent of passive, locative  
 no : genitive  
 de : locative: "at", "in",  
 instrumental: "with"  
 to : "and", "with"  
 e : "to"  
 kara : "from"

-----  
 11. In the thesis, I will use the term "Case" to denote abstract Case and "case" for surface cases which are indicated by case-markers.

The basic abstract Case-assigning system which we will adopt here is that proposed by Saito (1982), and can be summarized as follows:

- (3.25) a. Nominative Case marks "focus" and subject ([NP,S]).  
 Unlike English, nominative Case is not assigned by INFL. It is freely base-generated to the maximal projection of [-V] categories in [NP, S] position.
- b. Accusative Case is assigned by a verb to its object.
- c. Oblique Case is assigned by a postposition.

(Saito 1982, p.25)

This Case-assigning mechanism succeeds in clearing up the confusion between "surface" case and "abstract" Case by proposing a uniform treatment of all case phenomena. For instance, in his treatment of the particle ni, which is known as the "dative marker", as the "agent marker" in passive sentences, and as the "locative marker" required by certain types of verbs, Saito proposes that ni is a postposition that governs an argument of a verb that cannot be lexically expressed as the subject or object (Saito 1982, p.86). Consider the sentences in (3.26).

- (3.26) a. John-ga Mary-o nagur-ta.  
           -nom     -acc hit -past  
           "John hit Mary"
- b. Mary-ga John-ni nagur-are-ta.  
           -nom     -by hit-passive-past  
           "Mary was hit by John"

Sentence (3.26b) is the passive form of (3.26a). In (3.26a), the object NP Mary receives Case from the verb nagur- which governs it. The subject of (3.26a) John, however, does not receive Case from INFL because there is no subject-verb agreement, i.e. no INFL, in Japanese. According to Saito's Case-assigning mechanism, nominative Case is assigned to the position of [NP,S], as stated in (3.25a). In other words, nominative Case is inherent and is not assigned by any overt element. Thus, in (3.26a) John appears in the position of [NP, S], and so automatically has Case. In the case of a passive sentence such as (3.26b), since the

Saito's Case-assigning mechanism has several important implications for the overt case-marking system, especially for case-marking involving the nominative marker ga and the accusative marker o. First, with respect to accusative o-marking, Saito claims that objective Case is assigned by the verb to its object. This claim is based on the observation of "case-drop phenomena" in Japanese. There are actually two instances of postposition drop. One drops topic marker wa and the other drops accusative case-marker o. In some cases, this could lead to an ambiguous structure.

- Taro in (3.27) above could be underlyingly either Taro-wa or Taro-o. In order to abstract away from topic marker drop, we can use *wh*-words since *wh*-words can never be topic as shown below.

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- (3.29) a. Dare-ga kita no?  
           who-nom came Q  
           "Who came?"  
       b. \*Dare-wa kita no?  
           -top  
       c. \*Dare     kita no?
- (3.30) a. nani-o yonderu no?  
           what-acc reading Q  
           "What are you reading?"  
       b. \*nani-wa yonderu no?  
           -top  
       c. nani     yonderu no?  
           (Saito 1983b, p.252)

As shown in (3.30a), a wh-phrase may appear as the object of a sentence, but not as the topic (cf. (3.30b)). Nevertheless, (3.30c) is perfectly grammatical. The contrast between (3.29c) and (3.30c) suggests that ga is obligatory whereas o is optional in certain contexts.

In what contexts it is optional, and how accusative o-marking is affected by the Case Filter is unclear at the moment. However, the optionality of o suggests that it may not have a Case-assigning function.

The second point concerns nominative ga case-marking. Saito claims, as indicated in (3.25), that abstract Case is inherent in the position of [NP,S], the subject and focus position<sup>12</sup>; therefore it need not be assigned by an external Case-assigner such as INFL. Furthermore, Saito (1983b) states that

-----  
 12. According to Saito (1982), the focus position has the same status as the subject position in the phrase structure, [NP,S]. So-called "double-subject" sentences like (i) can be explained as focus constructions.

- (i) a. Masako-ga tookei-ga wakaru.  
           -nom statistics-nom know  
           "Masako knows statistics."  
       b. [ Masako-ga [ tookei-ga wakaru ]  
           S               S

In (ia), whose structure is as shown in (ib), Masako is in the focus position and tookei is in the subject position. It is important to note that both Masako and tookei, which both appear in the inherently Case-assigned position of [NP, S], are marked with ga.

...no abstract Case is assigned to the subject position. Thus, if the subject NP appears without the nominative Case marker, the structure is straightforwardly ruled out by the Case Filter.<sup>13</sup>

(Saito 1983b, p.252; emphasis mine)

Consider the following sentences.

- (3.31) a. Taro tuini ano hon-(o) katta yo.  
           finally that book-acc bought  
           "Taro finally bought that book."  
       b. Taro-wa imooto-\*(ga) buzi ie-ni kaette  
           -top sister-\*(nom) safely home-to come back  
           ansin-sita.  
           relieved  
           "Taro was relieved that his sister came home  
           safely."

In sentence (3.31a) the bare NP Taro can be justified as a topic, and the sentence is acceptable. In (3.31b), however, when the bare NP imooto appears in the subject position of the embedded clause, the sentence is not acceptable. The unacceptability of (3.31b) is due to the fact that the subject NP imooto does not have the nominative case-marker ga. This fact suggests that, unlike the accusative marker o, the nominative case-marker is obligatory in all contexts.

The obligatory versus optional distinction between the nominative and accusative case-markers has important implications for the relationship between abstract Case and the role of overt case-markers.<sup>14</sup>

13. When Saito designates the nominative case-marker ga as a "nominative Case marker", I am not sure whether he means that ga is actually a Case-assigner or not. He does not go into detail about the status of ga with respect to abstract Case theory.

14. Although I assume Saito's analysis of Case theory in this thesis, the relationship between the abstract Case-assigning mechanism, i.e. Case theory, and the surface case-marking system has not yet been clarified in Japanese. There has been no consensus as to what the mechanism of surface case-assignment is, and in particular, as to the way the nominative case-marker ga is assigned. Saito assumes that it is assigned structurally in the position of [NP, S]. Kuroda (1978, 1980) assumes that it is assigned by a linear linking system, i.e. non-configurationally, while Inoue (1985) proposes that ga is a default case-marker realized when there is no positive case-assignment.



Saito claims that abstract Case is not assigned by any element, but he also states that the appearance of ga is obligatory, i.e. that a bare subject NP violates the Case Filter. This statement seems to be somewhat contradictory. If nominative Case is inherent and freely base-generated in the subject position, then the lexical NP which fills this position automatically gets Case. If this NP has Case because of being in that position, then it should not violate the Case Filter, whether ga is attached to it or not. The appearance of ga seems somewhat redundant unless it has an important function in the sentence. The facts, however, indicate that if ga does not appear with the NP in subject position, the sentence is ungrammatical.

This observation has led me to speculate that the case-marker ga must play a role in abstract Case theory. That is, it would not be unreasonable to speculate that what assigns nominative Case is, in fact, the nominative case-marker. In other words, abstract Case may not be inherent to the position of [NP, S]. Since the nominative case-marker ga obligatorily appears in the position [NP, S], the NP appearing in that position will get Case independently of the way in which it is case-marked, possibly being marked at D-structure. Thus, I tentatively hypothesize that nominative Case is assigned, and thus the NP is licensed, by the nominative marker ga in the position of [NP, S]. In other words, the surface case-marker ga plays a role in abstract Case-assignment, perhaps actually as a Case-assigner.<sup>15</sup>

-----  
 15. There are three possible ways to account for the obligatory appearance of ga in the subject position. First, it could be a Case-assigner, that is, ga actually assigns Case to the NP marked by it. Second, it could be a realization of Case, i.e. once Case is assigned to the position of [NP, S], it must be realized somehow. Third, ga might be redundant. I suspect that what Saito intended was the second hypothesis, i.e. ga as an overt realization of the abstract Case inherent in the position of [NP, S]. Although for the purpose of psycholinguistic experiments I will assume the first hypothesis in this thesis, our basic assumption that ga is involved in abstract Case-assignment whereas o is not holds true for both hypotheses. The results obtained in the experiments reported in the following chapters do not depend on whether the first or the second hypothesis is correct. Instead, interestingly enough, the results obtained in this thesis indirectly support Saito's structural treatment of the case-assigning system and analysis of Case theory. In any case, what is important is that ga is treated differently from o, whatever its status in the Case theory, and that this difference is reflected in the process of sentence comprehension by aphasics. The different effects of ga and o on aphasics' sentence comprehension reported in Chapter 6 are rather difficult to account for if one assumes the non-configurational analysis of Japanese.

(3.32)    a. Hanako-o Masao-ga Taro-ni syookai-sita (no itsu?)  
               -acc      -nom      -to introduced (comp when)  
             b. \*Hanako Masao-ga Taro-ni syookai-sita (no itsu?)  
                 "When was it that) Masao introduced Hanako to Taro?"

(Kuroda 1986, p.15)

Kuroda (1986) suggests two possibilities. The first is that Case-assignment is optional in languages like Japanese where there are no agreement phenomena (in Kuroda's words, "Agreement is not forced" p.68). Case theory does not exert its full effects, so the surface sentence form is not subject to the Case Filter. If this is the case, the Case Filter is no longer valid, which would be undesirable for the theory.

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general theory of case-marking. Specifically, we need to know which case-markers are Case-assigners and which are not. This question, unfortunately, is not developed by Kuroda (1986). In order to identify Case-assigning and non-Case-assigning case-markers in Japanese, we need more empirical data from normal subjects.

At this point, however, we will pursue a different mode of inquiry, and will examine empirical data from a different source, namely the language of aphasic patients. I hypothesize, based on the sentences discussed above, that the nominative case-marker ga has a Case-assigning function whereas accusative case-marker o is not involved in Case theory. In other words, my claim is that ga is a Case-assigning case-marker while o is a non-Case-assigning case-marker. I will explore the implications of this hypothesis for psycholinguistic experiments in the next section; the results will be reported in Section 6.1.

Before ending this discussion of Case theory and case-markers, I must point out one more characteristic of case-markers. In Japanese, both the nominative case-marker ga and the accusative case-marker o must obligatorily be deleted in certain contexts. We will call this operation the "ga/o deletion" rule.

There are at least two contexts in which this deletion occurs: pseudo-cleft sentences and sentences containing adverbial particles. Consider the following sentences.

- (3.33) a. Taro-ga Hanako-ni hon-o age-ta.  
           -nom       -dat    -acc gave  
           "Taro gave a book to Hanako."  
       b. Hanako-ni hon-o age-ta-nowa Taro-\*ga-da.  
           -dat   -acc gave                    -\*nom-copula  
           "The person who gave a book to Hanako is Taro."  
       c. Taro-ga Hanako-ni age-ta-nowa hon-\*o-da.  
   -\*acc-copula  
           "The thing that Taro gave to Hanako is a book."  
       d. Taro-ga hon-o age-ta-nowa Hanako-ni-da.  
           -nom   -acc                           -dat-copula  
           "The person who Taro gave a book to is Hanako."

Sentences (3.33b) to (3.33d) are clefted versions of (3.33a). In (3.33b) and (3.33c), where subject and object respectively are clefted, ga and o respectively must be deleted before the sentence-final copula, da. On the other hand, in (3.33d), where the indirect object is clefted, the dative marker ni remains attached to the clefted NP and no deletion takes place.

Another context in which "ga/o deletion" occurs is when these case-markers are followed by adverbial or focus particles, such as mo "also", dake "only" and demo "even", as shown in (3.34).

- (3.34) a. Tomodati-no naka-de-wa Yoko-\*ga-dake genki-da.  
           friends-gen among-top                    -\*nom only cheerful-cop  
           "Among my friends, only Yoko is cheerful."  
       b. Masao-wa gengogaku-\*o-mo sitte-iru.  
           -top linguistics-\*acc-even know-pres  
           "Masao knows even linguistics."  
       c. Makoto-wa Akiko-ni-dake hana-o age-ta.  
           -top                   -dat only flower-acc gave  
           "Makoto gave flowers only to Akiko."

Sentences (3.34a) and (3.34b) are ill-formed if ga and o are not deleted before the adverbial particles dake and mo. In the case of the dative marker ni, however, no such deletion is necessary, as shown in (3.34c). We will assume that this deletion is performed at PF by an obligatory stylistic deletion rule.

To summarize this chapter: because of the existence of case-markers as well as S-O-V word order, data from a study of Japanese aphasics will not only characterize comprehension disturbances in these patients, but also provide important information for a universal theory of sentence processing, and will indirectly shed light on the sentence interpretation mechanism in natural language in general.

## **Chapter 4**

### **Hypotheses and Methodology**

#### **4.1 Hypotheses**

The present study of sentence comprehension in Japanese aphasics comprises two parts. The first part will focus on the role of word order with respect to the assignment of thematic relations and determine how this is reflected in the process of sentence interpretation by aphasics. The second part is devoted to the role of case-markers and postpositions in determining deficits involving closed class items in sentence comprehension tasks and grammaticality judgement tasks.

##### **4.1.1 The Role of Word Order**

As was mentioned in Chapter 3, English aphasics find the sequence N-V-N the easiest to interpret because it can be mapped quite regularly onto the role sequence Actor-Action-Theme, whereas the sequence N-N-V is the most difficult to interpret. In other words, English aphasics have trouble understanding object-cleft sentences and subject-object (SO) relatives, while finding active, subject-cleft sentences and object-subject (OS) relatives easy to understand. The former sentence-types have the order NNV whereas the latter are in

the canonical English NVN order. In Japanese the canonical word order is SOV, i.e. there are two preverbal nouns (N-N-V); we may thus see whether the ease of processing sentences is constrained by the word order of Japanese. In other words, we can discover whether the ease of sentence interpretation by aphasics is determined by language-universal markedness factors, perhaps ultimately epistemologically determined, which favor the SVO structure, or by a language-specific word order.

One testable hypothesis concerning simple sentences is:

- (H1) Sentences in the canonical word order of a language are the easiest to process for all speakers of that language, including aphasics.

The sentence types which could be used to test (H1) are as follows:

- (4.1) Taro-ga Hanako-o os-i-ta. (NNV)  
           -nom       -acc   push-past  
       "Taro pushed Hanako."  
 (4.2) Taro-ga os-i-ta-nowa Hanako-da. (NVN)  
           -nom push-past-top       -copula  
       "The person who Taro pushed is Hanako."  
 (4.3) Taro-ga os-i-ta Hanako-o. (NVN)  
           -nom push-past       -acc  
       "Taro pushed Hanako."

Hypothesis (H1) has several consequences. First of all, if sentences (4.2) and (4.3) are easier to process for Japanese aphasics than sentence (4.1), it would indicate that the aphasics' sentence-processing mechanism is operating on a language-universal basis. In other words, sentences with SVO order would be easier to process than those with the canonical Japanese SOV order.

If this is the case, it could be said that regardless of the word order of their native language, aphasics ultimately prefer the SVO order for interpreting sentences, and that this sequence is the unmarked form for sentence interpretation.

There is some evidence showing that Japanese aphasics do prefer NVN order to the canonical NNV order. Fujita, Miyake, Takahashi, Sakai, and Akitake (1977) tested strategies for comprehension of simple sentences with varying word orders in 27 aphasic patients. The types of sentences used comprised canonical NNV sentences like (4.1), non-canonical NVN sentences of the type presented in (4.3), and sentences with the order VNN, where the first NP is always marked with the nominative case-marker. The results were analyzed according to the percentage of correct responses. Some of the results, namely those for active and passive sentences varying according to the order of subject and object, are presented in Table 4.1.

Table 4.1 shows that the sequence NVN is slightly easier to process than the canonical NNV sequence in both active and passive sentences. Although the tendency towards a preference of NVN over NNV is small, this result suggests the possibility of the existence of a language-universal sentence comprehension mechanism based on word order. However, since the difference in the percentages of correct responses is so small, a replication of their study is clearly necessary.<sup>16</sup>

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16. A more detailed description of their experiments and some criticisms of their study will be presented in Chapter 5, where their findings will also be compared to the results obtained in the present study.



Table 4.1

Percentage of Correct Responses for  
Sentences with Different Word Orders,  
from Fujita et al.'s (1977) Study.

	NNV	NVN	VNN
Active	72.8%	79%	70.9%
Passive	62.3%	66%	66%

There are two types of NVN construction in Japanese: pseudo-cleft constructions and right-dislocation constructions, presented above in (4.2) and (4.3) respectively. Sentences (4.1) to (4.3) have the same grammatical relations and the same thematic roles, i.e. Taro is the subject and receives the thematic role of Agent, while Hanako is the object and has the thematic role of Theme. The difference between (4.2) and (4.3) is that the structure of (4.2), the pseudo-cleft sentence, is affected by the "focus" and "presupposition". In pseudo-cleft structures, the element preceding nowa, i.e. Taro-ga os-i-ta in (4.2), is usually called the "presupposition", and the one preceding the copula da, i.e. Hanako, the "focus".<sup>17</sup> On the other hand, right-dislocation constructions such as (4.3) do not carry such information.<sup>18</sup>

In this thesis, pseudo-cleft sentences like (4.2) and right-dislocation sentences like (4.3) will be compared to simple active sentences like (4.1) in Experiment 1, which is described in Section 5.1.

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17. The pseudo-cleft construction in Japanese has roughly the following structure:

$$\left[ \begin{array}{c} \text{S'} \\ \text{S} \end{array} \left[ \begin{array}{c} \text{X} \\ \text{ } \end{array} \left\{ \begin{array}{c} \text{ga} \\ \text{o} \end{array} \right\} \text{V} \right] \text{-nowa Y da} \right]$$

It is generally constructed from the corresponding non-cleft sentence by placing an NP (Y above) before the copula da, and adding nowa after the original sentence. The position before da is usually called the focus position, thus Y represents the "focus", while the remainder of the sentence represents the "presupposition". Although there are different analyses proposed for Japanese pseudo-cleft sentences, how they should be described in Japanese linguistic theory is not relevant to the present discussion. For analyses of Japanese cleft sentences, see Inoue (1978) and Watanabe (1979).

18. The element following the verb in such sentences, e.g. Hanako-o in (4.3), is a phrase from the previous sentence repeated. This type of sentence is sometimes called the right-dislocation construction, in spite of the fact that there is a consensus among Japanese linguists that they are not, in fact, derived by right-dislocation. How such sentences should be described in Japanese linguistic theory is not, however, relevant to the present discussion. What is important to this study is that sentences of this kind occur quite often in colloquial conversational speech, and that they are perfectly acceptable to normals. For the sake of convenience, nonetheless, we will continue to refer to this type of sentence as a right-dislocation construction. For some analyses of this kind of sentence, see Haraguchi (1973), Inoue (1978), Kuno (1978), Kuroda (1980), and Saito (1985).

#### 4.1.2 The Role of Case-Markers and Postpositions

The second part of the experimental portion of this thesis is devoted to the status of the closed class vocabulary in Japanese. Case-markers such as ga (nominative case-marker), o (accusative case-marker), ni (dative case-marker), and postpositions such as ni and de (both locatives) can be considered closed class items.

It is a well-known fact that some English aphasic patients have trouble understanding passive sentences (Schwartz et al. 1980, Caplan, Baker and Dehaut 1985, Grodzinsky 1984). One possible explanation of this fact is that they may not be able to detect the passive morphology, i.e. be, the inflectional morpheme -ed, and the preposition by, all of which are closed class items. Aphasics who have trouble with passives sometimes interpret sentences like (4.5) as if they were active sentences like (4.4), assigning the Agent theta-role to the first NP and the Theme theta-role to the second NP.

(4.4) John hit Mary.

(4.5) John was hit by Mary.

A similar misassignment of thematic roles to nouns by Japanese aphasics could occur in active sentences where the order of Subject and Object is reversed. Consider the following sentences:

(4.6) Taro-ga Hanako-o os-i-ta (SOV)  
      -nom       -acc   push-past  
      "Taro pushed Hanako."

(4.7) Taro-o Hanako-ga os-i-ta (OSV)  
      -acc       -nom   push-past  
      "Hanako pushed Taro."

In a sentence with the canonical order SOV, like (4.6), the first NP, i.e. Taro, which bears the nominative case-marker ga, is the Agent and the second NP, i.e. Hanako, which has the accusative case-marker o, is the Theme. In a sentence with the non-canonical order OSV, such as (4.7), the first NP Taro is the Theme because of the accusative case-marker attached to it, and the second NP Hanako is the Agent because it is marked by the nominative case-marker. The only difference between (4.6) and (4.7) is in the order of the case-markers, i.e. ga-o in (4.6) and o-ga in (4.7). If Japanese aphasics cannot detect these case-markers correctly, they may interpret OSV sentences as if they were SOV sentences. In other words, the correct assignment of thematic roles to nouns in Japanese sentences is dependent solely on the speaker's ability to detect case-markers such as ga and o.<sup>4</sup>

There is some evidence which shows that this is actually the case in sentence comprehension by Japanese aphasics. Fujita et al. (1977) tested the above two types of sentences, i.e. sentences with SOV order as in (4.6), and sentences with OSV order as in (4.7). Six sentences of each sentence type were presented to 27 aphasic patients in object manipulation tasks. The results were analyzed according to the percentage of correct responses, as shown in Table 4.2.

As Table 4.2 shows, sentences with SOV order are easier to comprehend than those with the non-canonical OSV order.

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4. It is assumed in this thesis that (4.6) and (4.7) have the structures shown below:

- (4.6)' [ Taro-ga [ Hanako-o os-i-ta]]  
           S          VP  
 (4.7)' [ Hanako-o [ Taro-ga [ t os-i-ta]]]  
           S      i      S          VP i

Assuming Saito's (1985) analysis, the OSV order in Japanese derives from the SOV order by movement of the object to the sentence-initial position.

Table 4. 2

Percentage of Correct Responses for  
Sentences with SOV and OSV Orders,  
from Fujita et al.'s (1977) Study

Sentence Type	Score	Percentage of correct responses
SOV (N-ga N-o V)	118/162	72.8%
OSV (N-o N-ga V)	86/162	53.1%

Given that case-markers and postpositions play an important role in sentence comprehension in Japanese aphasics, the next question we should investigate is whether all types of case-markers are equally important for comprehension. We know, for instance, that sentence (4.7) is more difficult for aphasics to interpret than sentence (4.6). Is it because 1) aphasics cannot detect the accusative case-marker o attached to the first NP, or 2) they cannot detect the nominative case-marker ga assigned to the second NP, or 3) neither ga nor o is available to them?

To put it differently, do aphasics have a different degree of sensitivity to the nominative and accusative case-markers in sentence comprehension tasks? If it is, in fact, the case that they are able to detect one case-marker but not others, what does this difference stem from?

At this point, one is reminded that, as was shown in the previous section, there is a "case-marker drop phenomenon" in modern Japanese colloquial speech. That is, in the normal grammar of Japanese, the nominative case-marker ga is obligatory whereas the accusative case-marker o is optional and may be deleted. I tentatively hypothesized that ga has a Case-assigning function whereas o does not.

We can now amalgamate this theoretical question about the nature of case-markers and the question concerning aphasics' ability to detect case-markers during sentence comprehension. The following hypothesis (H2) can be formulated.

- (H2) Case-markers which have a Case-assigning function tend to be utilized by aphasics during sentence interpretation.<sup>20</sup>

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20. A similar type of explanation for syntactic deficits in the speech output of English aphasics is proposed by Rizzi (1985) and Travis (1983). Based on the observation of English aphasics, Rizzi (1985) suggested that the elements which are most likely to be integrated into linguistic representations by Broca's aphasics are those which fall within the scope of Theta theory, i.e. elements which are either theta-role assigners or assignees. Travis (1983) examined the speech of Hebrew, Italian and Russian aphasics and proposed that the direction of Case and theta-role assignment, which determines the word order of a language, is retained in aphasia. It seems to be the case, however, that syntactic deficits in production and comprehension are quite different in nature. Since the relationship between

Given hypothesis (H2), our prediction concerning aphasics' performance on sentence interpretation would be:

- (P1) The nominative case-marker ga will be utilized better than the accusative case-marker o.

If (P1) is correct, then we would also expect prediction (P2) to be true.

- (P2) Sentences containing nominative case-markers are better comprehended than those without them, while the existence of accusative case-markers does not influence comprehension.

As an experimental condition, hypothesis (H2) can be tested by using sentences in which either ga or o is deleted. Thus, in the object manipulation task, sentences such as (4.8a), (4.8b) and (4.8c) can be used.

- (4.8) a. Taro-ga Hanako-o os-i-ta.  
          -nom       -acc push-past  
      b. Taro-ga Hanako- os-i-ta.  
          -nom  
      c. Taro- Hanako-o os-i-ta.  
                  -acc  
          "Taro pushed Hanako."

It is predicted that there would be no difference in performance between (4.8a) and (4.8b), even though the accusative case-marker o is deleted in (4.8b). Patients should comprehend (4.8a) and (4.8b) equally well, because both sentences contain the nominative case-marker ga. Since the accusative case-marker does not have a Case-assigning function, we expect that its appearance will not influence patients' performance on comprehension tasks. On the other hand, we expect that patients would perform better on (4.8a) and (4.8b) than on (4.8c). This

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agrammatic speech output and the disturbance of syntactic form in aphasics' comprehension is far from clear at the present stage of aphasiological research, we will put this hypothesis aside, pursuing the possibility that there is a distinction between Case-assigner and non-Case-assigner in sentence comprehension.

is because in (4.8c) the Case-assigning nominative marker is missing, which would create problems in understanding the sentence. It should be noted that in (4.8c) the bare NP Taro is actually a topic NP, not the subject NP, and since the topic marker wa is optional in Japanese, the sentence (4.8c) is perfectly grammatical even though it has no subject NP. It should also be noted that the difference in the grammaticality of (3.27c) and (4.8c) is due to the fact that the bare NP in (3.27c) is a wh-phrase whereas the bare NP in (4.8c) is a lexical NP, and that the presence of a wh-phrase precludes the possibility that the NP is a topic. Hence the deleted case-marker in (4.8c) is the topic marker wa. In any case, since the nominative case-marker ga does not appear in (4.8c), we expect that aphasics will have trouble understanding the sentence.

Hypothesis (H2) can also be tested in grammaticality judgement tasks. Given (H2), we made Prediction (P1). If (P1) is correct, then we also expect Prediction (P3) to be true in grammaticality judgement tasks.

- (P3) Sentences without nominative case-markers are considered unacceptable, while sentences without accusative case-markers are judged to be acceptable.

Sentences of the types shown in (4.9) are presented to patients.

- (4.9) a. \*Kooen-de-wa syoogakusei-tati-  
Park-loc-top school children-(nom)  
gomi-hiroi-o si-te-imas-u.  
litter-picking-acc doing  
"In the park, school children are  
picking up litter."  
b. Haru-ni-wa tutuzi-ga hana-  
spring-top azalea-nom blossom-(acc)  
sak-ase-mas-u.  
bloom-cause-polite.  
"Speaking of spring, the azaleas are  
in full bloom."



In sentence (4.9a), the nominative case-marker ga is deleted, whereas in (4.9b), the accusative case-marker o is deleted. We expect aphasics to rule out sentences like (4.9a), whereas sentences like (4.9b) should be judged acceptable. In other words, aphasics and normals should have the same grammaticality judgements. A detailed description of my experimental design will be provided and the results reported in Section 6.1.

So far, we have made a number of hypotheses concerning Japanese aphasics' sentence processing mechanisms which are based on the notion that there is an "epistemological basis of concepts" in the grammar of language-impaired subjects. Let us suppose that an aphasic's grammar comprises such primitive epistemological concepts, and that only lexical information such as the syntactic labels of the major lexical categories and the syntactic features associated with these lexical items is available to aphasics. This entails that syntactic features, such as subcategorization frames and selectional restrictions, which make up part of the lexical information about predicates, should be available - at least to some extent - to patients. It would not, then, be unreasonable to hypothesize that Japanese aphasics would appreciate the distinction between lexically derived case-markers and those which are derived by non-lexical operations. The particle ni, for example, has several different meanings. Consider the following sentences.

- (4.10) a. Uti-no      niwa-ni sakura-no  
                               \*de  
                  my house-gen yard-loc cherry blossom-gen  
                  ki-ga                    ari-masu.  
                  tree-nom      exist-pres-polite  
                  "There is a flowering cherry tree in my yard."
- b. Sensei-ga      gakusei-ni suugaku-o  
                               \*ga  
                  teacher-nom   student-dat   mathematics-acc  
                  benkyoo-sase-mas-i-ta.  
                  study-causative-past.  
                  "The teacher made the student study  
                  mathematics."

In sentence (4.10a), ni is a locative case-marker and is required by the selectional restrictions of the stative verb aru "to exist". This verb obligatorily selects ni instead of de, which is also a locative case-marker. (De is selected by action verbs such as oyogu "to swim".)

Sentence (4.10b), on the other hand, is derived by causativization from gakusei-ga suugaku-o benkyoo-suru "the student studies mathematics". As was explained in the previous section, it is assumed that causativization involves the morphological operation known as "Internalization of Theme". Thus, in (4.10b), the following morphological rule has taken place.

- (4.11) benkyoo-suru (Agent, Theme) ---->  
           benkyoo-sase- (Agent, Theme=Agent, 0=Theme)<sup>21</sup>

As a result of the operation in (4.11), the thematic role of gakusei has changed from Agent to Theme. In addition to changing the thematic roles of the noun, this rule also changes the case-marker ga, which is attached to it in the non-causative sentence to o. This is because gakusei, the causee, is the object of the causative predicate benkyoo-sase; as such, it takes the accusative case-marker. At this point in the derivation, we have two NPs which are marked -----

21. The verb benkyoo suru "to study" can be intransitive as well as transitive. Thus, its argument structure might be described as (Agent, (Theme)), where the parenthesized Theme is optional. In the case of (4.10b), however, since it is used as a transitive verb, I simply show its argument structure without parentheses, as in (4.11).

with o, i.e. gakusei and suugaku. There is, however, a constraint in Japanese to the effect that causative sentences cannot contain more than one accusative NP.<sup>22</sup> In such a case, the leftmost o-phrase must be converted to a ni-phrase. Thus, in (4.10b) the first NP, sensei, is the Agent, and the second NP, gakusei, is a Theme but takes ni instead of o, and, finally, the third NP, suugaku, is another Theme and is actually marked by o.

Given this structural information, it is now clear that sentences like (4.10a) do not involve a change of thematic roles as there is no morphological operation involved. The choice of case-markers and postpositions is solely dependent on the lexical nature of the predicate. In (4.10b), the choice of case-markers is determined by the nature of the morphological operation affecting the predicate, which changes the thematic role of the noun as well as the case-marker assigned to it from ga to o. The syntactic component forces the further change of the case-marker from o to ni.

When we consider the sensitivity of aphasics to case-markers and postpositions, and to the nature of those which are derived differently, we can formulate the following hypothesis:

- (H3) The distinction between lexically determined case-markers and syntactically determined case-markers is reflected in aphasics' performance on grammaticality judgement tasks.

If the aphasics' grammar is composed of primitive concepts, yet has access to lexical features like selectional restrictions, and if aphasics are insensitive to non-lexical operations, e.g. passivization and scrambling, our prediction concerning their performance on grammaticality judgement tasks would be:

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22. This constraint is called "the double o constraint"; it prohibits two o-phrases in one sentence, and is considered to be a surface filter. For details, see Harada (1973, p.138); for a recent analysis of the causative construction, see Iwamoto (1985).

- (P4) Lexically determined case-markers are detected better than syntactically determined case-markers.

We would expect that, if their deficits are syntactic and not lexical in nature, patients will correctly detect lexically determined case-markers such as those in (4.10a), whereas sentences containing syntactically determined case-markers, like (4.10b), will be judged erroneously. Hypothesis (H3) is tested and the results are reported in Section 6.2.

## 4.2 Methodology

Before we describe the experiments themselves, we will start by discussing the methodology of neuropsychological and pathological research. First we will clarify some of the basic assumptions of research into the human cognitive system and discuss the appropriate methods of testing Hypotheses (H1), (H2) and (H3), as well as the data analysis methods used in this thesis.

As Caramazza (1984) points out, the most fundamental and widely held assumption in cognitive neuropsychology is the belief that brain damage can result in the selective impairment of the components of cognitive processing; this is the *fractionation assumption*. This assumption presupposes that complex psychological functions can be represented in terms of more basic components of processing, or modules, i.e. the *modularity condition*. This assumption is also based on the *transparency condition*: the belief that the observation of pathological performance will provide a basis for identifying which component or module of the system is disrupted and provide some information about the nature of the disrupted component.

In the following subsections, the basic assumptions underlying the data collection methods used and the assumptions and statistical methods of the data analyses adopted in this thesis will be explained.

#### 4.2.1 Patient-Group Studies

In light of the assumptions discussed in 4.2, we can collect the data relevant for identifying the supposed disrupted component, e.g. the sentence-processing component, by means of the relevant task, e.g. a sentence comprehension task. There are two types of research methods used to identify the disrupted component, case-study methodology and patient-group study methodology. In case-study methodology, an individual case analysis can establish the deficit in a single case; that is,  $O(=observation)(X)$  implies some deficit  $L(=lesion)(X)$  in some cognitive system  $M(=model)$ , for that individual. If a patient is studied in sufficient detail, we will have obtained sufficient data to interpret the pattern of impairments in that individual.

In the patient-group study method, on the other hand, the finding of a statistically significant majority effect usually licenses the construction of a theory of an aspect of cognitive structure. That is, a set of observed performances  $O(x)$ , observed reliably in a brain-damaged population serving as subjects in the experimentation, establishes the statistically reliable occurrence of  $L(x)$  in  $M$  in that population, and is taken as relevant evidence for the existence of some aspect of normal cognition  $M$ , or properties of mind shared by the population from which the experimental subjects are drawn. Individual variation is usually taken to represent "noise" in the data.

Case-study methodology would not allow us to draw any conclusions about universal constraints on the sentence-processing mechanism. It would only allow us to speculate about

the possible deficit L in an individual patient. It could easily be the case that the observed performance of one patient is exceptional, as compared to the behavior of other brain-damaged patients speaking the same language.

In the present thesis, we will adopt the assumptions and methodology of patient-group study. My reasons for this choice are as follows: first, we will try to compare the disturbance of the comprehension of a particular syntactic form in English aphasics to that found in Japanese aphasics, in order to investigate, for instance, whether the sentence-processing mechanism of the human cognitive system is constrained by the word order of one's native language (cf. H1). This type of experimentation assumes that all speakers of Japanese have the same cognitive system, M(J). It also assumes that if a set of observed performances found in a brain-damaged population of speakers of Japanese, O(J), shows statistically significant majority effects, then it can be taken as relevant evidence for the existence of an aspect of normal cognition of Japanese, M(J), and licences the reliable occurrence of L(J) in M(J) in the Japanese brain-damaged population.

Once this is done, we will be able to compare two sets of observed performances on the comprehension of sentences with different word orders: the performance of an English brain-damaged population O(E) and the performance of a Japanese brain-damaged population O(J). Only after this has been done, is it possible to compare the sentence-processing mechanism which is part of the normal cognitive system of Japanese, M(J), to that which is part of the English system, M(E). We will then be able to infer the universal constraints on sentence-processing mechanisms which are considered to be an aspect of the human cognitive system, M(U).

For the above reasons, patient-group studies are also felt to be appropriate to test Hypotheses (H2) and (H3). The analyses must be formulated for the group as a whole and must arise from a database of a large number of subjects, which will allow the comparison of

the hypothesized disruption of some linguistic aspects of Japanese with analogous disturbances in speakers of other languages. Although the linguistic factors presumed in this thesis to account for aphasics' performance on sentence comprehension are not directly comparable to those in non-case-marking languages, we will be able to infer that similar factors may account for the dissociations of aphasics' performance found in speakers of other languages. Since the linguistic criteria proposed in this thesis are based on the theory of universal grammar, we will also be able to make predictions about the performance of aphasics who speak other languages, and to compare these with our results.

It should be noted that the subjects are not classified according to clinical syndrome type, e.g. Broca's, Wernicke's and Conduction aphasia. No attempt is made to correlate a hypothesized impairment with either lesion site or clinical lesion type. There are many justifications for this decision. First, in a study of English and French aphasics' sentence comprehension using a subset of the sentence types used in this thesis, Caplan and his colleagues found no correlation between type of impairment and either lesion site or clinical lesion type (Caplan, Baker, and Dehaut, 1985).

Second, there have been many discussions concerning the non-utility of either clinical syndrome or lesion site for theoretical purposes. This position is clearly stated by Caramazza (1984) as follows:

The classical aphasia syndromes are of the psychologically weak type. Syndromes such as Wernicke's, Conduction, and Broca's aphasia are defined loosely as the cooccurrence of impairments to grossly defined functions. Thus, quite independently of the empirical status of the classical syndromes, we should consider whether on strictly theoretical grounds the syndromes defined in psychologically weak terms offer a reasonable basis for patient grouping in psycholinguistic research. The answer is an unequivocal no! Patients in groups formed on the basis of the classical syndrome types could have impairments to different psychological mechanisms and, thus, violate the requirements of homogeneity in group research. Research with groups constituted on the basis of classical typology is *not theoretically defensible*.

(Caramazza 1984, p.18)

Regarding the correlation between lesion site and observable behavior, he states,

...the symptoms may cooccur because of a disruption to several processing mechanisms that are distributed in neuroanatomically adjacent areas. A lesion in one part of the brain may result in the impairment of several processing mechanisms and give rise with some regularity to a psychologically accidental pattern of symptoms. The dissociation of the symptoms that make up such a syndrome is not theoretically independent.

(Caramazza 1984, p.17, emphasis mine)

Third, it is necessary to have a detailed linguistic description and processing account of aphasic impairments to sentence comprehension before clinical syndromes can be differentiated with respect to distinctive differences in their effects on sentence comprehension. The object of study in this thesis is dissociations between sentence types. A correlation with lesion site or aphasia type is beyond the scope of an initial stage of linguistic study such as the one reported here.

Thus, although the information about the clinical diagnosis of impairment and lesion site is available for each patient, it is not reported in this thesis.



#### 4.2.2 Data Analyses

In this thesis the results of four independently conducted experiments are reported. Specifically, Experiment 1 and Experiment 2 are intended to test Hypothesis (H1), Experiment 3 is to test Hypothesis (H2), and Experiment 4 is to investigate Hypothesis (H3). The tasks used for Experiments 1 and 2 are object manipulation tasks; the analysis of the data in these cases is a repeated measure analysis of variance. In Experiment 3, in addition to object manipulation tasks, grammaticality judgement tasks are also conducted. The data obtained in judgement tasks are analyzed by means of a signal detection analysis. In Experiment 4, where the two conditions on case-markers are compared in a grammaticality judgement task, a signal detection analysis and the Wilcoxon matched-pairs signed-ranks test are used.

##### 4.2.2.1 The Repeated Measures Analysis of Variance

In the patient-group study of the sentence comprehension task, our main interest is in dissociations between sentence types. There are two steps to analyzing the relevant data. The first involves the use of an analysis of variance with repeated measures on the Sentence Type factor (Winer 1971, pp. 261-308). The assumptions underlying this analysis are as follows:

Assumptions:

- (A1) random sampling of the subjects.
- (A2) homogeneity of within-group variance.
- (A3) normal distribution in form.

(McCall 1970, p. 258)

First of all, the subjects must be randomly sampled. This random sampling of subjects guarantees that all the members of the Japanese aphasic population have an equal probability of being selected, and that any dissociations found in the population serving as subjects in this experiment have an equal probability of occurring in any other population of Japanese aphasics. Furthermore, since we are testing several different sentence types, and subjects' performance is measured for more than one sentence type, the analysis takes into account the fact that the variability of those conditions may be correlated, as would not be the case if different groups of subjects were tested for different sentence types.

Second, the population variances for the groups should be homogeneous. As was mentioned earlier, the concept of homogeneity hardly exists in the brain-damaged population; therefore, this condition is considered to be irrelevant to the present research.

Third, the population distributions from which the sample is drawn must be normal in form. One way to determine this factor is to plot the sample distribution and observe its general form. A normal distribution is typically characterized as being bell-shaped (thus this is a parametric test). If the sample distribution does not depart severely from the normal pattern, and if there is no reason that it should not be normal, then this condition is satisfied. Violations of the assumption of normality are not particularly damaging if a sufficient number of cases are sampled and the departure from normality is not severe. For samples of approximately 30 or more, mean and standard deviation are sufficiently good estimators of their respective parameters. This condition is satisfied for Experiment 1 and Experiment 3 in the present research. The number of subjects is 30 in both experiments. Since this condition is satisfied, it is assumed that our results satisfy the condition of normal distribution. For Experiment 2, this condition is not satisfied, since it was conducted as a pilot study and the sampling number is smaller. However, a tendency can be observed by applying this analysis of variance.

In addition to the procedure outlined above, Tukey's honestly significant difference procedure was applied at an experimentwise error rate of 0.05 to determine which sentence types differed significantly during processing (Winer 1971, p.198).

#### 4.2.2.2 Signal Detection Analysis

In the patient-group study involving a grammaticality judgement task, the object is to determine whether the subjects are able to discriminate grammatical from ungrammatical sentences. For this task, the logic and notation of signal detection analysis are used (Pastore and Scheirer, 1974). This analysis is applicable to situations in which two classes of events are to be discriminated. The basic assumption underlying the nonparametric model of signal detection is that, in deciding whether a particular event is a member of one of two classes of events, the subject bases his decision on two continuous probability density functions that are identical under the various experimental procedures. Green (1964, cited in Pastore and Scheirer, 1974) proposes the use of the area under the receiver-operating-characteristic (ROC) curve,  $A'$ , as a measure of observer sensitivity. The index of sensitivity,  $A'$ , is identical to the expected percentage of correct responses in a two-alternative forced choice experiment. The notation, as well as a computational formula to determine the value of  $A'$ , will be illustrated through the analysis in Chapter 6. For the application of this theory to grammaticality judgement tasks in agrammatic aphasics, see Linebarger, Schwartz and Saffran (1983).

#### **4.2.2.3 Wilcoxon Matched-Pairs Signed-Ranks Test**

In Experiment 4, in addition to using a signal detection analysis, specific accuracy rates on the grammaticality of sentences with lexically determined case-markers and with syntactically determined case-markers are directly compared to each other, in order to establish whether the difference in aphasics' sensitivity to the two types of sentences is significant or not. The Wilcoxon matched-pairs signed-ranks test is used to determine the significance of the difference between two pairs of sentence types (Siegel, 1956). The underlying assumptions of this nonparametric test are: first, the subjects must be randomly selected; second, the scale of measurement must be ordinal in nature, i.e. the differences may be ordered in magnitude. Both conditions are satisfied by our experiment.

In this chapter I have presented the Hypotheses I made, as well as the methodology appropriate to this approach to sentence comprehension. The next two chapters will provide a more detailed illustration of the methodology involved, through the analysis of each experiment.

## Chapter 5

### Syntactic Deficits in the Assignment of Thematic Relations

#### 5.1 Introduction

It has been observed that one deficit in sentence comprehension is patients' failure to assign thematic roles to nouns even in simple active declarative sentences (Schwartz et al. 1980), and that aphasics tend to utilize "strictly linear interpretive strategies" when normal comprehension fails (Caplan in press, Caplan and Futter 1986). One such strategy is:

- (5.1) Assign the thematic roles of Agent and Theme to N1 and N2 in a structure of the form N-V-N.

Given strategy (5.1), active sentences are easier to interpret than cleft object sentences because, in the latter, the first NP is not the Agent whereas in the former it is. Furthermore, a simple active sentence is in the canonical word order of English, whereas an object cleft is in non-canonical word order, i.e. there are two preverbal NPs.

The purpose of this chapter is (1) to investigate whether this "strictly linear strategy" of sentence interpretation is a language-universal mechanism or language-specific to SVO languages, and (2) to see whether and under what conditions such a strategy is used by Japanese aphasics. I will report the results of two experiments conducted independently three to four months apart. Experiment 1 was specifically intended to test Hypothesis 1 (H1).

With Experiment 2, I further investigated the language-specific syntactic determinants of sentence comprehension by Japanese aphasics.

## **5.2 Experiment 1: Effects of Word Order**

### **5.2.1 Materials**

The test I administered to the patients consisted of 120 sentences, 10 of each of the 12 types listed in Table 5.1. The test battery contains three types of one-verb sentence constructions, i.e. the simple declarative construction, the pseudo-cleft construction, and the right-dislocation construction.

Table 5.1  
Types of Stimulus Sentences  
for Experiment 1

1. Simple Active (SA):  
kuma-ga zoo-o os-i-ta.  
bear-nom elephant-acc pushed  
"The bear pushed the elephant."
2. Active Non-canonical (AN):  
kuma-o zoo-ga os-i-ta.  
bear-acc elephant-nom pushed  
"The elephant pushed the bear."
3. Pseudo-cleft Object (PCO):  
kuma-ga os-i-ta-nowa zoo-da.  
bear-nom pushed elephant-cop.  
"What the bear pushed was the elephant."
4. Pseudo-cleft Subject (PCS):  
kuma-o os-i-ta-nowa zoo-da.  
bear-acc pushed elephant-copula  
"What pushed the bear was the elephant."
5. Object Right-dislocation (RDO):  
kuma-ga os-i-ta zoo-o.  
bear-nom pushed elephant-acc  
"The bear pushed the elephant."
6. Subject Right-dislocation (RDS):  
kuma-o os-i-ta zoo-ga.  
bear-acc pushed elephant-nom  
"The elephant pushed the bear."
7. Simple Passive (SP):  
kuma-ga zoo-ni os-are-ta.  
bear-nom elephant-by push-pass-past  
"The bear was pushed by the elephant."
8. Passive Non-canonical (PN):  
kuma-ni zoo-ga os-are-ta.  
bear-by elephant-nom push-pass-past  
"The elephant was pushed by the bear."
9. Pseudo-cleft Agent Passive (PCAP):  
kuma-ga os-are-ta-nowa zoo-ni-da.  
bear-nom push-pass-past elephant-by-cop  
"What the bear was pushed by was the elephant."
10. Pseudo-cleft Subject Passive (PCSAP):  
kuma-ni os-are-ta-nowa zoo-da.  
bear-by push-pass-past elephant-copula  
"What was pushed by the bear was the elephant."

Table 5.1 (continued)

11. Agent Passive Right-dislocation (RDAP):  
kuma-ga os-are-ta zoo-ni.  
bear-nom push-pass-past elephant-by  
"The bear was pushed by the elephant."
12. Subject Passive Right-dislocation (RDSP):  
kuma-ni os-are-ta zoo-ga.  
bear-by push-pass-past elephant-nom  
"The elephant was pushed by the bear."



We will first focus on the category order of nouns and verbs. Specifically, the first question posed on this experiment is whether the ease of sentence interpretation by aphasics is determined by language-universal markedness factors, perhaps ultimately epistemologically determined, which favor the SVO structure, or by a language-specific word order. We intend to test the first hypothesis (H1) discussed in the previous chapter and repeated here for convenience:

- (H1) Sentences in the canonical word order of a language are the easiest to process for all speakers of that language, including aphasics.

(H1) is tested by comparing simple active sentences such as (5.2) with pseudo-cleft object sentences such as (5.3) and object right-dislocation sentences like (5.4).

- |       |  |       |
|-------|--|-------|
| (5.2) | kuma-ga zoo-o os-i-ta.<br>bear-nom elephant-acc push-past<br>"The bear pushed the elephant."                       | (NNV) |
| (5.3) | kuma-ga os-i-ta-nowa zoo-da.<br>bear-nom push-past-was elephant-copula<br>"What the bear pushed was the elephant." | (NVN) |
| (5.4) | kuma-ga os-i-ta zoo-o.<br>bear-nom push-past elephant-acc<br>"The bear pushed the elephant."                       | (NVN) |

The nouns in each of these sentences receive their thematic roles in the same way. All the sentences require the assignment of the Agent role to the first noun and the Theme role to the second noun. They differ, however, with respect to the category order of nouns and verbs. Sentence (5.2) has the basic constituent order of Japanese, i.e. two nouns before the verb. The Pseudo-cleft sentence in (5.3), which is equally frequently used in daily speech, has only one noun before the verb, i.e. N-V-N order. Sentence (5.4), which also has the category order N-V-N is used to replicate Fujita et al.'s (1977) study of word order, and to

see whether any difference in performance appear in different sentence constructions with the same category order, i.e. N-V-N in this case.

We will next focus on the Subject-Object order of nouns. Since Japanese is a case-inflecting and free word order language, the order of Subject and Object can be reversed. Consider the following pair of sentences.

- (5.5) kuma-ga zoo-o ker-ta.  
bear-nom elephant-acc kicked  
"The bear kicked the elephant."
- (5.6) kuma-o zoo-ga ker-ta.  
bear-acc elephant-nom kicked  
"The elephant kicked the bear."

Sentence (5.5) is in the canonical word order S-O-V, whereas sentence (5.6) is in the non-canonical order O-S-V. This difference reflects a reversal in the assignment of the thematic roles to NPs; the first NP is Agent and the second NP Theme in (5.5), whereas the first NP is Theme and the second NP Agent in (5.6).

The assignment of thematic roles by aphasics is solely dependent on whether they can detect case-markers or not. If they cannot detect case-markers, it is quite likely that they rely on a linear strategy for the assignment of thematic roles. One of the possible linear strategies which Japanese aphasics could utilize can be stated as follows:

- (5.7) Assign the thematic role of Agent to N1  
and Theme to N2 in structures of the  
form N-N-V.<sup>23</sup>

If they use the heuristic strategy in (5.7), patients should constantly misinterpret sentences like (5.6), while sentences such as (5.5) should always be interpreted correctly. An interesting situation arises when a passive sentence is in the non-canonical word order.

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23. Note that this heuristic strategy for Japanese does not differ from the one presented in (5.1), which is considered to be one of those used by English aphasics to determine the thematic roles of nouns. It differs only with respect to the structure of the form to which it applies.

- (5.8) kuma-ga zoo-ni ker-are-ta.  
 bear-nom elephant-by kick-passive-past  
 "The bear was kicked by the elephant."
- (5.9) kuma-ni zoo-ga ker-are-ta.  
 bear-by elephant-nom kick-passive-past  
 "The elephant was kicked by the bear."

Sentence (5.8) is a passive sentence in the canonical word order, where the first NP kuma-ga is Theme and the second NP zoo-ni is Agent of the verb ker-are-ta. In (5.9), on the other hand, the first NP kuma-ni is the Agent and the second NP zoo-ga the Theme of the passive verb. If aphasics make use of the linear strategy in (5.7) for passive sentences, then the number of correct responses to (5.9) should be higher than that for (5.8). Thus, whether or not aphasics rely on a linear strategy such as (5.7) can be revealed by their performance on these sentences, and is solely dependent on whether they can detect case-markers or not.

## 5.2.2 Methods

### 5.2.2.1 Subjects

Thirty aphasic patients served as subjects in this experiment. They were selected by speech therapists in seven different hospitals in Aichi, Gifu and Himeji. Therapists were asked to select patients who had demonstrated a good single word auditory receptive vocabulary, regardless of the type of aphasia or lesion site. The resulting group is essentially an unselected population.

#### 5.2.2.2 Procedure

The testing procedure I used for this study is an object manipulation task. This task requires the subject to manipulate toy animals in such a way as to demonstrate the thematic roles of nouns in verbally presented sentences.

In designing the stimuli, five toy animals and ten verbs were used.

Nouns:	<u>kuma</u> <u>saru</u> <u>kirin</u>	"bear" "monkey" "giraffe"	<u>zoo</u> "elephant" <u>usagi</u> "rabbit"
Verbs:	<u>nadata</u> <u>tataita</u> <u>osita</u> <u>aratta</u> <u>taosita</u>	"patted" "hit" "pushed" "washed" "knocked down"	<u>ketta</u> "kicked" <sup>24</sup> <u>osaeta</u> "held down" <u>dakisimeta</u> "hugged" <u>tukamaeta</u> "caught" <u>kusugutta</u> "tickled"

The past tense verb form was selected for use as it would sound most natural in this type of story-telling setting. Sentences were presented in pseudo-random order, such that no more than two examples of any sentence type followed one another. Sentences were not grouped according to type, in order to minimize the possibility that a patient's initial decision concerning the meaning of a particular sentence structure might influence his/her interpretation of subsequent sentences of the same type. Two toy animals were presented to the patient at a time and sentences were arranged in such a way that the noun phrases taking

<sup>24</sup>The surface form of ker-ta is ketta, as shown in (5.5).

specific thematic roles in each sentence type were represented in each position in the spatial array of toys an equal number of times.

Each experimental session started with a short conversation, an explanation of the experiment, the identification of the animals by the patient, and an examination of the patient's short term memory by means of a pointing task using the toy stimuli. The experimenter, myself, spent a fair amount of time learning the way each individual patient expressed what he/she heard until I felt confident scoring each patient's responses for all sentence types. During the test session, if a subject requested a repetition the sentence was repeated after an interval of about ten sentences. No immediate repetition of a sentence was performed. Sentences were spoken with a normal intonational contour. The entire session lasted an average of forty minutes for each patient.

Scoring was done according to a uniform system of notation. Nouns in the sentence are numbered consecutively in order of occurrence from left to right. Patients' responses are assigned to canonical slots separated by commas, where the first slot denotes Agent, the second slot Theme. An example of this notation is shown in (5.10):

- (5.10)        1            2  
         Kuma-ga usagi-o os-i-ta  
         bear-nom rabbit-acc push-past  
         "The bear pushed the rabbit."  
         Answer: \_\_\_\_\_, \_\_\_\_\_, V  
                         Agent       Theme

The correct answer in (5.10) would be 1,2 and would indicate that the first NP kuma was selected as Agent, the second NP usagi was selected as Theme. An example of an incorrect response would be 2,1 for (5.10).

### 5.2.3 Results and Discussion

#### 5.2.3.1 Results

The means and standard deviations of the subjects' scores for each type of sentence are presented for the group as a whole in Table 5.2.

An analysis of variance with repeated measures on the Sentence Type factor revealed a significant effect of this factor on the number of correct responses ( $F(6.38)$ ,  $p < 0.001$ ) (in other words some sentence types were easier than others). Tukey's honestly significant difference procedure was applied at an experimentwise error rate of 0.05 to determine which sentence types differed significantly during processing from others (Winer, 1971). The sentence type Simple Active (SA) is significantly easier than all other sentence types except Pseudo-cleft Subject (PCS) and Subject Right-dislocation (RDS). The sentence type Pseudo-cleft Object (PCO) is significantly more difficult than the Simple Active (SA) sentence. The means obtained in a planned comparison of sentences with the canonical order Subject-Object and those with the non-canonical order Object-Subject do differ for active sentences but not for passive sentences: Simple Active (SA) is significantly easier than Active Non-canonical (AN), whereas Simple Passive (SP) and Passive Non-canonical (PN) do not differ. The means obtained in a planned comparison of all types of Pseudo-cleft sentences (PCO, PCS, PCSP, and PCAP) and all types of Right-dislocation constructions (RDO, RDS, RDAP, and RDSP) do not differ from each other.

Table 5.2

Results for the Group as a Whole  
for Experiment 1

	<u>Mean</u>	<u>S.D.</u>
Simple Active (SA)	9.03	1.129
Pseudo-cleft Subject (PCS)	7.63	1.866
Subject Right-dislocation (RDS)	7.53	2.063
Object Right-dislocation (RDO)	7.27	2.164
Agent Passive Right-dislocation (RDAP)	7.07	2.664
Pseudo-cleft Agent Passive (PCAP)	6.83	2.506
Pseudo-cleft Subject Passive (PCSP)	6.56	2.582
Active Non-canonical (AN)	6.43	2.269
Passive Non-canonical (PN)	6.43	2.373
Subject Passive Right-dislocation(RDSP)	6.33	2.783
Simple Passive (SP)	6.10	2.856
Pseudo-cleft Object (PCO)	5.70	2.601

Results of Tukey's procedure (Experimentwise error rate of 0.05)

SA PCS RDS RDO RDAP PCAP PCSP AN PN RDSP SP PCO

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Sentence types underlined by a common line do not differ significantly from each other; sentence types not underlined by a common line do differ significantly.

#### 5.2.3.2 Discussion

First of all, the statistical results for the comparison of sentence types with N-N-V order and sentence types with N-V-N order show that both types are equally easy to interpret. Thus, our Hypothesis (H1) has been disconfirmed, in that sentences in the canonical word order of a language are not the easiest to process for speakers of that language, including aphasics. On the other hand, close examination of the results for each sentence type brings up some interesting facts concerning language-specific interpretive mechanisms in sentence comprehension by Japanese aphasics. As is the case with English aphasics, Japanese aphasics tend to interpret sentences according to uniform principles of interpretation, and how they assign thematic roles seems to be constrained by language-specific features of Japanese.

The sentence types PCS and RDS are as easy to interpret as the sentence type SA, but PCO and RDO are significantly more difficult to interpret than SA. In other words, when the object is clefted or dislocated to the position following the verb, a sentence becomes more difficult to interpret than when the subject is clefted or dislocated. In addition, the sentence type AN is also significantly harder than SA. The category sequences of these sentence types are shown in examples (5.11) to (5.14).



- (5.11) N-ga N-o V (SA)  
           -nom -acc
- (5.12) N-o N-ga V (AN)  
           -acc -nom
- (5.13) N-o V N-(ga)-(da)<sup>25</sup> (PCS, RDS)  
           -acc -nom -copula
- (5.14) N-ga V N-(o)-(da) (PCO, RDO)  
           -nom -acc-cop

The present data clearly show that there are two dissociations among these sentence types. The first dissociation separates performance on (5.11) and (5.12), and the second dissociation distinguishes performance on (5.11) and (5.14). On the other hand, there is no dissociation between performance on (5.11) and (5.13), nor between performance on (5.12) and that on (5.14). These facts can be interpreted as follows. First, Japanese aphasics tend to interpret the first NP as Agent and the second NP as Theme in a structure of the form N-N-V. Second, they interpret the first NP as Theme and the second NP as Agent in a structure of the form N-V-N. Third, they interpret the NP which is marked by the nominative case-marker ga as Agent. These Interpretive rules (IRs) can be summarized as follows:

- (IR-1) Assign the thematic roles of Agent  
           and Theme to N1 and N2 in structures  
           of the form N-N-V.
- (IR-2) Assign the thematic roles of Theme  
           and Agent to N1 and N2 in structures  
           of the form N-V-N.<sup>26</sup>

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 25. In a pseudo-cleft construction, the case-marker is obligatorily dropped. Only in right-dislocation constructions does a case-marker appear in this position, but without the copula. The same principle applies to (5.14).

26. (IR-1) and (IR-2) can be collapsed into the following rule, (IR-X).

- (IR-3) Assign the thematic role of Agent to the N which is marked by the nominative case-marker ga.

All of these Interpretive Rules are considered to be language-specific rules for Japanese. The aphasics' better performance on the Simple Active sentence type (SA) in (5.11) than on the Active Non-canonical type (AN) in (5.12) can be explained on the assumption that aphasic patients apply (IR-1) and (IR-3) to both (5.11) and (5.12). The application of (IR-1) and (IR-3) yields the correct assignment of thematic roles in (5.11), which accounts for the patients' large number of correct responses. In the case of (5.12), on the other hand, if patients apply (IR-1) to the sentence, it does not yield the correct assignment of thematic roles. The rule (IR-1) is working against the correct interpretation of sentence type (5.12). The lower score that patients achieve for sentence type (5.12) is thus predicted.

The patients' better performance on the sentence types PCS and RDS shown in (5.13) than on PCO and RDO, as in (5.14), can be explained by assuming that they apply (IR-2) and (IR-3) to both sentences. The application of both rules to sentence type (5.13) yields the correct assignment of thematic roles to nouns, accounting for the high number of correct responses. In the case of (5.14), the rule (IR-2) conflicts with the actual assignment of thematic roles and its application leads to misinterpretation of the sentence. Hence the patients' bad performance on sentence type (5.14) is predicted, and the results support this prediction.

Now we must consider what the results of the present experiment tell us about the *Epistemological hypothesis* presented at the beginning of this thesis. Before doing that we must look at the data from a different point of view. When we think of word order -

- (IR-X) i. Assign the thematic role of Theme to the immediately preverbal N.  
ii. Assign the remaining theta-roles to NPs as required by V.

including both the category order of nouns and verbs and Subject-Object order - and the assignment of thematic roles to nouns, we notice that we are looking at two kinds of ordering relationships, namely, word order and thematic role order. If we consider these two orders separately, some quite interesting facts emerge regarding the heuristic strategies used by aphasics for sentence comprehension. First, my results show that the sequence N-N-V, which is the epistemologically marked word order and, in Japanese, the canonical category order, tends to be interpreted with the first noun as Agent and the second or immediately preverbal noun, as Theme. In other words, the order Agent-Theme is the unmarked and canonical thematic role order for the word order N-N-V.

On the other hand, the sequence N-V-N, which is the epistemologically (i.e. language-universally) unmarked word order and the non-canonical category order in Japanese, tends to be interpreted with the first noun, which is the immediately preverbal noun, as Theme and the second noun as Agent. The order Theme-Agent is, then, the marked <sup>but</sup> canonical thematic role order for the word order N-V-N. What these facts indicate is that, if one controls thematic role order, word order does not matter. In other words, in Japanese the category order of nouns and verbs is not an important factor once the thematic role order for a given word order is controlled. The interaction of the word order, thematic role order, canonicity and markedness factors is presented in Table 5.3.

Assuming the canonicity and markedness factors presented in Table 5.3 to be true, the relationship between sentence type, word order and thematic role order with respect to the markedness and canonicity factors can be summarized and presented as in Table 5.4. It is fairly clear from Table 5.4 that the sentence types in which thematic role order is canonical, e.g. SA and PCS, are easier to interpret than the sentence types in which thematic role order is non-canonical, e.g. AN and PCO, irrespective of the canonicity and markedness of the word order in question.

Table 5.3

The Interaction of Word Order, Thematic Role  
Order, Canonicity and Markedness

		Canonicity	Markedness
Word order	N-N-V	canonical	marked
	N-V-N	non-canonical	unmarked
Thematic role order for N-N-V	A-TH	canonical	unmarked
	TH-A	non-canonical	marked
Thematic role order for N-V-N	A-TH	non-canonical	unmarked
	TH-A	canonical	marked

Table 5.4

The Relationship between Sentence Type,  
Word Order, Thematic Role Order  
and Mean Correct Score

Sentence Type	Word Order		Thematic role order		Mean Correct Score
	Canonicity	Markedness	Canonicity	Markedness	
SA	+	+	+	-	9.03
PCS	-	-	+	+	7.63
AN	+	+	-	+	6.43
PCO	-	-	-	-	5.70

Note: Canonicity: + = canonical; - = non-canonical  
Markedness: - = unmarked; + = marked

Results of Tukey's procedure (Experimentwise error rate of 0.05)

SA	PCS	AN	PCO
<hr/>			
	<hr/>		
		<hr/>	

Sentence types underlined by a common line do not differ significantly from each other; sentence types not underlined by a common line do differ significantly.

Thus, the data from Japanese aphasics in the present study clearly refute the *Epistemological hypothesis*. That is, the fact that the markedness and/or canonicity of the word order of a sentence does not play an important role in its comprehension by Japanese aphasics shows that the sentence-processing mechanism of brain-damaged patients is *not* entirely determined by primitive notions such as "precedence" and "agent-of-action". What determines the ease of sentence processing is the thematic role order of a given sentence, and in particular, the relationship between thematic role order and word order. For the marked but canonical N-N-V word order, the unmarked and canonical Agent-Theme thematic role order is favored (SA > AN, see Table 5.4), and for the unmarked but non-canonical N-V-N word order, the marked and canonical Theme-Agent thematic role order is favored (PCS > PCO, see Table 5.4). The canonicity of thematic role order, itself dependent upon word order, determines ease of interpretation, and not the markedness of either word or thematic role order.

An additional interesting finding is that Japanese aphasics tend to assign the Theme theta-role to the immediately preverbal noun. In other words, whenever they hear the sequence N-V, they tend to assign the Theme theta-role rather than the Agent to the noun in that position. This is a language-specific characteristic of Japanese. It has been reported that English aphasics tend to assign the Agent theta-role to the immediately preverbal noun (Caplan, in press). These facts concerning Japanese and English aphasics' sentence interpretive rules have significant implications for the theory of heuristic strategies and sentence comprehension in aphasics. These will be considered in Section 6.1.4.

There are some other interesting findings as well. First, the sentence type Pseudo-cleft Object (PCO) is significantly harder to interpret than Pseudo-cleft Subject (PCS). This finding is quite interesting in that the same relationship between type of cleft sentence and ease of sentence processing holds for both English and Japanese. In English, it is reported

that cleft-object sentences are much harder to interpret than cleft-subject sentences. The results of the present experiment show that Pseudo-cleft Object sentences are also more difficult than Pseudo-cleft Subject sentences. These facts suggest that there may be some sort of language-universal constraint on the sentence-processing mechanism, as it relates to simple cleft and pseudo-cleft sentences. This might be stated as in (5.15):

- (5.15) (Pseudo-) cleft-Object sentences are  
more difficult to process than (pseudo-)  
cleft-Subject sentences regardless of  
the language in question.

One interpretation of the phenomenon expressed in (5.15) is proposed by Bates, McNew, MacWhinney, Devescovi and Smith (1982) and MacWhinney, Bates and Kliegl (1984), in their functional model of sentence processing. One of their main claims is that there are "coalitions" of functions which map onto formal devices. For instance, the functions of Agent, Actor, and Topic (and perhaps Focus) prototypically map onto the formal notion of Subject. They claim that these coalitions derive, in large measure, from facts about the ways in which things "go together" in the world as well as the way in which the human processing system interacts with the conversational task. If we adopt their assumptions, then the greater difficulty of interpreting cleft-object sentences over cleft-subject sentences in both Japanese and in English may be explained in that the coalition between Agency and Focus breaks down in cleft-object sentences. Agency and Focus are split apart and assigned to different items (i.e. Subject and Object respectively), which creates difficulties in processing. In the case of cleft subject sentences, these notions "go together" and assigned to the same item, which facilitates the ease of processing. Thus a language-universal principle like (5.15) holds for simple cleft and pseudo-cleft sentences where the number of lexical items to be processed is small.

It should be noted, however, that a principle like (5.15) cannot be extended to complex sentences. As we will see in the following section, certain relative clauses such as Object-Subject relatives, are the easiest for English aphasics whereas they are the most difficult sentences for Japanese aphasics to interpret. Such data fall outside the scope of a functional model of sentence interpretation like those proposed by Bates et al. (1982) and MacWhinney et al. (1984).

In addition, the fact that there was no difference between performance on pseudo-cleft sentences and on sentences with right-dislocation constructions suggests that the type of sentence structure is not important as long<sup>as</sup> the category order of nouns and verbs is the same.

Finally, our results are consistent with Fujita et al.'s (1977) findings in two respects. First, the sentence type Simple Active SA is significantly easier to interpret than Active Non-canonical AN. In Fujita et al.'s study, the mean score for SA is 7.28 and for AN is 5.3, as shown in Table 5.5.<sup>27</sup> Second, there is no dissociation between performance on Simple Active SA and on Subject Right-dislocation RDS in either study. The means for the two types are 7.28 and 7.16 respectively, in their study.

On the other hand, our results differ from their findings in that the sentence type RDO is slightly easier than SA in their study whereas the opposite tendency was observed in our study, in which SA is found to be significantly easier than RDO, as shown in Table 5.5.

It is important to note, however, that their experiment is affected by some methodological problems. First, a very limited number of lexical items was used: only two nouns, "the bear" and "the lion", and three verbs, "hit", "bite" and "see". This might have confused patients' performance, since the same animals are used in every single sentence. Second, they included sentences which had the category sequence V-N-N, which is quite

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27. The mean scores from Fujita et al.'s study are recalculated on the basis of ten responses per sentence type in order to compare them with our results. The actual scores in their study are presented on the basis of six responses per sentence type.



unnatural in Japanese. This factor also may have affected patients' performance. Thus, the results they obtained cannot necessarily be considered reliable.

The present study, on the other hand, not only does not have those flaws in the experimental design but also has several additional advantages. First, we included the pseudo-cleft sentence type, which is very frequently used, and which, together with the right-dislocation construction, exhibited interesting and significant dissociations in the present study. Second, the number of the sentences of each sentence type is larger in our study, i.e. ten; in their study, it was six. Third, the analysis used in the present study is considered to be the best statistical method for the determination of the significance of differences in mean scores for this type of experiment. Hence, our results are far more reliable and conclusive than theirs in these respects.

Table 5.5

Comparison of Our Results and  
Fujita et al.'s (1977) Results

	SA	RDS	RDO	AN
Our results	9.3	7.53	7.27	6.43
Fujita et al.'s	7.28	7.16	7.9	5.3

### **5.3 Experiment 2: Other Language-Specific Effects**

This experiment was conducted as a pilot study to test language-specific syntactic determinants of sentence comprehension in Japanese. Specifically, I tested more complex sentences than those tested in Experiment 1. We will present preliminary data regarding how the category order of nouns and verbs interacts with the hierarchical organization of syntactic structures in sentence comprehension; we will also see at what point the effect of case-markers disappears in the interpretation of complex sentences.

#### **5.3.1 Materials**

The test administered consisted of 150 sentences, 10 of each of the 15 types listed in Table 5.6. The test battery contains two types of one-verb sentence constructions, the simple declarative construction and the pseudo-cleft construction, and several types of two-verb constructions.

Table 5.6

Types of Stimulus Sentences  
for Experiment 2

1. Simple Active (SA):  
kuma-ga zoo-o os-i-ta.  
bear-nom elephant-acc pushed  
"The bear pushed the elephant."
2. Active Non-canonical (AN):  
kuma-o zoo-ga os-i-ta.  
bear-acc elephant-nom pushed  
"The elephant pushed the bear."
3. Pseudo-cleft Object (PCO):  
kuma-ga os-i-ta-nowa zoo-da.  
bear-nom pushed elephant-cop.  
"What pushed the bear was the elephant."
4. Pseudo-cleft Subject (PCS):  
kuma-o os-i-ta-nowa zoo-da.  
bear-acc pushed elephant-copula  
"What pushed the bear was the elephant."
5. Simple Passive (SP):  
kuma-ga zoo-ni os-are-ta.  
bear-nom elephant-by push-pass-past  
"The bear was pushed by the elephant."
6. Passive Non-canonical (PN):  
kuma-ni zoo-ga os-are-ta.  
bear-by elephant-nom push-pass-past  
"The elephant was pushed by the bear."
7. Pseudo-cleft Agent Passive (PCAP):  
kuma-ga os-are-ta-nowa zoo-ni-da.  
bear-nom push-pass-past elephant-by-cop  
"What the bear was pushed by was the elephant."
8. Pseudo-cleft Subject Passive (PCSP):  
kuma-ni os-are-ta-nowa zoo-da.  
bear-by push-pass-past elephant-copula  
"What was pushed by the bear was the elephant."

Table 5.6 (continued)

9. Conjoined (C):

kuma-ga zoo-o os-i-te usagi-o tukamae-ta.  
bear-nom elephant-acc push-cnjp rabbit-acc catch-past  
"The bear pushed the elephant and caught the rabbit."

10. Subject-Object Relative (SO):

kuma-ga os-i-ta zoo-ga usagi-o tukamae-ta.  
bear-nom push-past elephant-nom rabbit-acc catch-past  
"The elephant that the bear pushed caught the rabbit."

11. Subject-Subject Relative (SS):

kuma-o os-i-ta zoo-ga usagi-o tukamae-ta.  
bear-acc push-past elephant-nom rabbit-acc catch-past  
"The elephant that pushed the bear caught the rabbit."

12. Object-Subject Relative (OS):

kuma-ga zoo-o os-i-ta usagi-o tukamae-ta.  
bear-nom elephant-acc push-past rabbit-acc catch-past  
"The bear caught the rabbit that pushed the elephant."

13. Object-Object Relative (OO):

kuma-ga zoo-ga os-i-ta usagi-o tukamae-ta.  
bear-nom elephant-nom push-past rabbit-acc catch-past  
"The bear caught the rabbit that the elephant pushed."

14. Pseudo-cleft Object Relative (COR):

kuma-ga os-i-ta zoo-ga tukamae-ta-nowa usagi-da.  
bear-nom push-past elephant-nom catch-past rabbit-cop  
"The one that the elephant that the bear pushed caught  
was the rabbit."

15. Pseudo-cleft Subject Relative (CSR):

kuma-ga os-i-ta zoo-o tukamae-ta-nowa usagi-da.  
bear-nom push-past elephant-acc catch-past rabbit-cop  
"The one that caught the elephant that the bear pushed  
was the rabbit."

We will consider the effect of the category order of nouns and verbs in complex sentences as well as in simple sentences to see how it is related to the hierarchical organization of syntactic structure. Conjoined sentences (C) like (5.16) and Subject-Object (SO) relatives such as (5.17) are presented to patients to see whether embedding causes difficulties in sentence interpretation.

- (5.16) kuma-ga zoo-o os-i-te usagi-o  
 bear-nom elephant-acc push-conjunctive rabbit-acc  
 particle  
 tukamae-ta  
 catch-past

"The bear pushed the elephant and caught the rabbit."

- (5.17) kuma-ga os-i-ta zoo-ga usagi-o tukamae-ta.  
 bear-nom push-past elephant-nom rabbit-acc catch-past  
 "The elephant that the bear pushed caught the rabbit."

It is reasonable to interpret patients' responses as indicating comprehension of the nature of embedding if they consistently fail to assign the role of Agent of the second verb to the first NP in (5.17). The assignment of the Agent to the first NP kuma by the second verb tukamae-ta is required in (5.16), which has no embedded clause, but would result in a misinterpretation (5.17).

The patients' recognition of embedding can also be checked by comparing Conjoined structures like (5.16) with OS relatives like (5.18) and OO relatives like (5.19). The category order of nouns and verbs is the same in all these sentences, i.e. N-N-V-N-V.

- (5.18) kuma-ga zoo-o os-i-ta usagi-o tukamae-ta.  
bear-nom elephant-acc push-past rabbit-acc catch-past  
"The bear caught the rabbit that pushed the elephant."
- (5.19) kuma-ga zoo-ga os-i-ta usagi-o tukamae-ta.  
bear-nom elephant-nom push-past rabbit-acc catch-past  
"The bear caught the rabbit that the elephant pushed."

It should be noted that Conjoined structures like (5.16) and OS relatives like (5.18) also share the same sequence of case-marking. The only difference lies in the verbal morphology, that is, the inflectional morpheme of the first verb in (5.16) is the conjunctive particle te and the equivalent morpheme in (5.18) is the past tense marker ta. If the patients can appreciate case-markers and verbal inflections, we would expect them to perform equally well on these sentence types.

### 5.3.2 Methods

#### 5.3.2.1 Subjects

I tested ten patients who were selected by speech therapists in three hospitals in Aichi and Himeji. Therapists were asked to select patients who had demonstrated a good single word auditory receptive vocabulary, regardless of type of aphasia and lesion site. The criteria for the selection set were the same as in Experiment 1.

### 5.3.2.2 Procedure

The testing procedure used in this experiment was the object manipulation task, as in Experiment 1. The patients were asked to manipulate toy animals so as to demonstrate the thematic roles of nouns in verbally presented sentences. The advantage of this task is that the patient is free to make his/her own errors. For instance, in complex sentences, there are 36 logically possible combinations of thematic roles. The sentence-picture matching task is unable to search for all possible errors. Besides, given that error analyses will be conducted for relative clause constructions in the present experiment, an object manipulation task seems to be appropriate.

Two toy animals were presented to the patient for simple sentences - i.e. those containing one verb and two nouns - and three animals for complex sentences.<sup>28</sup> Each session lasted thirty to forty minutes, and two or three sessions on the average, held at approximately weekly intervals, were conducted with each patient.

Scoring was done according to a uniform system of notation. For example, the nouns in sentence (5.20) are numbered consecutively in order of occurrence from left to -----

28. It has been pointed out to me by Yukio Otsu (personal communication) that methodologically speaking, presenting only three animals for a sentence with a restrictive relative clause construction such as (5.17) violates its "felicity conditions", whereas this is not the case with conjoined sentences like (5.16), and that this might influence subjects' responses. The term "felicity conditions" means something like "what should be true of the context for a given sentence (with a particular reading)". For example the felicity conditions for (5.17) include the condition that there should be more than one elephant available. Thus we should present one bear, one rabbit, and several elephants. (For the rationale behind this method and the results of an experiment testing children with it, see Hamburger and Crain (1982).)

Although such a precise method seems quite appropriate for eliciting children's grammatical knowledge, the situation for brain-damaged patients is somewhat different. First, the object manipulation task (as compared to picture identification tasks) is not an easy task for aphasics, especially for severely impaired patients who have suffered right hemiparesis. Thus, presenting, say, five or six animals would cause more trouble for the patients for physical reasons than presenting three. Another clinical reason for the difficulty of such a task is that some patients may have a narrowing of the visual field, and therefore may not be able to see all the animals presented if there are too many of them. Third, assuming that aphasics have a fairly accurate metalinguistic sense (Linebarger et al. 1983), they might be familiar with the concepts of "presupposition" and "assertion". If this is the case, then they should understand the "restrictiveness" of restrictive relative clauses. Thus, taking all these factors into account, I decided to use only three animals for relative clause sentences.



right, as indicated. Patients' responses are assigned to canonical slots separated by commas, where the first slot denotes the Agent and the second slot the Theme of the first verb, and the third slot the Agent and the fourth slot the Theme of the second verb.

(5.20)        1            2                            3  
 kuma-ga    kirin-o        os-i-ta    usagi-o    nade-ta  
 bear-nom   giraffe-acc   push-past   rabbit-acc   pat-past  
 "The bear patted the rabbit that pushed the giraffe."

Answer:        \_\_\_\_\_,        \_\_\_\_\_, V1        \_\_\_\_\_,        \_\_\_\_\_, V2  
                  Agent        Theme                            Agent        Theme

The correct response in (5.20) would be 3,2;1,3 and would indicate that the third NP usagi was selected as Agent and the second NP kirin was selected as Theme of the first verb os-i-ta, while the first NP kuma was selected as Agent and the third NP usagi was selected as Theme of the second verb nade-ta. Thus in (5.20), the thematic roles assigned by the verb in the relative clause, i.e. those of the first verb in the sentence, are denoted by the first and second slots, and those of the verb in the matrix clause, i.e. those of the second verb, by the third and fourth slots. <sup>29</sup> The design of the stimuli and other procedures are as the same as in Experiment 1.

-----  
 29. It was pointed out to me by Yukio Otsu (personal communication) that the relative clause indicates "presupposition" while the matrix clause indicates "assertion", and that there might be subjects who act out only the matrix clauses, as they presuppose the material contained in the relative clause, and thus see no need to act it out.

In fact, there were three patients who acted out either relative clauses or matrix clauses but not whole sentences. However, such response patterns were very rare (1 to 3 sentences out of 70, for each of those three patients), and there was no consistency in the pattern of such responses for each subject e.g. performing only the relative clause action or only the matrix clause action. Thus, we did not pay much attention to such a possibility in the present experiment. Detailed consideration of the question, however, is certainly necessary for future research. For related experiments, see Hamburger and Crain (1982), and Otsu's (1981) acquisition study.

### 5.3.3 Results and Discussion

#### 5.3.3.1 Results

The means and standard deviations of subjects' scores for each sentence type are presented for the group as a whole in Table 5.7. Table 5.8 shows the number of responses of each type for each sentence type, including the number of errors the patients made for each sentence type.

An analysis of variance with repeated measures on the Sentence Type factor revealed a significant effect on the number of correct responses (  $F(9.48)$   $p < 0.01$ ). Tukey's honestly significant difference procedure was applied at an experimentwise error rate of 0.05 to determine which means differ significantly from each other (Winer, 1971).

The sentence type Simple Active (SA) is significantly easier than all the two-verb sentence types except Conjoined. None of the one-verb sentence types used differ significantly from each other. Among the two verb sentence types, Object-Subject relatives (OS) and Object-Object relatives (OO) are significantly more difficult than Conjoined (C) and Subject-Object relatives (SO).

Since the number of observations exceeds the number of subjects, i.e. 10 subjects with 15 scores apiece, the application of any statistical test is somewhat problematic. Nonetheless, the major finding is that (with this small population) there are differences in performance on different sentence types with two verbs, which are of interest.

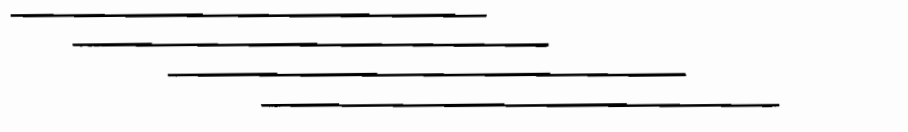
Table 5.7

Results for the Group as a Whole  
for Experiment 2

	<u>Mean</u>	<u>S.D.</u>
Simple Active (SA)	9.7	0.445
Pseudo-cleft Subject (PCS)	8.5	1.857
Pseudo-cleft Object (PCO)	7.8	1.886
Pseudo-cleft Agent Passive (PCAP)	7.3	2.71
Simple Passive (SP)	7.3	2.19
Active Non-canonical (AN)	7.2	2.4
Pseudo-cleft Subject Passive (PCSP)	7.2	2.315
Passive Non-canonical (PN)	7.1	1.44
Conjoined (C)	6.5	3.008
Subject-Object Relative (SO)	6.3	2.325
Pseudo-cleft Object Relative (COR)	5.2	3.62
Subject-Subject Relative (SS)	4.9	3.33
Pseudo-cleft Subject Relative (CSR)	4.3	3.132
Object-Object Relative (OO)	2.8	2.722
Object-Subject Relative (OS)	2.5	3.008

Results of Tukey's procedure (Experimentwise error rate of 0.05)

PCAP AN  
SA PCS PCO SP PCSP PN C SO COR SS CSR OO OS



Sentence types underlined by a common line do not differ significantly from each other; sentence types not underlined by a common line do differ.

Table 5.8

Response to Each Sentence Type by Subjects

Simple sentences:

Response	SA	AN	PCO	PCS	SP	PN	PCA	PCS
1.2	*97	28	78	15	27	*71	22	*72
2.1	3	*72	22	*85	*73	29	*78	28

Complex sentences:

	C	SO	SS	OS	OO	COR	CSR		C	SO	SS	OS	OO	COR	CSR
12:12								23:12				2	3		
12:13	*65	12	4	19	14	8	12	23:13						*27	
12:21								23:21	1					4	
12:23	18	*63	16	21	19	*52	11	23:23							
12:31		2	4	5	1	8	6	23:31	1				1		2
12:32	3	3	1	3	2	9	*43	23:32							
13:12		2						31:12				1	2		
13:13								31:13							
13:21		1				1	1	31:21				2			
13:23		1	1				1	31:23	2			2		1	2
13:31								31:31							
13:32					1	1		31:32				1			1
21:12								32:12				3			
21:13	1	2	10		4	1		32:13	1		1	*25	7		
21:21		2						32:21				1	1	1	
21:23	4	4	*49	3	5	4	2	32:23				1			
21:31	1		2	4	1	4		31:31	1	1			1		
21:32		5	4	2	2	3	6	32:30							
								NR	2	2	2	8	7	7	3

\*Correct response

### 5.3.3.2 Discussion

The results for complex sentences reveal several quite interesting facts. First, the sentence types Conjoined and Subject-Object Relative (SO) are interpreted equally well, and performance on these types is better than on any other complex sentence types. Here we see the emergence of one of the language-specific factors affecting sentence interpretation. The Subject-Object relative is considered to be one of the most difficult two-verb sentence types to comprehend in English, whereas it is one of the easiest types in Japanese.

If embedding *per se* causes trouble in understanding sentences, then the mean scores on Conjoined and SO Relatives should differ; that is, SO should be significantly more difficult than Conjoined, since the creation of an embedded S node requires an extra computational step. That this is not the case in Japanese can be seen from our results. The mean scores for the Conjoined and SO types are 6.5 and 6.3 respectively. Consider the structures of the two types of sentence, as shown in (5.16) and (5.17), repeated here as (5.21) and (5.22) respectively.

- (5.21) kuma-ga zoo-o os-i-te usagi-o  
 bear-nom elephant-acc push-cnjp rabbit-acc  
 tukamae-ta.  
 catch-past  
 "The bear pushed the elephant and caught the rabbit."
- (5.22) kuma-ga os-i-ta zoo-ga usagi-o  
 bear-nom push-past elephant-nom rabbit-acc  
 tukamae-ta.  
 catch-past  
 "The elephant that the bear pushed caught the rabbit."

In English, the relative pronoun signals an embedded structure, whereas there is no such thing in Japanese. The creation of an embedded S node in (5.22) is done as soon as the nominative case-marker ga in the second NP zoo-ga is detected. One of the reasons for the patients' good performance on Japanese SO relatives is that local interpretation of the first three elements can lead one to the correct assignment of thematic roles by the first verb; that is, the first NP is the Agent and the second NP the Theme of the first verb. The interpretation of the matrix clause can also be done locally, i.e. the second NP is the Agent and the third NP the Theme of the second verb. The fact that patients correctly failed to assign the first NP the thematic role of Agent of the second verb indicates that they recognized the existence of an embedded clause, whose head is the second NP. It is unlikely that this performance resulted solely from the patients' use of a heuristic interpretive strategy. Rather, it is likely that the patients are actually trying to parse SO relatives by means of structure-building operation, and succeed in embedding the first verb beneath the second NP.

Another important point concerns the existence of significant dissociations between performance on Conjoined and SO types and performance on OO and OS types, whose structures are presented in (5.23) to (5.26).

- (5.23) N-ga N-o V-te N-o V (C)  
 (5.24) N-ga V-ta N-ga N-o V (SO)  
 (5.25) N-ga N-ga V-ta N-o V (OO)  
 (5.26) N-ga N-o V-ta N-o V (OS)

OO relatives and OS relatives are significantly more difficult than Conjoined and SO Relative types. One of the reasons for this dissociation may be the fact that the patients interpret the first three elements locally, without taking the rest of the sentence into account. If they were able to process the fourth element, i.e. the third NP, they would be able to correctly assign the thematic roles of Agent and Theme respectively to the second and third NPs around the first verb in OO relatives. Likewise, they would be able to assign the thematic roles of Agent and Theme respectively to the third and second NPs around the first verb in OS relatives. The patients' error types on these sentence types suggest that they are locally interpreting the sequence N-N-V. As is shown in Table 5.9, 63% of the errors they made in OO relatives consisted of interpreting either the first NP (46.6%) or the second NP (16.4%) as Agent of the first verb. In OS relatives, 77.3% of their errors result from the assignment of Agency either to the first NP (65.3%) or to the second NP (12%) around the first verb. Thus, it appears that in interpreting OO and OS relatives, patients tend to base their interpretation on the linear sequence of lexical categories, not taking the hierarchical organization of syntactic structure into consideration.

Table 5.9

Error types on OO and OS relatives

OO relatives		OS relatives	
Response type	Number	Response type	Number
12;13	14	12;13	19
12;23	19	12;23	21
12;31	1	12;31	6
12;32	2	12;32	3
Total:	34/73 46.6%	Total:	49/75 65.3%
21;13	4	21;23	3
21;23	5	21;31	4
21;31	1	21;32	2
21;32	2		
Total:	12/73 16.4%	Total:	9/75 12.0%
13;32	1	23;12	2
23;12	3		
*23;13	*27		
23;21	4		
23;31	1		
32;13	7	31;12	2
32;21	1	31;32	1
32;31	1	32;12	3
		*32;13	*25
		32;21	1
NR	7	NR	8
Total number of			
Errors:	73		75
Correct:	27		25

\* correct response



It appears that Japanese aphasics' performance on two-verb sentence interpretation has some features similar to that of English aphasics, in that they tend to interpret sentences according to the linear sequence of lexical categories, as shown in the type of interpretive rules presented in (IR-1) and (IR-2) for Japanese, and (5.1) for English. Thus, we may say that the use of linear interpretive strategies for sentence comprehension is a language-universal characteristic of aphasia.

The error patterns for OO and OS relatives also reveal some interesting facts about another language-specific characteristic, i.e. patients' sensitivity to case-markers. As we saw in Experiment 1, aphasics are sensitive to the case-markers in simple sentences and take case-markers as one of the clues to the assignment of thematic roles to nouns in sentence interpretation, as stated in (IR-3). That is, they tend to interpret the NP with the nominative case-marker ga as the Agent. Whether they are also able to utilize case-markers in complex sentences can be seen in their patterns of interpretation in OO and OS relatives. If they are sensitive to case-markers, then in OO relatives they should interpret either the first or the second NP as Agent of the second verb, since both are marked with ga, perhaps taking the second NP as Agent of the second verb more frequently than the first NP, since the second NP is closer to the second verb. On the other hand, in OS relatives, if they are able to detect case-markers, they should interpret the first NP as the Agent of the second verb rather than the second NP, since the first NP is the only one marked with ga. In other words, if they are able to rely on the case-markers in interpreting complex sentences as well as simple sentences, then they should make responses of the type (XX;23) more for OO relatives than for OS relatives and responses of the type (XX;13) more for OS relatives than for OO relatives.

That this is not the case can be seen in Table 5.10, which shows the frequency of these response types. The numbers of (XX;23) responses and (XX;13) responses are roughly

the same for both OO and OS relatives; the former type occurs 24 times for both relative types, and the latter occurs 18 times for OO relatives and 19 in OS relatives. This suggests that heuristics based on case-marking are abandoned in favour of those based on word-order in more complex sentences.

Table 5.10

Errors for OO and OS relatives

Response type		OO number	OS number
XX;23	12;23	19	21
	21;23	5	3
Total		24	24
XX;13	12;13	14	19
	21;13	4	0
Total		18	19

It should be noted that among the ten patients tested in the present experiment, two were only mildly impaired and generally performed better on complex sentences than the other eight patients. The average scores for the Conjoined type and all Relative types for these two patients were 86% and 94%; the rest of the patients had scores coming somewhere between 18% and 52%. For these two patients, the average scores for Conjoined and SS relatives were 100%, for SO, 95%, for OO, 75%, and for OS, 80%. It appears that these two patients were able to process not only Conjoined, SO and SS types but also OS and OO types quite well, and that they were capable of handling a structure-building operation when parsing sentences.

On the other hand, for the remaining eight aphasics, who were moderately to severely impaired, the average score for the Conjoined type was 56%, for SO, 55%, for SS, 36%, for OO, 15%, and for OS, 11%. It is fairly clear that these eight patients exhibited a dissociation between their performance on the Conjoined and SO types and on the OO and OS types. The error analyses for OO and OS relatives for these patients show that most of their errors are responses of the form (12;XX) and (21;XX). These facts suggest that they are interpreting sentences locally and process only the number of elements needed to complete the argument structure of a verb. The fact that (12;XX) and (21;XX) responses are equally frequent in those patients also suggests that they are no longer able to utilize case-markers as a heuristic or cue for interpreting these types of sentences.

Thus, we can conclude that the effects of case-markers disappear in the interpretation of OO and OS relatives, where local interpretation yields a misassignment of thematic roles to nouns. In other words, some patients are no longer able to utilize the information carried by case-markers in certain types of complex sentences, whereas they rely heavily on case-markers in interpreting simple sentences in which the number of lexical items is small.

We will have to analyze why OO and OS relatives are more difficult than Conjoined and SO relatives for Japanese aphasic patients, whereas normals do not normally show such patterns of dissociation in sentence comprehension. It is assumed throughout this thesis that the aphasics' sentence comprehension impairment is due to their failure to correctly assign thematic relations to nouns. It is also assumed that this impairment is due to a deficit in their sentence-processing mechanism, while their knowledge of syntactic structure is kept intact but is not fully available to them in this task (Sproat 1986). One possible analysis of this condition may be formulated in terms of a deficit in the parsing mechanism.

We will adopt the parsing model proposed by Berwick and Weinberg (1984) and originally intended to parse English. This parsing model is able to provide a functional account of certain linguistic constraints within the framework adopted in this thesis. One of the characteristics of Berwick and Weinberg's parser is that it is not allowed to backtrack if it makes an error, i.e. the parser is deterministic. This parser also has the advantage that it reflects human constraints on processing capacity, e.g. memory. The input buffer of this parser is able to hold approximately three constituents. It thus can look ahead to see the words in the succeeding buffer cells as it accesses the word in the first buffer position. It is, thus, a plausible model of a human processor.

We will first try to show how this parser works for Japanese, and will then suggest a possible impairment of the parser in Japanese aphasics. We assume that parsing is executed from left to right. We will assume one of Berwick and Weinberg's basic notions, viz. that in parsing a sentence, an element is not complete until it receives its thematic role (Berwick and Weinberg 1984, p.174).

It should also be noted that, unlike English, where relative pronouns like who and that may signal the beginning of an embedded clause, and sometimes trigger the gap-hunting procedure, Japanese provides no such structural clues preceding the elements of an embedded

clause. Let us compare the normal parsing, for instance, of SO relatives like (5.27) and OS relatives like (5.28).

(5.27) kuma-ga os-i-ta zoo-ga usagi-o tukamae-ta.  
bear-nom push-past elephant-nom rabbit-acc catch-past  
"The elephant that the bear pushed caught the rabbit."

(5.28) kuma-ga zoo-o os-i-ta usagi-o tukamae-ta.  
bear-nom elephant-acc push-past rabbit-acc catch-past  
"The bear caught the rabbit that pushed the elephant."

First, in parsing SO relatives like (5.27), the assignment of thematic roles to NPs by the first verb, os-i-ta, is completed as soon as the parser encounters the second NP, zoo-ga, which appears immediately after this verb. In other words, the parser creates an embedded S-node as soon as it detects the nominative case-marker ga on the second NP. Another cue for the creation of an embedded S-node would be the intonational contour encountered along with the nominative case-marker, i.e. non-falling intonation in (5.27), since the NP zoo-ga is not the sentence-final element.

It is assumed that, as soon as an embedded S-node is created, a gap is also created in an object position before the first verb os-i-ta and is bound to the head of the relative clause, zoo-ga. The head receives the thematic role of Theme from the first verb via the gap in the object position. At this point the embedded S is completed, and so is dropped into the buffer, and the parsing of the rest of the sentence will proceed in the usual way.

In parsing OS relatives such as (5.28), on the other hand, the parser first creates S- and NP-nodes and the first NP, kuma-ga, is attached to the NP-node. Next, the parser must detect the beginning of an embedded clause in order to create another S-node. Here, quite a troublesome problem arises in Japanese. Since the embedded clause is not preceded by a relative pronoun, the creation of an embedded S-node is delayed until the parser encounters the fourth element in the sentence, i.e. the third NP, usagi-o. Berwick and Weinberg's parser

contains a "lookahead buffer", and three words at a time can enter the parser's domain via this buffer. Given this function, when the parser is processing the second NP, zoo-o, and the verb os-i-ta, it can "look ahead" to the third NP, usagi-o. Thus, if the parser operates normally, it can correctly create an S-node after the parsing of the first NP is completed. At this point the parser realizes that the verb which usually signals the end of a sentence in Japanese is not the last element of this sentence, and creates the relative clause whose head is the NP, usagi-o, which appears immediately after the verb os-i-ta.

Thus the parser can correctly create the S-node of an embedded clause and an NP-node as a gap in an embedded subject position. This gap is now co-indexed with the head NP, usagi-o, and the assignment of thematic roles to the second and third NPs, which are required by the first verb os-i-ta, is completed. At the same time, the VP-node in the matrix clause is created and usagi-o is processed as an object of the verb, tukamae-ta, in the matrix clause. Finally, the first NP, kuma-ga, receives its thematic role of Agent from the verb tukamae-ta, and the assignment of thematic roles to all the NPs is completed. The entire sentence is now able to drop into the buffer and is correctly processed.

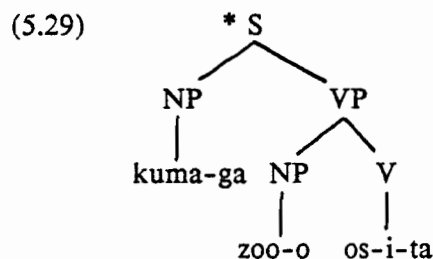
The point here is that one of the functions of a normal parser, i.e. the "lookahead", increases the memory demands of the parsing process, as does the maintenance of more structure in the parser's push-down stacks in OS sentences.<sup>30</sup> This heavy memory load makes sentence interpretation difficult. As a result, it is difficult for a brain-damaged patient to create and maintain an embedded S-node in his memory when parsing an OS relative like (5.28).

Suppose that the aphasic's parser is not able to hold more than three elements in the buffer, or that as soon as the number of NPs in the buffer equals the number of arguments

30. The push-down stack (or, in another term, active node stack) is the data structure containing items that represent phrases that have not yet been completely built, i.e. are active. For example, the matrix S in (5.28) is active because it has not been completely built. It will remain active until all the elements in the sentence are parsed. In contrast, the NP attached to the matrix S is inactive because it has been completely built.

required by a verb, the assignment of thematic roles to nouns is executed. Assuming this limited buffer capacity in the impaired parser and the aphasics' sensitivity to the marker ga, the problem in parsing OS relatives such as (5.28) is already apparent. In parsing the OS relative (5.28), when the parser encounters the first NP it can look ahead to the second NP, zoo-o. At this point, the number of NPs in the active node stack is equal to that necessary for the assignment of thematic roles by the transitive verb, os-i-ta. Thus, the first NP, kuma-ga, is assigned the Agent theta-role and the second NP, zoo-o, is assigned the Theme theta-role. The difference between (5.27) and (5.28) is due the presence of two-ga markers in (5.27). As we will see in the following experiment aphasics are sensitive to the presence of ga. When encountering two gas separated by a verb aphasics, like normals, will know that the first ga NP must be the Agent of an embedded clause modifying the following NP-ga. The patient then correctly assigns Agent theta-role to kuma-ga and the remaining Theme theta-role of the embedded verb to zoo-ga. This NP is dropped into the buffer so that the remaining part of the sentence may be correctly parsed.

Returning back to the sentence (5.28), we can see more precisely the problems that are encountered. Suppose that the aphasic's parser creates a VP-node in processing zoo-o os-i-ta, instead of an embedded S-node after recognizing the first NP in (5.28), and that it then incorrectly attaches this VP to the S-node which dominates the first NP, kuma-ga; the parser would then have incorrectly created the sentence which is diagrammed in (5.29).





At this point the number of NPs in the active node stack is equal to the number of arguments required by the transitive verb os-i-ta. Thus the first NP, kuma-ga, is assigned the Agent thematic role and the second NP, zoo-o, is assigned the Theme theta-role by the first verb. The first NP thus incorrectly receives the Agent theta-role from the first verb. Since the assignment of thematic roles by the first verb is completed, the S-node to which the VP-node is incorrectly attached drops into the buffer. According to the operating principles of the parser, the syntactic structure under the S-node is no longer available for any parsing decisions, with its argument structure being shunted off to the "propositional" domain. Thus, only the S-node is visible in the active node stack. Upon seeing the third NP, usagi-o, with an accusative case-marker attached, the parser will create a VP-node, and this third NP will receive the thematic role of Theme from the verb tukamae-ta. This VP-node needs to attach to the S-node and to assign the Agent thematic role to an NP in order to complete a sentence. At this point, there is an S but no NP available in the active node stack. This is due to the fact that the NP dominated by S is in the "propositional list" and thus is unseen by the element which is operating at present. Hence, the VP cannot be attached to the S-node and the Agent role of the verb tukamae-ta is assigned randomly to either the first NP, kuma-ga, or the second NP zoo-o. As a result, patients exhibit either the (12;13) or the (12;23) pattern of responses.

As was shown in Table 5.9, such error patterns are predominant for OS relatives; the pattern of (12;13) occurs 19 times and the pattern of (12;23) occurs 21 times. Thus patients' random assignment of the second verb's Agent theta-role to either NP1 or NP2 can be correctly accounted for within this model.

In the case of OO relatives, such as (5.19), repeated here as (5.30), the same response patterns can be predicted.

(5.30) kuma-ga zoo-ga os-i-ta usagi-o tukamae-ta.  
 bear-nom elephant-nom push-past rabbit-acc catch-past  
 "The bear caught the rabbit that the elephant pushed."

Similarly to the way in which the parsing of OS relatives was impaired, in OO relatives the parser does not create a gap in preverbal position. Since our results confirmed that case-markers are no longer available to aphasics in complex sentences, the first three elements in the sentence will appear to the patient as is represented in (5.31).

(5.31) kuma . . zoo . . os-i-ta . .

The parser will incorrectly create a structure similar to the one in (5.29); the first NP, kuma will receive the Agent thematic role and the second NP, zoo, the Theme theta-role from the first verb, os-i-ta. The parsing of the rest of the sentence is done in the same way as for OS relatives, namely, patients randomly assign the Agent thematic role of the second verb either to NP1 or to NP2.

As was shown in Table 5.9, the (12;13) pattern occurs 14 times and the (12;23) pattern 19 times in OO relatives. Thus the patients' random assignment of the second verb's Agent theta-role is accounted for, and their predominant error patterns are explained.

The analysis adopted here, based on a parsing model, is one possible analysis accounting for the aphasic patients' deficient sentence-processing mechanism. The impairments hypothesized in the aphasics' parser, such as the space limitations in the buffer and the push-down stack, are compatible with the assumption that brain-damaged patients have a memory deficit. As yet, the results presented here can only be considered suggestive. A more detailed examination of a greater amount of empirical data will be necessary, if they are to be confirmed.

## **Chapter 6**

### **Syntactic Deficits in the Detection of Case-Markers and Postpositions**

In the previous chapter we saw that aphasic patients are unable to assign thematic relations to nouns when interpreting certain types of sentences, and have shown that language-specific factors such as word order and position of embedding affect impairment patterns in sentence comprehension. In this chapter, we will consider another language-specific factor, namely, case-markers and postpositions in Japanese, and investigate whether these closed class items play an important role in sentence comprehension.

More specifically, we will test the Hypotheses (H2) and (H3) formulated in the previous chapter. These hypotheses will be examined in two separate experiments: (H2) in Experiment 3, and (H3) in Experiment 4.

#### **6.1 Experiment 3: Detection of Case-Assigners and Non-Case-Assigners**

The question we are asking in this experiment is whether aphasics show any degree of difference in detecting case-markers which have a Case-assigning function and case-

markers which do not. The hypothesis we are testing and the predictions following from it are repeated here for convenience:

- (H2) Case-markers which have a Case-assigning function tend to be utilized by aphasics during sentence interpretation.

As was explained in Section 3.2, the nominative case-marker ga assigns nominative Case to the subject NP, while the accusative case-marker o does not have a Case-assigning function. Thus, we can make the following prediction concerning sentence interpretation:

- (P1) The nominative case-marker ga is utilized better than the accusative case-marker o.

If (P1) is correct, then we also expect Prediction (P2) to be true for sentence comprehension, and (P3) to be true in grammaticality judgement tasks.

- (P2) Sentences containing nominative case-markers are comprehended better than those without them, while the existence of accusative case-markers does not influence comprehension.
- (P3) Sentences without nominative case-markers are considered unacceptable, while sentences without accusative case-markers are judged to be acceptable.

### **6.1.1 Methods**

#### **6.1.1.1 Subjects**

Thirty aphasic patients served as subjects in this experiment. They were referred by speech therapists in seven different hospitals in Aichi, Gifu, and Himeji, and were selected according to the criterion that they must retain a good single word vocabulary in auditory comprehension. In fact, they are the same group who served as subjects in Experiment 1.

#### **6.1.1.2 Procedure**

Subjects were tested individually either in the hospital or in their homes. Testing was carried out in a quiet room, insulated from the usual hospital or household noises. There were two different tasks involved in this experiment: an object manipulation task and a grammaticality judgement task. The former task was conducted in the same way as in Experiments 1 and 2.

The grammaticality judgement task was introduced to the patient after we had finished the object manipulation task and taken a short break. Patients were asked to respond to the stimuli by pointing to cards on which either a circle (meaning "good") or a cross (meaning "bad") were drawn. Since the task is not straightforward, a practice session was held in which the experimenter, myself, explained the task and went through some examples to make sure that the subjects understood it.

For both tasks, the stimulus sentences were tape-recorded in order to ensure a uniform manner of reading; the deliberate omission of case-markers might have caused stumbling or hesitations, if the sentences had to be read anew each time. A short intonational break was supplied as if the case-markers had in fact been read. I expended considerable care on this aspect of the procedure in order to make the sentences sound natural. Sentences were read once in the object manipulation task and twice in the grammaticality judgement task. Responses were not timed, but all subjects responded rather quickly. Many of them responded after the first reading of a sentence in the judgement task. When a patient requested the repetition of a sentence in the object manipulation task, where it was read only once, the experimenter returned to the sentence in question after all the sentences had been presented by tape-recorder.

The entire session lasted an average of thirty minutes for each individual.

### **6.1.2 Materials**

#### **6.1.2.1 Object Manipulation Task**

The following three conditions were used: (1) no deletion of case-markers, (2) deletion of the accusative case-marker, and (3) deletion of the nominative case-marker. Examples of each type of sentence are presented in (6.1), (6.2), and (6.3), respectively. All sentences were in the active form.

- (6.1) Kuma-ga zoo-o ker-ta.  
           bear-nom elephant-acc kick-past
- (6.2) Kuma-ga zoo- ker-ta.  
           -nom
- (6.3) Kuma- zoo-o ker-ta.  
           -acc

"The bear kicked the elephant."

According to (P2), there should be no difference between an aphasic's performance on (6.1) and (6.2), even though the accusative case-marker o is deleted in (6.2). Patients should comprehend (6.1) and (6.2) equally well, because both sentences contain the nominative case-marker ga. Since the accusative case-marker does not have a Case-assigning function, we expect that its appearance will not influence patients' performance on comprehension. On the other hand, we expect that patients will perform better on (6.1) and (6.2) than on (6.3). This is because in (6.3) the nominative case-marker ga is absent, which would create problems in understanding the sentence. In (6.3), the bare NP must be a topic phrase. Since the topic-marker wa is not obligatory in Japanese, it can be dropped as a matter of stylistic variation. In addition, sentences with non-canonical word order were tested in conditions (6.2) and (6.3); examples of each sentence type are presented in (6.4) and (6.5), respectively.

- (6.4) zoo- kuma-ga ker-ta  
           -nom
- (6.5) zoo-o kuma- ker-ta  
           -acc

"The bear kicked the elephant."

These sentences were added in order to get further confirmation of (H2). Our belief is that, if (H2) is true, (P1) and (P2) should be true for all types of sentences, and not just for sentences with canonical word order. It should be noted that sentences like (6.4) and (6.5) are also grammatical and are frequently used in daily conversation. The bare NPs in (6.4) and (6.5) are topic phrases without a topic marker; in (6.5) the topic phrase is demoted to the

sentence-medial position. Hence, it is not unnatural to present these sentences to patients. We would expect patients to perform better on (6.4) than on (6.5), since the nominative case-marker is absent in (6.5). All the sentence types tested are presented in Table 6.1.



Table 6.1

List of Stimulus Sentences for the  
Object Manipulation Task  
for Experiment 3

- |                           |  |
|---------------------------|--|
| 1. S-O No deletion:       | Kuma-ga zoo-o ketta<br>bear-nom elephant-acc kicked<br>"The bear kicked the elephant." |
| 2. S-O Accusative-absent: | Kuma-ga zoo- ketta<br>-nom<br>"The bear kicked the elephant."                          |
| 3. S-O Nominative-absent: | Kuma- zoo-o ketta<br>-acc<br>"The bear kicked the elephant."                           |
| 4. O-S Accusative-absent: | Kuma- zoo-ga ketta<br>bear elephant-nom kicked<br>"The elephant kicked the bear."      |
| 5. O-S Nominative-absent: | Kuma-o zoo- ketta<br>-acc<br>"The elephant kicked the bear."                           |

The test administered consisted of 25 sentences, 5 of each of the 5 types of which examples are presented in (6.1) to (6.5). In designing the stimuli, five toy animals and five verbs were used.

Nouns:	<u>kuma</u>	"bear"
	<u>zoo</u>	"elephant"
	<u>saru</u>	"monkey"
	<u>usagi</u>	"rabbit"
	<u>kirin</u>	"giraffe"
Verbs:	<u>nadeta</u>	"patted"
	<u>ketta</u>	"kicked"
	<u>tataeta</u>	"knocked down"
	<u>osita</u>	"pushed"
	<u>dakisimeta</u>	"hugged"

The 25 sentences were presented in pseudo-random order. In the same way as in Experiments 1 and 2, the toys were arranged in front of the patient so that the noun phrases having specific thematic roles in each sentence type were represented in each position of the spatial array an equal number of times.

#### 6.1.2.2 Grammaticality Judgement Task

In this task, sentences with either ga or o deleted were used. Some of the examples presented to the patients are shown below.

- (6.6) a. \*Sakana-wa tai- oisii-desu.  
 fish-top red snapper-(nom) delicious-cop-pres  
 "Speaking of fish, red snapper is delicious."
- b. \*Kooen-de-wa syoogakusei-tati-  
 Park-loc-top schoolchildren-pl-(nom)  
 gomi-hiroi-o si-te-imasu.  
 litter-picking-acc doing  
 "In the park, schoolchildren are picking up  
 litter"
- (6.7) a. Okaa-san-ga hon- yom-de-imas-u.  
 mother-nom book-(acc) read-pres  
 "Mother is reading a book."
- b. Mati-de-wa oozei-no hito-tati-ga kaimono-  
 city-in-top many-gen people-nom shopping-(acc)  
 si-te-imasu.  
 doing-pres  
 "In the city, many people are shopping."

In sentence (6.6a), the nominative case-marker ga is deleted in the position adjacent to the subject NP tai "red snapper". Since the adjective oisii "delicious" does not assign nominative Case to tai, the subject NP has no Case, which violates the Case Filter. Thus, the resulting sentence is ungrammatical.<sup>31</sup>

In (6.6b), the subject NP syoogakusei-tati "schoolchildren" does not have any marker assigning Case to it, and thus has no Case. Therefore, the sentence is ungrammatical.

-----  
 31. It should be noted that in the context of (6.6a) the subject NP tai can only take the nominative case-marker ga and not the topic-marker wa. According to Kuno (1973), only one topic NP with the topic-marker wa can appear in a sentence in Japanese. When the combination of NP + wa appears more than once, the first NP is a topic and the remaining NPs have a contrastive meaning. In (6.6a), tai cannot be a topic because there is already a topic NP in the sentence, i.e. sakana-wa. It cannot be a NP taking Contrastive wa either, because no other kind of fish is mentioned. Contrastive wa could be attached to tai only if the sentence contained other information, as in (i).

- (i) Sakana-wa tai-wa oisii-desu-ga, saba-wa  
 fish-top red snapper- delicious-cop-but mackerel-  
 oisi-ku-nai-desu  
 delicious-not-cop  
 "Speaking of fish, red snapper is delicious but  
 mackerel is not."

The case-marker attached to tai could be only ga in (6.6a), and its deletion yields an ungrammatical sentence.

In sentence (6.7a), on the other hand, the accusative case-marker o is not attached to the object NP hon- "book", while the subject NP okaa-san "mother" does have ga. Although the accusative case-marker o is absent, the object NP hon receives Case from the verb yom-; thus the Case Filter is not violated. The sentence is acceptable. The accusative case-marker o is also absent in (6.7b), but the sentence is still grammatical for the same reason as (6.7a): The verb si "do" and not the accusative case-marker assigns Case to the object NP kaimono.

A list of all the stimulus sentences is presented in Table 6.2. Sentence length is evenly varied between the two types of sentences. Sentences are started with a topic NP, when this is necessary, in order that the absent case-marker is not interpreted incorrectly as the topic marker wa. The sentences were presented in pseudo-random order.

Table 6.2

List of Stimuli for the Grammatical  
Judgement Task in Experiment 3

Sentences with the nominative case-marker ga deleted.

1. \*Sakana-wa tai- oisii-desu.  
fish-top red snapper-(nom) delicious-cop-pres.  
"Speaking of fish, red snapper is delicious."
2. \*Nihon-wa Nagoya- sumi-yasui-soo-desu.  
Japan-top Nagoya-(nom) live-easy-seem-pres.  
"Speaking of Japan, Nagoya seems to be a comfortable  
place to live in."
3. \*Kooen-de-wa syoogakusei-tati- gomi-hiroi-o si-te-imas-u.  
Park-loc-top schoolchildren-(nom) litter-picking-acc doing  
"In the park, schoolchildren are picking up litter."
4. \*Kono kurasu-de-wa Yamada-kun- Yosiko-san-o suki-desu.  
this class-loc-top Mr. Yamada-(nom) Yosiko-acc like-pres.  
"In this class, Mr. Yamada likes Yosiko."
5. \*Kyoo-wa otoo-san- bangohan-o tukuri-mas-u.  
Today-top father-(nom) supper-acc cook-pres.  
"Today, my father is cooking supper."

Sentences with the accusative case-marker o deleted.

6. Eki-in-ga kippu- kitte-imas-u.  
station-staff-nom ticket-(acc) punch-pres.  
"A member of the station staff is punching a ticket."
7. Okaa-san-ga hon- yom-de-imas-u.  
mother-nom book-(acc) read-pres.  
"Mother is reading a book."
8. Kinoo-wa Koono-sensei-ga watasi-  
yesterday-top Dr. Koono-nom I-(acc)  
mi-te-kure-masi-ta.  
medical treatment-give-past.  
"Yesterday, Dr. Koono gave me a medical treatment."
9. Haru-ni-wa tutuzi-ga hana- sai-ase-masu.  
spring-in-top azalea-nom blossom-(acc) bloom-cause-pres.  
"In spring, the azaleas are in full bloom."
10. Mati-de-wa oozei-no hito-tati-ga kaimono- si-te-imas-u.  
city-in-top many-gen people-nom shopping-(acc) doing-pres.  
"In the city, many people are shopping."

### 6.1.3 Results and Discussion

#### 6.1.3.1 Results

The questions posed in this study are 1) whether the presence or absence of case-markers affects aphasics' performance on sentence comprehension, and, if this is the case, 2) whether aphasics show different degrees of sensitivity to different case-markers. If case-markers are not important to sentence comprehension, then patients should perform equally well on sentences with and without case-markers. Moreover, if nominative and accusative case-markers are equally important, they should perform equally well on sentences in which either nominative or accusative case-markers are absent in the object manipulation task. In the grammaticality judgement task, they should, if this is the case, be just as likely to respond "bad" to sentences in which accusative case-markers are absent as to those in which nominative case-markers are absent. On the other hand, if they appreciate the differences between nominative and accusative case-marker deletion, they should do well on the grammaticality judgement task.

Table 6.3 presents the means and standard deviations of the subjects' scores for each sentence type in the object manipulation task, and Table 6.4 is the contingency table of stimulus and response for the thirty subjects as a whole in the grammaticality judgement task.

Table 6.3

Results for the Group as a Whole for  
Experiment 3

Sentence Type	<u>Mean</u>	<u>S.D.</u>
S-O No deletion	4.33	0.922
S-O Accusative-absent	4.26	1.112
S-O Nominative-absent	3.50	1.196
O-S Accusative-absent	3.26	1.172
O-S Nominative-absent	2.43	1.590

Results of Tukey's Procedure (Experimentwise error  
rate of 0.05)

SO No deletion	SO Acc- absent	SO Nom- absent	OS Acc- absent	OS Nom- absent
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Sentence types underlined by a common line do not differ  
significantly from each other; sentence types not  
underlined by a common line do differ.

For the object manipulation task, an analysis of variance with repeated measures on the Sentence-Type factor revealed a significant effect of this factor on the number of correct responses ( $F(8,6126) = 21.39, P < 0.0001$ ). Tukey's honestly significant difference procedure was applied at an experimentwise error rate of 0.05 to determine which means differ from others (Winer, 1971). Sentence types SO No Deletion and SO Accusative Absent are significantly easier than other sentence types. Sentence types SO Nominative Absent and OS Nominative Absent are significantly harder than SO No Deletion and SO Accusative Absent. These differences indicate that sentence type has an effect on the number of correct responses.

As for the grammaticality judgement task, we adopted the logic and notation of signal detection analysis. As shown in Table 6.4, Sg and Sb designate well-formed, i.e. good, and ill-formed, i.e. bad, sentences respectively. Thus, Sg indicates sentences with the accusative case-marker absent, and Sb designates those with nominative case-marker absent. Rg designates the response "good", and Rb "bad".



Table 6.4

Contingency Table of Stimulus and Response  
Summarizing Results on Case-marker Drop  
for Thirty Subjects as a Whole.

<u>Stimulus Conditions</u>		<u>Responses of 30 subjects</u>		
	Sg	Sb		
Rg	hits	false alarms	122	28
Rb	misses	correct rejections	30	120

Two very important features of the data can be seen in Table 6.4. First, there is clear evidence of discrimination between sentence types, that is, sentences with accusative case-markers missing are treated differently than those with nominative case-markers missing. To be precise, sentences without accusative case-markers are judged as acceptable while sentences without nominative case-markers are considered unacceptable.

Second, the numbers of false alarms and of misses are nearly the same. That is, there is no distinctive tendency to err either by accepting ill-formed sentences or by rejecting well-formed sentences. The proportion of false alarms (false alarms/false alarms + misses) is 0.48. A non-parametric index of sensitivity,  $A'$ , based upon the estimated area under the receiver-operating-characteristic (Roc) curve is 0.88, which indicates an expected score of 88% correct on a good/bad forced choice procedure with these sentence materials.<sup>32</sup>

The results for all the responses made by the subjects tested are shown in Table 6.5.

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32. To determine this value we used the computational formula developed by Grier (1971):  $A' = 0.5 + (y - x) (1 + y - x) / 4y (1 - x)$  where  $x$  = proportion of false alarms and  $y$  = proportion of hits, i.e.  $x = 0.19$   $y = 0.81$ .

Number of  
test sentences

Order of  
presentation

Normal judgement

Table 6.5

List of All the Responses Made by Thirty Subjects for Experiment 3

			Subject number																																
			1	2	3	6	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33			
1	3	*	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	/	-	-	-	-	-	-	-	-	-	+	-		
2	10	*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	/	-	+	+	-			
3	5	*	-	-	-	-	-	-	-	-	-	+	-	-	+	-	-	-	+	-	-	+	-	-	+	-	/	-	-	-	+	-			
4	9	*	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	+	-	-	+	+	+	-	-	+	-	-	+	+	-			
5	8	*	-	-	-	-	-	-	-	-	-	+	-	-	+	-	-	-	-	-	+	-	-	-	-	-	/	-	-	-	+	-			
6	4	OK	+	+	+	+	-	+	-	-	+	+	-	+	+	-	+	+	+	+	-	+	-	-	+	+	+	+	+	+	+	+	+		
7	2	OK	-	+	+	+	+	+	+	+	+	+	-	+	-	+	-	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+		
8	1	OK	-	+	+	+	+	-	+	+	+	+	-	+	+	-	+	+	+	+	-	+	-	+	+	+	+	+	+	+	+	+	+		
9	7	OK	+	+	+	+	-	+	+	+	-	+	-	+	-	+	-	+	+	+	+	+	+	-	-	+	+	+	+	+	+	+	+		
10	6	OK	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	-	+	+	+	+	+	+	+	+		

Note: OK : Stimulus 'good'  
 \* : Stimulus 'bad'  
 + : Response 'good'  
 - : Response 'bad'  
 / : No response

### 6.1.3.2 Discussion

We will first consider the results obtained in the comprehension tasks. The sentence types with canonical SO order which we tested are repeated below:<sup>33</sup>

- (6.8) S-O No Deletion:  
Kuma-ga zoo-o ketta  
bear-nom elephant-acc kicked.  
"The bear kicked the elephant"
- (6.9) S-O Accusative-Absent:  
Kuma-ga zoo- ketta  
-nom
- (6.10) S-O Nominative-Absent:  
Kuma- zoo-o ketta  
-acc  
"The bear kicked the elephant"

As we predicted in (P2), the presence of the accusative case-marker o did not influence aphasics' performance on comprehension. The means for the sentence types in (6.8) and (6.9) do not differ. On the other hand, the means for sentence types (6.8) and (6.9) differ significantly from that for (6.10). Sentences without nominative case-markers are much more difficult than those with nominative case-markers. This result is rather striking, even though we did expect it. It means that the presence of the nominative case-marker ga has a strong effect on the comprehension of even simple active sentences.

As for sentences with the non-canonical OS order, I tested two types, repeated below:

-----  
33. We treat canonical SO sentences and non-canonical OS sentences separately. This is because the thematic roles of the first and second NPs in the two types of sentences differ. Since we are only examining the effects of case-markers, other factors such as word order should be the same in the examples compared.

(6.11) O-S Accusative-Absent:

Kuma- zoo-ga ketta  
bear elephant-nom kicked  
"The elephant kicked the bear"

(6.12) O-S Nominative-Absent:

Kuma-o zoo- ketta  
-acc  
"The elephant kicked the bear"

The results show that performance is significantly better on (6.11) than on (6.12). Our prediction that sentences containing ga are better comprehended than those without ga is shown also to be true for non-canonical sentence types. If it were not the nominative case-marker ga but the accusative case-marker o which is crucial for comprehension, then performance would be better on (6.12) than on (6.11). The results show that this is not the case. The fact that ga influenced comprehension and o did not indicates that ga is more salient for Japanese aphasics.

Given that, in Japanese, the nominative case-marker is a Case-assigner whereas the accusative case-marker o is not, the results of this experiment show that our hypothesis (H2) has been borne out. That is, our results show that case-markers which have a Case-assigning function tend to be utilised by aphasics during sentence interpretation.

Given that the difference between nominative and accusative case-markers is reflected in aphasics performance on comprehension, we now need to explain why this difference is crucial and how it is realized in the sentence-processing mechanism of aphasics.

In order to do this, we will make two assumptions. First, the noun phrase must have Case in order to receive a thematic role. Second, the process of recovering missing case-markers or topic-markers is difficult and takes up processing capacity in comprehension tasks.<sup>34</sup> In canonical sentences with case-markers, like (6.8), repeated here as (6.13):

(6.13) Kuma-ga zoo-o ketta.  
-----

34. These assumptions were suggested to me by Nancy Hildebrandt.

both the subject NP and the object NP have Case, which is assigned by the nominative case-marker ga and the verb, respectively. Thus, thematic roles can immediately be assigned correctly when aphasics process this sentence. They assign the Agent theta-role to kuma at the same time as they assign the Theme theta-role to zoo.

In sentences in which case-markers are missing, e.g. (6.9) and (6.10), repeated here as (6.14) and (6.15) the difficulty of processing depends on which case-marker is absent.

(6.14) Kuma-ga    zoo-    ketta.

(6.15) Kuma-    zoo-o    ketta.

In (6.14), kuma receives nominative Case from ga and zoo is assigned objective Case by the verb ketta. Since both NPs have Case, the assignment of thematic roles can be executed without problems, as was the case for (6.13). In other words, the accusative case-marker o need not be recovered in order to complete theta-role assignment or Case-assignment, since objective Case is assigned by the verb, not by the accusative case-marker.

In (6.15), on the other hand, where the nominative case-marker ga is missing, the patient will first assign the Theme theta-role to the second NP zoo, which already has objective Case assigned by a verb. At the same time the parser is holding the non-theta-marked NP kuma in the buffer. When the patient processes the transitive verb ketta, he realizes that the verb requires two arguments, Agent and Theme. Then he looks for another NP to assign the Agent thematic role to. Since the first NP kuma is not yet theta-marked, he will assume that it is a candidate for Agency. However, he would not be sure whether it is subject or topic. The bare NP must be licenced by Case to receive a thematic role.

If aphasics do correctly parse the first NP kuma as a topic phrase, and correctly recover the topic marker wa, further computational steps are still required. This topic NP has to be co-indexed with the trace in subject position so that it can get Case. When this is done, the patient will be certain that the bare NP is an Agent. The process of recovering the

topic-marker wa, as well as licensing the bare NP, takes up processing capacity; thus aphasics have a certain amount of difficulty interpreting sentences like (6.15).<sup>35</sup>

We will now turn to sentences with the non-canonical OS order. Sentence types (6.11) and (6.12) repeated here as (6.16) and (6.17), were tested. The results show that performance is significantly better on (6.16) than on (6.17).

(6.16) Kuma        zoo-ga    ketta.

(6.17) Kuma-o     zoo        ketta.

This difference between performance on (6.16) and (6.17) stems from the fact that the nominative case-marker is missing in (6.17), whereas it is present in (6.16). In parsing (6.16), the patient will first realize that the second NP zoo-ga is the subject of the sentence and will assign the Agent theta-role to it. Then the parser will look for another argument to assign the Theme theta-role to. However, the non-theta-marked bare NP Kuma must be Case-marked before it can receive the Theme theta-role. In order to do that, the aphasics' parser has to recover either wa or o for kuma, as this bare NP can be either topic or object. These processes mean that the patients require processing capacity to interpret (6.16).

In parsing (6.17), which was the most difficult task for aphasics, the patients seem to give up trying to recover the topic-marker wa for the bare NP zoo. As a result, they assign the Agent and Theme theta-roles randomly to the NPs in the sentence. The fact that the mean score for sentence type (6.17) is 2.43 out of 5 shows that this is precisely how aphasics performed on this type of sentence.

In the grammaticality judgement task, the aphasics' good performance on both sentences without nominative case-markers and sentences without accusative case-markers -----

35. The term "processing capacity" could be defined in several ways, e.g. the memory load which algorithmic processes place on the parser, or the time and effort required for aphasics to comprehend sentences. Further work which is directed to the construction of a theory of parsing and sentence interpretation in aphasics, as well as in normals, will provide us with a more precise definition of this term.

suggests that they correctly identified the differences between these two case-markers. The results show that aphasic patients are sensitive to ga, which has a Case-assigning function. Although we do not know whether they are sensitive to o or not in the grammaticality judgement task at this moment, not having sufficient data on this task, the present data do suggest that, as hypothesized in (H2), Case-markers which have a Case-assigning function tend to be utilized by aphasics during sentence interpretation. Further work will be directed to the investigation of aphasics' sensitivity to other case-markers and postpositions with respect to their status in terms of Case-assignment. It should also be noted that in the present experiment, I investigated how the absence of different types of case-markers influences the sentence interpretation processes of aphasic patients. It would be interesting to see whether aphasics are also capable of detecting the substitution of case-markers and postpositions. This factor will be considered in Experiment 4, discussed in the following section.

There are several things which should be mentioned here. First, it is clear from the score of the non-parametric index of sensitivity,  $A' = 0.88$ , that aphasic patients are quite sensitive to the presence or absence of case-markers. Second, it is important to note that the rates of false alarms and misses are very similar. This indicates that aphasics are not rejecting sentences just because case-markers are missing. If they dislike sentences without case-markers, then they should have rejected all the stimulus sentences.<sup>36</sup>

The results shown in Table 6.4 and Table 6.5 indicate that aphasics do find the stimulus sentences differentially acceptable, and that acceptability depends on case-markers. The aphasic patients clearly discriminate among the sentences on the basis of which case-marker is missing.

-----  
 36. There was one patient (subject number 14) who rejected almost all the stimulus sentences presented to him (9 out of 10). On the other hand, two patients (subjects 23 and 32) accepted all the sentences presented to them (see Table 6.5). Taking into account the fact that case-marker drop occurs in colloquial speech, there seem to be individual differences in its acceptability to patients.



We must now consider the implications of these case-marker-related effects for the study of aphasia.

#### 6.1.4 Implications for Aphasiology

We have indicated at many points that the results obtained in Experiment 3 show that case-markers play an important role in sentence comprehension in Japanese, and that the nominative case-marker ga tends to be more salient for aphasics than the accusative case-marker o and is utilized by them during sentence comprehension.

I tested aphasics' performance on the distinction between ga and o with two different tasks, a comprehension task and an acceptability judgement task. Both tasks revealed the aphasics' strong sensitivity to the nominative case-marker.

As we hypothesized at the beginning of Experiment 3, the different effects of nominative and accusative case-markers on aphasics' performance could be attributed to the different status of the case-markers with respect to Case-assignment. Although we are not claiming that this is the only possible explanation of the aphasics' performance on comprehension of case-markers, it is certainly a reasonable hypothesis.

Furthermore, once we adopt this explanation for the aphasics' performance with respect to closed class vocabulary, we are able to compare our findings for Japanese with those for other languages. For instance, in English, which is a non-case-marking language, there can obviously be no data on aphasics' performance on case-markers. Instead, English has different kinds of prepositions. Consider, for example, for in sentence (6.18) and of in (6.19).

(6.18) John bought a book for Mary.

(6.19) John is very fond of Mary.

In (6.18), for is a Case-assigner for Mary and also a theta-role assigner, i.e. it assigns the Goal theta-role to Mary. In (6.19), on the other hand, the preposition of assigns Case but no theta-role to Mary. It is the adjective fond that assigns the Theme theta-role to Mary. These two prepositions differ not in their Case-assigning function but in their theta-role assigning properties, i.e. for is a theta-role assigner but of is not. If English aphasics show a different degree of sensitivity to these two types of prepositions in sentence comprehension tasks, then one might be able to attribute their performance to the theta-role assigning properties of the prepositions. Unfortunately, at the present time, there are no reliable data on English aphasics' comprehension of prepositions. Thus, we cannot yet compare our findings for Japanese case-markers with their counterparts in English.

However, there are at least three important points to be mentioned. First, the syntactic determinants of sentence comprehension in aphasics differ depending on the characteristic features of their native language. In non-case-marking languages such as English, word order might be the most crucial syntactic determinant in sentence interpretation. On the other hand, in case-marking languages such as Japanese, word order and case-markers are the most important factors influencing aphasics' performance on sentence comprehension. Although I do not know to what extent English aphasics rely on information from prepositions and determiners in comprehending sentences, it is clear that Japanese aphasics use nominative case-markers as one of the most important cues for the assignment of thematic roles in sentence interpretation. Thus, it would seem that the importance of closed class items in sentence comprehension differs, depending on the structure of the language.

Second, if it is the case that the theory of theta-role assignment is able to explain aphasics' performance on closed class vocabulary in non-case-marking languages such as English, a comparable determinant of the aphasics' behavior for case-marking languages like Japanese might be the theory of Case-assignment. The results obtained in Experiment 3 suggest that the accusative case-marker o behaves similarly to the preposition of in English, in that it is relatively unimportant in comprehension and tends to go unutilised. On the other hand, the Case-assigning nominative case-marker ga behaves like a theta-role assigner, such as for in English, in that it plays an important role in the assignment of thematic relations in comprehension.

Third, we find in Experiment 1 that, as predicted in (IR-X) (see footnote 26), Japanese aphasics tend to assign the Theme theta-role to the immediately preverbal noun, irrespective of the category order of nouns and verbs. In other words, as soon as they hear the N-V sequence, they recognize that the noun immediately preceding the verb is the Theme and has the grammatical relation of Object. It was mentioned in Section 3.1 that, in Japanese, it is not the accusative case-marker but the verb that assigns Objective Case, and that it directly assigns the Theme theta-role to the object NP which is its internal argument and for which it is subcategorized. Furthermore, Case- and theta-role assignment is always executed from right to left in Japanese. It now seems fairly clear that Japanese aphasics attempt to preserve the integrity of VP. As is shown in Table 6.6, in sentences in which the integrity of VP breaks down, such as AN, PCO and passives, patients perform quite badly at interpretation.

By contrast, it has been reported that English aphasics tend to assign the Theme theta-role to the NP immediately preceded by the verb (Caplan, in press). That is, they recognize that in the sequence V-N the noun immediately following the verb is the Theme and the object of the verb, and thus is the internal argument and the complement for which

the verb is subcategorized. It also seems to be the case that, like Japanese aphasics, English aphasics try to preserve the integrity of VP, and that when this integrity breaks down, they perform badly; this accounts for their poor performance on sentences such as passives and cleft-object sentences.

It seems that the strong relationship between the verb and its object, rather than its subject, in sentence comprehension both in Japanese and English may stem from the way in which theta-roles are assigned to nouns (or arguments). That is, the object is an internal argument of a verb, and that verb directly assigns the Theme theta-role to its object NP. The subject, on the other hand, is the external argument of a verb, and that verb indirectly assigns the Agent theta-role to it. It might be said that the distinctions between direct versus indirect theta-marking, and between external versus internal argument, are reflected in aphasics' performance on sentence comprehension.

Furthermore, it seems to be the case that when Case-assignment and theta-role assignment conform to their directionality in the normal grammar of a language (Koopman 1984), and the conditions governing these theories are satisfied (e.g. the adjacency condition on Case-assignment (Stowell 1981)), aphasic speakers of that language tend to perform well at sentence comprehension. On the other hand, when the directionality of Case- and/or theta-role assignment is not the normal one, or when the conditions governing these functions are not satisfied, aphasics tend to perform badly. Thus, we may say that Case-assignment, Theta-role assignment and their respective directionalities in a given language play a role in the theory of sentence comprehension, and that they can be a basis for aphasic patients' heuristic strategies for sentence comprehension.<sup>37</sup>

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37. Interestingly enough, a similar claim is made by Kamio (1985) concerning production in aphasics. He examined Japanese, French, and Hindi agrammatic aphasics' speech and found that when the direction of control is in accordance with the direction of government, the forms of target sentences tend to be retained. Given that the assignment of Case is defined in terms of Government within the framework adopted in this thesis, this approach seems to be fruitful in that it seems to have yielded results both in production and comprehension tasks (i.e. in Kamio's and my own work, respectively). Further work needs to be directed to other linguistic elements which fall

Finally, our results support the Case-theory of Japanese proposed by Saito (1982, 1985), in that aphasics make a clear-cut distinction between the acceptability of sentences without nominative case-markers and the acceptability of sentences without accusative case-markers, as well as evidencing a dissociation in the comprehension task. These differences in acceptability and in the difficulty of sentence comprehension suggest that the nominative and accusative case-markers are different with respect to the Case-assigning feature; this supports Saito's proposed subject/object asymmetry with respect to the assignment of abstract Case. Thus, our data from brain-damaged subjects indirectly support the configurational analysis of Japanese.

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within the scope of Case- and Theta-theories, and also to the relationship between comprehension and production in terms of these theories.

Table 6.6

Comparison of English and Japanese  
with Respect to the Position of  
the Verb and its Object

	English	Japanese
Case-assignment	Left to right	Right to left
Theta-role assignment	Left to right	Right to left
SA	$\begin{array}{c} \text{N-V-N} \\ \text{Th} \end{array} \quad (\text{L} \rightarrow \text{R})$	$\begin{array}{c} \text{N-N-V} \\ \text{Th} \end{array} \quad (\text{R} \rightarrow \text{L})$
(P)CS	$\begin{array}{c} \text{N-V-N} \\ \text{Th} \end{array} \quad (\text{L} \rightarrow \text{R})$	$\begin{array}{c} \text{N-V-N} \\ \text{Th} \end{array} \quad (\text{R} \rightarrow \text{L})$
AN	----	$\begin{array}{c} \text{N-N-V} \\ \text{Th} \end{array} \quad (\text{not adjacent})$
(P)CO	$\begin{array}{c} \text{N-N-V} \\ \text{Th} \end{array} \quad (\text{R} \rightarrow \text{L}), \quad (\text{not adjacent})$	$\begin{array}{c} \text{N-V-N} \\ \text{Th} \end{array} \quad (\text{L} \rightarrow \text{R})$
Passive	$\begin{array}{c} \text{N-V-N} \\ \text{Th} \end{array} \quad (\text{R} \rightarrow \text{L})$	$\begin{array}{c} \text{N-N-V} \\ \text{Th} \end{array} \quad (\text{not adjacent})$

## 6.2 Experiment 4: Detection of Lexically Determined and Syntactically Determined Case-Markers

This section is mainly motivated by the "Lexical node hypothesis" proposed by Caplan (1983a). As was explained in Chapter 2, this hypothesis predicts that the syntactic representation available to aphasics comprises information contained in the lexical entries of open class items, e.g. subcategorization frames, as well as semantic information, such as the thematic roles of nouns and selectional restrictions of predicates. If this is correct, we can posit an interesting distinction between case-markers and postpositions.

In Japanese there is a distinction between case-markers and postpositions which are lexically determined and those determined by operations which are not lexical in nature. The questions we must ask are (1) whether aphasic patients exhibit a dissociation between these two types of case-markers in judgement tasks, and, if they do, (2) what are the implications of this dissociation for the nature of syntactic deficits in sentence comprehension in Japanese aphasics.

The hypothesis we will test is repeated here:

- (H3) The distinction between lexically determined case-markers and syntactically determined case-markers is reflected in aphasics' performance on grammaticality judgement tasks.

Hypothesis (H3) is based on the following assumptions:

- (i) In Experiment 1 and Experiment 2, we found that Japanese aphasics had trouble understanding passive sentences and sentences with non-canonical word order, while simple active sentences were overwhelmingly easier to interpret.

- (ii) In Japanese, passive sentences are derived by the grammatical operation "move alpha" and a morphological operation, i.e. the absorption of the Case-assigning feature by the passive morpheme rare. Sentences with non-canonical word order are derived by the movement operation "scrambling", by means of which an object NP is moved from its original position into the sentence-initial position and adjoined to S. Active sentences, on the other hand, do not involve such operations.<sup>38</sup>

If one of the possible impairments of sentence comprehension in aphasic patients is due to their insensitivity to those syntactic and morphological operations, while they retain lexical information such as the concept of thematic roles and selectional restrictions, it would not be unreasonable to speculate that evidence to this effect would appear in aphasics' detection of case-markers and postpositions in Japanese. The findings of Experiment 3 indirectly support our prediction.

- (iii) In Experiment 3, we found that there is a performance dissociation between Case-assigning case-markers and non-Case-assigning case-markers in sentence comprehension and in grammaticality judgement tasks.

Although the feature of case-markers which was examined in Experiment 3, i.e. Case-assignment, is slightly different from the subject of Experiment 4, i.e. lexically determined and syntactically determined case-markers, the basic assumptions are the same: i.e. that deficits in sentence comprehension are syntactic not lexical in nature, and that the different features contained in case-markers are reflected in aphasics' performance on sentence interpretation.

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38. Saito (1985) claims that "scrambling" is an instance of "move alpha" in Japanese. According to his analysis, sentences with the non-canonical word order "N-acc N-nom V" are derived by means of the movement of the object NP from the position dominated by VP to the sentence-initial position dominated by S, leaving a trace in its original position.



If aphasics are sensitive to lexical information but insensitive to nonlexical operations, e.g. passivization and scrambling, our prediction concerning their performance on a grammaticality judgement task would be as follows:

- (P4) Lexically determined case-markers are better detected than syntactically determined case-markers.

#### **6.2.1 Methods**

##### **6.2.1.1 Subjects**

The thirty aphasic patients tested here are the same group who also served as subjects in Experiment 1 and Experiment 3.

##### **6.2.1.2 Procedure**

Subjects were tested individually either in the hospital or at home. Testing was carried out in the same way as for the grammaticality judgement task in Experiment 3. The test sentences were recorded on tape and each sentence was read twice, slowly but with normal intonation. In the case of the ungrammatical sentences, each was read with the intonational contour appropriate to a well-formed sentence with the substitution of pauses for case-markers or postpositions. I devoted a considerable amount of care to this procedure in order to avoid anomalous intonation, which would be a potential cue to the ungrammaticality of a sentence. Each sentence was read twice. Responses were not timed. Patients were asked to respond by pointing to a card on which either a circle (meaning "good") or a cross

(meaning "bad") was drawn. The entire session lasted an average of twenty minutes for each patient.

### 6.2.2 Materials

Subjects made judgements on a total of twenty sentences, of which ten were ill-formed. The sentences I tested comprised two types: some contained lexically determined case-markers and postpositions, and others had syntactically determined case-markers. The particle ni, for instance, has several different meanings, as shown in the following sentences.

- (6.20) uti-no niwa-ni sakura-no  
house-gen yard-loc cherry blossom-gen  
ki-ga ari-masu.  
tree-nom exist-pres-polite.  
"There is a flowering cherry tree in my yard."
- (6.21) sensei-ga gakusei-ni suugaku-o  
teacher-nom student-dat mathematics-acc  
benkyoo-sase-mas-i-ta.  
study-causative-past.  
"The teacher made the student study mathematics."

In sentence (6.20), ni is a locative marker and is required by the selectional restrictions of the stative verb aru "to exist". This verb obligatorily selects ni instead of de, which is also a locative marker. (De is required by action verbs such as oyogu "to swim".) Sentence (6.21), on the other hand, is derived from gakusei-ga suugaku-o benkyoo-suru "The student studies mathematics", which is the non-causative form. This derivational process of causativization, called "Internalization of Theme", was discussed in Chapter 3. This morphological operation changes the thematic role of the noun as well as the case-marker assigned to it from ga to o. The syntactic component then forces the further change of the case-marker from o to ni by

the surface constraint on the case-marking mechanism. As a result, the dative case-marker ni is required in that position, rather than other case-markers, such as ga or o.

The sentences consisted of five grammatical and five ungrammatical sentences of each type. Lexical items in the paired sentences, i.e. well-formed and ill-formed sentences, were different because of the small number of the stimulus sentences. The sentences were presented in a pseudo-random order. For sentences with lexically determined case-markers and postpositions (Condition A), we used intransitive, transitive, double object, and locative verbs. For sentences with syntactically determined case-markers (Condition B), causative sentences and sentences with obligatory case-marker deletion were used. Table 6.7 summarizes this information. All of the stimulus sentences are given in Table 6.8. (For a detailed analysis of the stimulus sentences, see Chapter 3.)

Table 6.7

Conditions on Case-markers and  
Sentence Types Used for Experiment 4

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Conditions

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A: Lexically determined case-markers  
and postpositions:

1. intransitive verb
2. transitive verb
3. double object verb
4. locative verb [+stative]
5. locative verb [-stative]

B: Syntactically determined case-markers:

6. intransitive causative
  7. transitive causative, (i)
  8. transitive causative, (ii)
  9. ga-deletion
  10. o-deletion
-

Table 6.8

List of stimulus sentences with lexically  
determined and syntactically determined case-markers.

Condition A:

Sentences with lexically determined case-markers and postpositions.

- 1.a. Kaze-ga hui-te boosi-ga tob-de-simai-masi-ta.  
wind-nom blow-cnjp hat-nom blown off-past-perf.  
"The wind blew and (someone's) hat was blown off."
- 1.b. \*Ame-ga hur-te hanabira-\*o tir-te-simai-masi-ta.  
rain-nom fall-cnjp flower petal-\*acc fall-past-perf-pol.  
"Since it was raining, the petals fell off the flowers."
- 2.a. Kato-san-ga osusi-o tabe-masi-ta.  
Mr. Kato-nom sushi-acc eat-past.  
"Mr. Kato ate sushi."
- 2.b. \*Otoo-san-ga sinbun-\*ni yom-i-masi-ta.  
Father-nom newspaper-\*dat read-past.  
"My father read a newspaper."
- 3.a. Yamasita-san-ga onna-no ko-ni ohana-o age-masi-ta.  
Mr. Yamasita-nom girl-dat flower-acc give-pol-past.  
"Mr. Yamasita gave flowers to a girl."
- 3.b. \*Ueda-san-ga otoko-no hito-\*kara hon-o age-masi-ta.  
Ms. Ueda-nom man-gen person-\*from book-acc give-pol-past.  
"Ms. Ueda gave a book to a man."
- 4.a. Uti-no niwa-ni sakura-no ki-ga ari-mas-u.  
my house-gen yard-loc cherry blossom-gen tree-nom exist-pres  
"There is a flowering cherry tree in my yard."
- 4.b. \*Otera-no niwa-\*de ike-ga ari-mas-u.  
temple-gen garden-loc pond-nom exist-pres.  
"There is a pond in the garden of the temple."
- 5.a. Kodomo-tati-ga nohara-de e-o kak-i-te-imas-u.  
children-nom field-loc picture-acc draw-pres.  
"Children are drawing pictures in the field."
- 5.b. \*Kodomo-tati-ga kooen-\*ni nawatobi-o si-te-imas-u.  
children-nom park-loc jumping rope-acc do-pres.  
"Children are jumping rope in the park."

Table 6.8 (continued)

Condition B:

Sentences with syntactically determined case-markers.

- 6.a. Watasi-wa kuruma-o hasir-ase-masi-ta.  
I-top car-acc run-cause-polite-past.  
"I made a car run."
- 6.b. \*Watasi-wa haguruma-\*ni kaiten-sase-masi-ta.  
I-top gearwheel-\*dat turn-cause-polite-past.  
"I made a gear turn."
- 7.a. Sensei-ga gakusei-ni suugaku-o  
teacher-nom student-dat mathematics-acc  
benkyoo-sase-masi-ta  
study-cause-polite-past.  
"The teacher made the student study mathematics."
- 7.b. \*Sensei-ga gakusei-\*ga buturi-o  
teacher-nom student-\*nom physics-acc  
benkyoo-sase-masi-ta.  
study-cause-polite-past.  
"The teacher made the student study physics."
- 8.a. Okaasan-ga kodomo-ni kinoo asob-da heya-o  
mother-nom child-dat yesterday play-cop room-acc  
katatuke-sase-masi-ta.  
clean-cause-polite-past.  
"Mother made the child clean the room s/he played in  
yesterday."
- 8.b. \*Otoo-san-ga kodomo-\*o kyoo kat-te-kita hon-o  
father-nom child-\*acc today bought book-acc  
yom-ase-masi-ta.  
read-cause-polite-past.  
"Father made the child read the book he bought today."
- 9.a. Tiisa-na kodomo-demo zitsensya-ni not-te-imas-u.  
small child-even bicycle-on ride-pres.  
"There is even a small child riding a bicycle."
- 9.b. \*Tosiyori-no obaasan-\*ga-demo pool-de oyoi-de-imas-u.  
old-gen woman-\*nom-even pool-in swimming-pres.  
"There is even an old woman swimming in the pool."
- 10.a. Yamada-san-wa oniku-dake tabe-masi-ta.  
Mr. Yamada-top meat-only eat-pol-past.  
"As for Mr. Yamada, he ate only meat."
- 10.b. \*Kato-san-wa yasai-\*o-dake tabe-masi-ta.  
Mr.Kato-top vegetables-\*acc-only eat-polite-past.  
"As for Mr Kato, he ate only vegetables."

Table 6.8 (continued)

NB: nom=nominative case-marker  
acc=accusative case-marker  
dat=dative case-marker  
loc=locative marker  
gen=genitive marker  
cause=causative morpheme

cnjp=conjunctive particle  
cop=copula  
pol=polite morpheme  
pl=plural  
pres=present tense  
perf=perfect tense

### 6.2.3 Results and Discussion

#### 6.2.3.1 Results

We saw in the previous experiment that aphasics are strongly sensitive to the absence of case-markers. The questions posed in this experiment are 1) whether or not aphasics are capable of detecting substitutions of these items, and, if they are, then 2) is there any difference between their performance on lexical case-markers and case-markers which are put in place by morphological and other operations.

The answer to the first question can be found in Table 6.9, which is the contingency table of stimulus and response for Condition A and Condition B for the thirty subjects as a whole. The analysis we have adopted in the present experiment is the same as the one for Experiment 3, i.e. a signal detection analysis. The notations Sg and Sb indicate well-formed and ill-formed sentences respectively. Rg indicates the response "good", and Rb, "bad". The critical cells of the contingency table are those that represent "hits" ( $P(Rg/Sg)$ ), the proportion of well-formed sentences to which the subject responds "good": and "false alarms" ( $P(Rg/Sb)$ ), the proportion of ill-formed sentences to which the subject replies "good".



Table 6.9

Contingency Tables of Stimulus and Response Summarizing Results on Two Conditions for Thirty Subjects as a Whole.

Stimulus Conditions

	Sg	Sb
Rg	hits	false alarms
Rb	misses	correct rejections

Condition A

144	27
6	123

Condition B

134	50
16	100

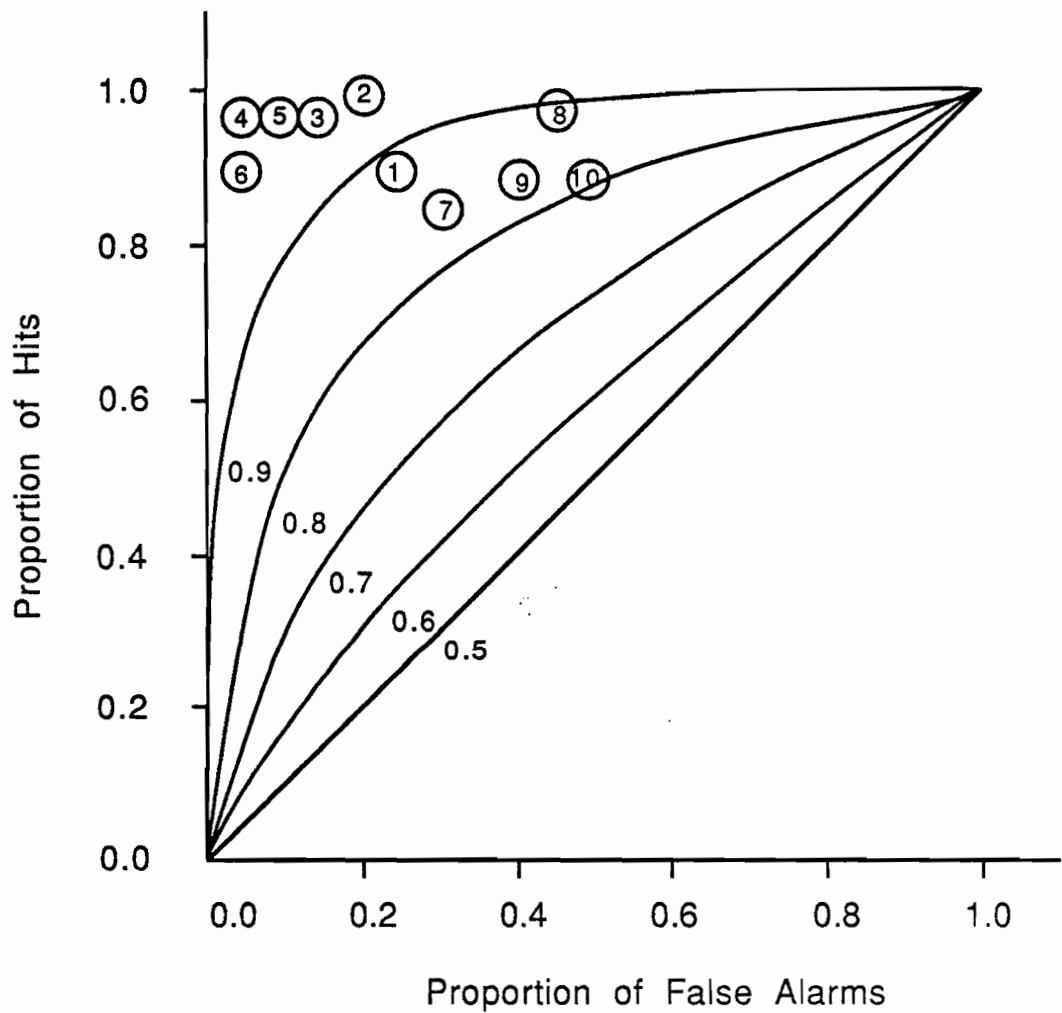
First, there is clear evidence of discrimination in both conditions, i.e. well-formed sentences are treated differently from ill-formed ones. Second, in both conditions, the tendency is to err by accepting ill-formed sentences, rather than rejecting well-formed ones. Thus, the proportion of false alarms (false alarms/false alarms+misses) is 0.82 for Condition A and 0.76 for Condition B.

In order to answer the second question posed above, I applied the Wilcoxon matched-pairs signed-ranks test to see whether the scores for the sentences in Condition A and those in Condition B differ (Siegel, 1956). There are 8 cases of ties, 18 negative cases (mean rank = 12.17), and 4 positive cases (mean rank = 8.50). We can see that the number of correct answers is significantly lower for Condition B than for Condition A ( $p < .01$ ).

More details are provided in Figure 6.1, where patients' performance as a whole for each sentence is represented as a point on the conventional unit square of signal detection analysis. A non-parametric index of sensitivity,  $A'$ , was used to identify the fixed level of sensitivity to the sentences whose conditions are defined in Table 6.7. For instance, point number one indicates the patients' performance on good and bad sentences with intransitive verbs and lexically required case-markers.

Figure 6.1

A Breakdown of Performance by Condition of Case-markers and Postpositions for Thirty Subjects as a Group. The proportion of hits is plotted against the proportion of false alarms. Each numbered point represents the outcome for one sentence type (e.g. point number one summarizes performance on good and bad sentences with intransitive verbs and lexically derived case-markers).



The cluster of points in the upper left corner of the square testifies to the accuracy of patients' discrimination. Most of the sentences with lexically required case-markers and postpositions (points two to five) and the intransitive causative sentence (point six) cluster in this area. Although the tendency is rather slight, the two transitive causative sentences (points seven and eight) and the sentences with ga or o deletion fall out of the cluster of points. The simple intransitive sentence (point one) lies on the edge of the cluster of points.

Table 6.10 presents the values of A' for all sentences in the two conditions. The value of A' can be interpreted such that an A' value of 0.96, for instance, translates as an expected score of 96% correct on a good/bad forced choice procedure with these sentence materials. Figure 6.2 represents the histogram of value of A' versus condition of case-markers and postpositions. The list of all responses made by the subjects is shown in Table 6.11.

Table 6.10

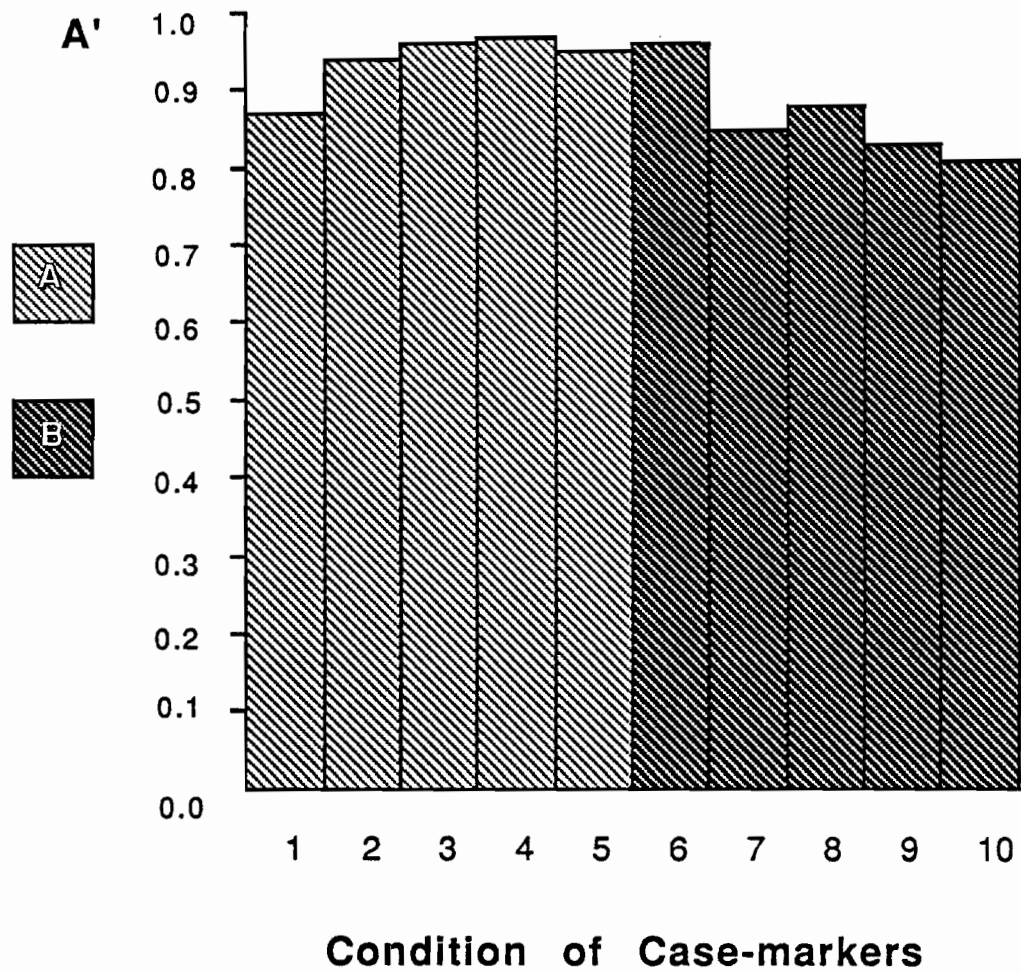
Grammaticality Judgements on  
Case-Markers by Thirty Subjects

Condition	Hits <sup>a</sup>	False <sup>b</sup> Alarms	A' <sup>c</sup>
<b>Lexical</b>			
1	0.90	0.27	0.87
2	1.00	0.23	0.94
3	0.97	0.13	0.96
4	0.97	0.10	0.97
5	0.97	0.16	0.95
<b>Non-lexical</b>			
6	0.93	0.07	0.96
7	0.83	0.30	0.85
8	0.97	0.43	0.88
9	0.87	0.40	0.83
10	0.87	0.46	0.81

Note a: P(Rg/Sg), i.e. "good" responses to well-formed sentences,  
 b: P(Rg/Sb), i.e. "good" responses to ill-formed sentences,  
 c: A' = index of sensitivity;  
 $A' = 0.5 + (y - x) (1 + y - x) / 4y (1 - x)$   
 where  $x = P(Rg/Sg)$  and  $y = P(Rg/Sb)$

Figure 6.2

Histogram of Value of A' Versus Condition of Case-markers and Postpositions.



Number of  
test sentences  
Order of  
presentation  
Normal judgement

Table 6.11

List of All the Responses Made by Thirty Subjects for Experiment 4

			Subject number																																
			1	2	3	6	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33			
1a	1	OK	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	-	+	+	+	+	-	+	+	+	+	+	+		
b	4	*	-	-	+	-	-	-	-	+	-	-	-	+	-	-	-	-	-	-	-	-	-	-	+	+	+	-	-	+	/	-			
2a	5	OK	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+			
b	13	*	-	-	-	-	-	+	-	-	-	-	-	+	-	-	-	-	+	+	-	-	-	-	-	-	+	-	-	+	/	-			
3a	8	OK	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+			
b	17	*	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	+	+	-	-	+	-			
4a	2	OK	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+			
b	9	*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	+	-	+	-	-	-	-	-			
5a	16	OK	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+			
b	11	*	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	+	-	-	-	+	-	+	-	+	-	-	-	-	-			
6a	18	OK	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	-	+	+	+	+	+	+	+			
b	3	*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+	-	-	-	-			
7a	7	OK	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	-	-	+	+	+	+	+	+	+	+	-			
b	15	*	+	-	-	+	-	-	-	+	-	-	-	-	+	+	-	-	-	-	-	-	-	+	-	-	+	+	-	-	+	-			
8a	12	OK	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+			
b	19	*	+	-	-	-	-	-	-	+	-	+	-	-	+	+	-	+	+	-	-	+	+	-	+	+	+	-	-	-	-	+			
9a	14	OK	+	+	+	+	+	+	+	+	+	-	+	+	-	+	+	+	+	-	+	-	+	+	+	+	+	+	+	+	+	+			
b	10	*	+	-	-	-	-	-	-	-	-	+	-	-	-	+	-	-	-	+	+	-	+	+	-	+	/	+	-	+	+	-			
10a	20	OK	+	+	+	+	+	+	+	+	+	+	+	-	+	-	+	+	-	+	+	+	+	-	+	+	+	+	+	+	+	+			
b	6	*	+	+	-	-	-	-	-	-	-	-	-	+	+	+	-	-	-	+	-	+	+	-	+	+	+	-	-	+	+	+			

Note: OK: Stimulus 'good'; \*: stimulus 'bad'; + : response 'good'; -: response 'bad'; /: no response

#### 6.2.3.2 Discussion

At the beginning of this section, we posed three questions, repeated below:

- (1) Are aphasics sensitive to the substitution as well as the absence of case-markers?
- (2) Is there any difference in their performance on sentences with lexical case-markers and sentences with case-markers which are the products of morphological and syntactic operations? That is, do the present data support the Hypothesis (H3)?
- (3) What are the implications of the patients' performance on the grammaticality judgement task for our understanding of the nature of syntactic deficits in sentence comprehension?

We will consider these three points in order. First, as can be seen in Table 6.9 and Figure 6.1, Japanese aphasics are quite aware of when case-markers and postpositions are used incorrectly. In other words, they are capable of detecting case-markers to some extent, although their degree of sensitivity to them depends on the type of case-markers.

Second, the statistical result of the comparison of the sentences in Condition A and those in Condition B was significant. Thus, Hypothesis (H3) is supported and prediction (P3) has been borne out. That is, there is a dissociation between performance on sentences with lexically determined case-markers and performance on sentences with syntactically determined case-markers: the former are comprehended better than the latter.

In order to answer the third question, we must examine the data more closely. Within each condition, there was one sentence which did not behave in the predicted fashion.



In Condition A, performance on the simple intransitive sentence type was not as good as on other sentences. In Condition B, performance on intransitive causative sentences was much better than on other causative sentences. The exceptional behavior of these sentences cannot be attributed to sentence length. In Condition A, the length of double object sentences such as (6.23), and of locative sentences is roughly equal to that of intransitive sentences, such as (6.22).

- (6.22) Kaze-ga hui-te, boosi-ga tonde-simai-masita.  
 wind-nom blow-cnjp hat-nom blown off-past-perf  
 "As the wind blew, my/his hat had been blown off."
- (6.23) Yamasita-san-ga onnano ko-ni ohana-o age-masita.  
 Mr. Yamasita-nom girl-dat flower-acc give-past  
 "Mr. Yamasita gave flowers to a girl."

The rather low score for intransitive sentences may be due to the fact that they contain subordinate clauses, making them more complex than the other sentences.

Among the sentences in Condition B, the intransitive causative sentences like (6.24) have the same length as sentences with obligatory case-marker deletion like (6.25).

- (6.24) a. Watasi-wa kuruma-o hasir-ase-masi-ta.  
 I-top car-acc run-causative-past  
 "I made a car run."  
 b. \*Watasi-wa haguruma-ni kaiten-sase-masi-ta.  
 I-top gear-dat turn-causative-past  
 "I made a gear turn."
- (6.25) a. Yamada-san-wa oniku-dake tabe-masi-ta.  
 Mr. Yamada-top meat-only eat-past  
 "Mr. Yamada ate only meat."  
 b. \*Kato-san-wa yasai-o-dake tabe-masi-ta.  
 Mr. Kato-top vegetables-acc-only eat-past  
 "Mr. Kato ate only vegetables."

Aphasics performed nearly perfectly on the sentences in (6.24), but quite badly on the sentences in (6.25).

As we have seen, the sentences in Condition B involve either a morpho-syntactic operation (i.e. causative sentences) or a stylistic deletion operation. It is particularly important to note that the morpho-syntactic operation not only substitutes one case-marker for another (i.e. ni for ga) but also changes the thematic roles of nouns such that the Agent NP in the non-causative form is changed into the Theme NP in the causative form. If aphasics do not understand the thematic roles of nouns, then they would have no way of knowing whether the appropriate case-marker is attached to a given noun.

On the other hand, the sentences of Condition A do not involve such operations. Both the thematic roles of nouns and their case-markers are determined simply by the selectional restrictions of the predicates.

The aphasics' bad performance on sentences with case-marker deletion, e.g. (6.25), could be due to the possibility that a focusing adverbial particle like dake "only" or demo "even" behaves like another case-marker immediately following the original case-marker as in \*yasai-o-dake. As a result, the patients might be able to detect only the focusing particles and not the nominative or accusative case-markers in the ill-formed sentences. Their tendency to err in the direction of accepting the ill-formed sentences suggests that they heard such sentences as if they were their well-formed counterparts.

Returning to the question of what these results tell us about impairments to Japanese aphasics' sentence comprehension, several possible sources of impairments are suggested. First, as we found in the present experiment, aphasics are less capable of handling sentences in which case-markers are determined by morpho-syntactic and stylistic deletion operations. They seem to be less sensitive to the change in case-markers as well as in the thematic roles of nouns in sentences which have been determined by means of some operation. Given that they are quite insensitive to these non-lexical operations, while they have a fairly accurate knowledge of case-markers and postpositions which are selected by predicates, it could be the

case that this dissociation reflects a disruption of their linguistic knowledge, which might also be manifested in other tasks, e.g. sentence comprehension. I am not saying that knowledge deficits and deficits in on-line sentence interpretation should always co-occur. This is certainly not the case, as has been shown in studies of English aphasics (Linebarger et al., 1983). But I am saying that the somewhat reduced detectability of syntactically determined case-markers, as well as the change in the thematic roles of nouns, could be one possible source of impairments to sentence comprehension. Although I did not test the same sentences in both comprehension and judgement tasks, my results suggest that comprehension deficits stemming from a failure to assign thematic roles to nouns could reflect aphasics' reduced sensitivity to closed class vocabulary, such as case-markers, and to the change in the thematic roles of nouns resulting from various morphological processes.

## Chapter 7

### Conclusion

In this study of sentence comprehension disturbances in Japanese aphasics, we have revealed several important aspects of the sentence-processing mechanism in aphasics.

We began by exploring the idea that the grammar of aphasics retains such notions as the "primitive basis of concepts" and "epistemological priority", but not structural notions like "dominance" and grammatical relations like "subject" and "object". On the basis of this idea, I hypothesized that the ease of processing the category order of nouns and verbs is determined by the "epistemological priority" factor in brain-damaged subjects: this is the *Epistemological hypothesis*. This hypothesis predicts that the sequence N-N-V is harder than N-V-N for brain-damaged subjects to process, regardless of whether the canonical category order of their native language is N-V-N or N-N-V.

As we saw in Chapter 5, the statistical results obtained in Experiments 1 and 2 on the comparison of sentence types with the N-N-V and N-V-N orders show that both of them are equally easy to interpret for Japanese aphasics, whose canonical category order is N-N-V. Thus the data from Japanese aphasics falsify the *Epistemological hypothesis*. The fact that the markedness and/or canonicity of the word order of a sentence does not play an important role in its comprehension by Japanese aphasics shows that the sentence-processing mechanism of brain-damaged patients is not entirely determined by primitive notions such as

"precedence" and "agent-of-action". What determines the ease of sentence-processing is the thematic role order of a given sentence.

This fact is compatible with the view that aphasics' grammar consists not only of notions such as the "primitive basis of concepts" and "precedence", but also of structural notions such as "dominance" and the grammatical relations such as "subject" or "object", which are defined in terms of these notions. In this case, patients would be assigning theta-role to a structure of the form [s N [vp N V]] and interpreting sentences according to the normal rules of Japanese. As we saw in Section 6.1.4, it seems quite probable that aphasics are sensitive to the distinction between internal and external arguments, and thus also to the distinction between direct and indirect theta-marking. There is some evidence that they attempt to preserve the integrity of the VP.

However, my results may also be interpreted as showing that Japanese aphasics tend to interpret sentences according to heuristic principles of sentence interpretation that are derived from the structure of Japanese. Some structurally constrained language-specific interpretive strategies for sentence comprehension by Japanese aphasics are proposed. The following are possible heuristic interpretive rules for Japanese.

- (IR-1) Assign the thematic roles of Agent and Theme to N1 and N2 in structures of the form N-N-V.
- (IR-2) Assign the thematic role of Theme and Agent to N1 and N2 in structures of the form N-V-N.
- (IR-3) Assign the thematic role of Agent to the N which is marked by the nominative case-marker.

It is suggested that one of the differences in performance on sentence comprehension by Japanese aphasics and English aphasics is that the category sequence of

nouns and verbs is the most crucial factor in the comprehension of English sentences, whereas the case-markers *and* the thematic role order of a given word order are critical factors in the comprehension of Japanese sentences.

Another interesting finding for simple sentences is that cleft-object sentences are more difficult to interpret than cleft-subject sentences both in Japanese and in English. Adopting the functional model of sentence interpretation proposed by Bates et al.(1982) and MacWhinney et al. (1984), I suggest that the "coalition" between Agency and Focus breaks down in cleft-object sentences, creating difficulties in sentence interpretation, whereas in cleft-subject sentences these two notions "go together", which facilitates the ease of processing.

On the other hand, the results of Experiment 2 on complex sentences fell outside the scope of this functional model of sentence processing, which suggests that such a model may be valid only for the interpretation of simple sentences. It was shown that some patients attempted to parse sentences by a structure-building operation, just as normals do, and that they succeeded in parsing even OO relatives and OS relatives, which are the most difficult sentence types to interpret.

Another interesting finding from Experiment 2 was that Japanese aphasics exhibit a dissociation between their performance on Conjoined sentences and SO relatives and on OO relatives and OS relatives. The Conjoined and SO Relative types are comprehended equally well, and both are performed significantly better than any other complex sentence types. The fact that SO relatives are considered to be the most difficult two-verb sentence type for English aphasics, when compared to the findings for Japanese aphasics, indicates that the ease of processing sentences is significantly constrained by language-specific structures. The Japanese aphasics' difficulties in comprehending OO and OS relatives are interpreted as showing that they tend to interpret the first three elements of a sentence locally, without

taking the rest of the sentence into account. The patients' error types for these sentence types suggest that they are, in fact, locally interpreting the sequence N-N-V in these sentences and that they process only the number of elements needed to complete the argument structure of a verb.

The error analysis of the performance of moderately to severely impaired patients suggests that the effects of case-markers disappear in sentences where local interpretation does not yield the correct assignment of thematic roles, e.g. OO relatives and OS relatives, although these patients rely heavily on the case-marker cue in interpreting simple sentences with a small number of lexical items.

The detailed examination of the availability of nominative and accusative case-markers in Experiment 3 suggests that nominative case-markers are better comprehended than accusative case-markers for Japanese aphasics, and that they tend to utilize the nominative case-marker as a cue to sentence comprehension. These results indicate that the syntactic determinants of sentence comprehension in aphasics differ depending on the characteristic features of their native language.

The findings of Experiment 4 suggest that Japanese aphasics do appreciate the lexical information associated with predicates, such as selectional restrictions and the notion of thematic roles. The fact that their ability to comprehend lexically determined case-markers and postpositions and syntactically determined case-markers differed in a grammaticality judgement task suggests that one possible source of the impairment of sentence comprehension in these aphasics could be their reduced sensitivity to syntactically determined case-markers and the change in the thematic roles of nouns.

Finally, we have noted that the data from the brain-damaged subjects obtained in Experiment 3 concerning "case-marker drop" supports the Case theory proposed by Saito (1982); thus, our results indirectly support the configurational analysis of Japanese. Japanese

aphasics exhibit a significant dissociation of their acceptability judgements for sentences without nominative case-markers and sentences without accusative case-markers, in both grammaticality judgement tasks and sentence comprehension tasks. It has been shown that such differences between their performance on nominative and accusative case-markers can be explained in terms of the Case-assigning properties of these markers.

My results suggest that the linguistic factors constraining the language of brain-damaged subjects may differ from language to language; for case-marking languages such as Japanese, Case theory may be the crucial factor, while for non-case-marking languages like English theta-theory might be more important. At the present stage of linguistic aphasiological research, this possibility can only be considered suggestive; more detailed cross-linguistic investigations of the language of aphasic patients will be necessary to confirm it.

My results also suggest that when Case-assignment and theta-role assignment conform to their directionality in the normal grammar of a language, and the conditions governing these theories are satisfied, aphasic speakers of that language tend to perform well at sentence comprehension. On the other hand, when the directionality of Case- and/or theta-role assignment is not the normal one, or when the conditions governing these functions are not satisfied, aphasics tend to perform badly. It is suggested that Case-assignment, theta-role assignment and their respective directionalities in a given language play a role in the theory of sentence comprehension, and that they can be a basis for the aphasic patients' heuristic strategies for sentence comprehension.

There are several important points to be mentioned for future research. First, in order to confirm my results from Experiment 2, the examination of complex sentences with a much larger aphasic population is clearly necessary.



Second, in order to further confirm the Case hypothesis concerning the utilization of closed class items in sentence comprehension in Japanese, it is essential to investigate other case-markers and postpositions, and to compare these with comparable counterparts in other languages as well.

Third, we have seen that the elements which fall within the scope of Case and Theta-theory and the directionality defined in these theories play a crucial role in sentence comprehension. In order to confirm this hypothesis, further work needs to be directed toward other linguistic elements falling within the scope of these theories, and also to the relationship between comprehension and production in terms of these theories.

In general, we can hope that future linguistically-based research into the language of brain-damaged patients will reveal more of the nature of the sentence-processing mechanism in aphasics, and ultimately in normals as well.

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